Well being in hospitals : design-aids for functionally environmentally-sound therapeutic buildings

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Design-aids for Functionally -Environmentally-sound Therapeutic Buildings

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PROEFSCHRIFT

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door

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The final aim of this thesis is to give a contribution for "creating a future where the built environment supports the highest level of human health, well being, and achievement in all aspects of life and work"
(The Center for Health Design, Lafayette ,CA, U.S.A.)

A new social background, increased means of therapy and the improved well-being conditions of people are producing change in the traditional image of hospitals. Those directly involved in the hospital realisation and function are facing a new reality. Awareness of a series of problems is increasing among experts of different countries concerning the existence of failings in hospital conditions and design.
The aspects of this new reality are discussed by experts now maintaining that modern criteria are needed in hospital planning. Hospitals are destined to be transformed in order to resolve specific failings and to meet more modern patterns of social welfare. It is stated by Russell C. Coile Jr., president of the Health Forecasting Group of Santa Clarita in California: *"if they hope to survive in a managed care marketplace, hospitals and healthcare facilities must be reinvented"* [1]. As the realisation of sustainable buildings is promoted all over the world according to the issues of the World Health Organisation, the realisation of sustainable hospitals should be also supported and promoted. The aim of this study is to individuate the indispensable requisites to support Health and Well Being in Hospitals.

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S. Di Cicco

Rome, October 2003

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INTRODUCTION

A number of factors related to Health and Environment influence Building Design of private and public buildings (1-Present Background of Building and Hospital Design). They can briefly be explained as follows:

1- *Specific factors related to Building Design, Health and Environment [1,2,3,4]*
2- *The policy of the W.H.O. supporting Health and Well Being of the population also by means of Sustainable Design [5,6,7]*

Patients and staff of hospitals have complaints related to health disturbances and lack of well being mostly in relation to hospital environments (2- Current Condition of Hospitals). Hospital design has been seriously criticised by experts too and not only in relation to these facts. Complaints of designers are also reported in the literature regarding the limits of the design of conventional hospitals which do not correspond to the recent social development.

The aim of this thesis is to identify the requisites for the Hospital supporting Health and Well Being against the background of the above mentioned facts (3- The Aims of the Thesis). This Hospital should:

- find 'remedies and cures' for the current critical condition of hospitals
- support the health and well being of patients according to the policy of the W.H.O.

For these reasons such a hospital would support Health and Well Being.

A number of factors which influence hospital function (in relation to design and maintenance) and activity (in relation to health care and management), the design of other public buildings (in relation to the design background) are considered relevant factors for the contribution that hospital design can give to produce well being and 'healthier' environmental conditions. For this reason past and present conditions, future perspectives of hospitals were investigated in this study in relation to health care and building design.

1- PRESENT BACKGROUND OF BUILDING AND HOSPITAL DESIGN

1.1 Factors influencing the Quality of Environment and the Health of the People in relation to the Buildings:

1.1.1 Social Development

Social progress and welfare, as well as the recent growth in population have increased the use of transportation and various widespread technological systems. Rapid development of industrial production and large scale use of energy and resources led to environmental pollution and depletion of resources. Simultaneously, the same situations implied the loss of certain conditions of life, which were taken for granted until recently. The need of re-establishing the pre-existent natural quality of our environment emerged against pollution and depletion of natural resources. Relative criteria were promoted in politics and in design for the realisation of 'buildings' and for a 'healthy' environment.

1.1.2 Relationship between Health and Building Material/Technology

Various materials and products used in building appeared dangerous for the health of the public [1,2]; either to those working at their manufacturing process or to those generally exposed to them. The damage those materials produce can vary from real diseases to health disturbances like headaches,

tiredness, vertigo, irascibility, breathing disturbances, skin rash etc. [8]. It was proved that asbestos exposure can produce cancer, benzene represents a risk for leukaemia, chrome and nickel can produce allergies and can be poisonous in higher concentrations. In addition formaldehyde and other solvents have toxic effects, being dangerous to lungs, central nervous system, liver, kidneys and skin [8]. Oils, waxes, dyes, lacquers and other chemical compounds, like phenol formaldehyde used in the manufacturing of plywood, have been investigated as potential cause of symptomatic distresses reported by many people [1,2,3].

Specific regulations forbade the use of the incriminated materials and components. The German Sanitary Regulations (January '93) included for example new dangerous substances -like isocynate, benzol and styrol- in the list of components that cause work related diseases. But the National Research Council (N.R.C.) assessed that no information existed on toxic effects of almost all of the 50.000 industrial chemicals in use in U.S.A. [10]. There wasn't, in fact, a proper system to control the toxicity of products and the security of their manufacturing process. If determined measures have been taken over time in this sense, further research is still needed to investigate several compounds simply suspected of being responsible for diseases.

1.1.3 Specific Factors affecting the Health of the People in Buildings

A) Radon

The relationship between cancer and radon's presence in buildings is often the object of research [17,18]. Several studies are carried out on the presence of radon indoors. In these the researchers assert that the concentration of this gas varies from 5 to 20 Bq./ mq. But, accumulating inside the building, it may result much higher than the level of radon outside in the open air. Determined concentrations of radon can be the cause of disease for the occupants of the building. It is estimated in a report of the American Environmental Protection Agency that in the U.S.A. radon causes up to 14.000 deaths per year [15]. A percentage that seems to be quite high compared to other causes of death. For this reason radon radiation is taken under control mostly where there are particular geological situations. To prevent the risk of radiation, appropriate measures are taken either in the construction of the building or to abolish the risk where it is already present.

B) Electromagnetic Fields

While the total responsibility of radiation is recognised in producing cancer, partial responsibility is attributed to electromagnetic fields considered responsible for producing leukaemia of children. But strong suspicion still exists concerning the damage connected to health and the problem is still being debated. There are scientists who suggest avoiding the influence of 'electricity floods' on the base of physical and biological considerations [20]. According to Hartmann for example the body is particularly receptive during its rest and it is very important that the bed is placed in an area not affected by the 'electricity flood'. Since South would be the pole attracting electrical energy, then, the best position for the bed is the head towards North. In the application and consideration of these easy rules, some apparently minor symptoms reported by individuals may find positive solutions.

1.1.4 Sick Building Syndrome and Sick Hospital Syndrome

People have different levels of sensitivity to different substances and the sum of small amounts of chemicals can affect the health of single individuals. A syndrome, known as multiple chemical sensitivity (MCS), highlighted the evidence of a chemicals-exposure risk implying the simultaneous action of different chemical compounds contributing to produce individual symptomatic distresses [10].

New technologies and components, used in building and furnishing have increased the quantity of artificial materials being in contact with users. Widespread scale use of chemicals has become common to improve the products in building activity. The ever more frequent reported allergies and diseases related to building and environment supported the urgent need to take measures against the so called 'Sick Building Syndrome' [9].
The Sick Building Syndrome and many factors contributing to the presence of environmental pollution outside and inside the building have started to be studied by more and more researchers. Complaints of patients and staff of hospitals are also recorded in relation to health and well being. The similar phenomenon of the Sick Building Syndrome is emerging in hospitals as Sick Hospital Syndrome. Researchers investigating the problem assert that building design and maintenance are particularly responsible for many of the failings reported in hospital environments that are at the same time related to health.

1.1.5 Consumption of Raw Materials and Resources in Buildings
It is building activity which occupies the prevailing position in terms of the highest quantity percentage use of raw materials, production of wastes and energy and water consumption as stated in the 'State of the World' '95. From a report of "State of the World" 1995 we read besides that '...buildings account for roughly 40% of the materials entering the global economy each year...' and '...the building sector's share of energy consumption from 36% to roughly 45% -more than any other use...' and these two uses -direct domestic consumption and power production- contribute about equally to the one sixth share of global water use accounted for by buildings...' [14]. In addition, the importance of using recycled products in building production, it is reported that '...construction and demolition activities (in Europe) produce 50% more waste than municipal garbage ...' [14].
An estimation of the world population increase up to 2100, compared to the energy demand pro capita referred to 1990, gives an immediate image not only concerning the present situation but also the future perspectives. In relation to these facts specific measures have been taken in different countries against the depletion of natural resources.

1.1.6 Responsibility of Building Design in relation to Health and Environment
A correlation exists between several health disturbances and illnesses and the presence of negative influences from the building [15,16]. In practice our body is affected by various factors related to the building design which influence our health. Toxic substances released by cleaning products (commonly used at home as well as in public buildings) and building materials and products (polluting or releasing toxic emissions) and other kinds of emissions (like electrostatic and magnetic fields or gases from earth) can all affect our health. Our reaction is depending on the capacity of our immunity system and physical level of tolerance.
At the same time the building realisation and function produces a significant impact on the environment by contributing to the depletion of our resources and to the increase of environmental pollution that are mostly attributed to the building activity. The building takes more and more responsibility for producing health disturbances and diseases to its occupants and more generally to the public. Appropriate measures of prevention are taken in building design against this situation.
On the base of these considerations it is possible to conclude that a complex relationship generally exists between Building, Health and Environment [13,14] influencing also condition and design of Hospitals. Relative measures should be taken in hospital design against this situation.

1.1.4 Prevention of Disease and Criteria for Sustainable Design

Appropriate measures have been taken in different countries against the plural factors affecting our health in relation to building and environment. Specific measures have been also taken against environmental pollution and the depletion of natural resources. World-wide interest has increased at every level to support and promote the use of safe genuine materials and the use of natural renewable energy. The alarm already given by more sensitive countries has reached every part of the world. Many national institutions have tried to bring 'ecological' technologies into the building sector [11,12]. The Netherlands (already in 1989), the U.S.A., Denmark, Sweden and Norway have promoted the production of Sustainable Design. In 1993 the European Community pointed out the urgent need of co-operation and the Dutch National Environment Policy Plan in 1993 indicated ecological issues and advised on the realisation of sustainable buildings: energy saving and improved efficiency, recycling of building products, elimination of toxic materials and tropical timber [13].

1.1.6 International Support for a Holistic Collaboration

Many international organisations have been created to give support to the diffusion of information, such as Greenpeace and World Wild Fund for Nature. Efforts have been also addressed to involve the participation of the community and to encourage an ecologically positive contribution from the world-wide population. General responsibility has been solicited to defend the life of individuals, plants and animals; not only at the present time but mostly concerning the future. People's awareness and sensitivity concerning the ecological and biological repercussions associated with these situations are growing as well as the responsibility of single individuals and various categories of people [13,14]. To align with these purposes, long-term considerations are needed from general public and mostly from those responsible for building activities. The consciousness and responsibility of builders and designers becomes an essential contribution towards Sustainability in building. The final goal is the realisation of 'healthy' buildings. They take into consideration the prevention of specific risks related to health and environment, the application of renewable material, the energy saving and the social future perspectives.

1.2 Social Attitude in Life and in Health Care

The renewed interest of people in natural products is evident in every activity of life. The renewed interest of the people is recorded also for the therapies including therapeutic ingredients and means. It appears to be a spontaneous reaction against both allopathy and sophistication. Not only in life, but also in building activities the interest of the public in products made of natural materials and components is evident. This attitude also implies an analogous interest in health care where, in relation to these facts, initiatives have been taken by doctors, medical managers and designers of hospitals. The local authorities in the area of Seattle (U.S.A.) for example encouraged the realisation of a number of hospitals practicing natural therapies [22].

All over the world there is renewed interest in natural therapeutic treatments not only for the cure of disease but mostly for its prevention. On the basis of these new perspectives concerning health care and disease prevention, special clinics are emerging particularly supporting patient's well being and comfort. The relative more modern approach of the public is emerging towards prevention, therapy and cure of disease.

To practice physical activity is not only considered positive in the prevention of diseases but also in their cure [23,24]. Alternative models of hospitals are emerging in the U.S.A. where comfort and well being of the patients are more carefully taken into considerations by designers and experts [25]. The

Crozer-Keystone Healthplex in Philadelphia (U.S.A.) -supposed to provide primary, preventive and rehabilitative care at the same time- is for example designed particularly to support physical activities. Home-like environment and closer individual assistance is provided by the newly built hospitals where the patient got a new role as the consumer/client. There are hospitals practicing natural cures, promoting the application of natural therapeutic means and the performance of physical activities [26]. Various typologies of hospitals are already emerging on these new basis [27], often including a mall and proposing types of buildings which look like hotels or residential buildings. A larger proportion of day-hospital activities supports both health care and prevention.
The recent rapid development of the social context has improved the condition of people, physically and psychologically. Improved welfare is evident in many activities of life, based on the development of new technologies and improved knowledge. A widespread use of modern technological means is made in life and particularly in hospitals where the preponderant technology at present denies the human atmosphere over time proper of hospitals.

1.3 Policy promoted by the W.H.O.

Already in 1961 the World Health Organisation defined 'Health' as "not merely the absence of disease or infirmity, but a state of complete Physical, Mental and Social Well-being" [6]. More properly concerning the realisation of our environment the W.H.O. was also asserting: "environments are not just the visible structures and services surrounding us but have spiritual, social, cultural, economic, political and ideological dimensions as well. Furthermore, all the different facets of life are interwoven and inseparable" [28]. "The purpose of development" as stated by the W.H.O. "is to improve all people's quality of life, including their health" [5].
On the basis of a policy of prevention, the W.H.O. has recently promoted the realisation of Sustainable Buildings supporting the health and well being of the public. The issue is consequently emerging in design to provide physical-psychological well being to the 'occupants of the building' in the different circumstances -at home and in offices, schools, universities, etc. Various categories of public buildings (Healthy Offices, Healthy Universities, etc.) have been studied as 'Sustainable Buildings' [5,6] by including determined criteria of design. These criteria mostly focus on the fulfilment of the physic and psychological well being of the occupants of the building. In order to produce for example 'Health Promoting Universities' this aim is fulfilled by "protecting the health and promoting the well-being of students, staff and the wider community" [5]. In case of a 'Healthy Office' its definition is given in this way: "a healthy office building is one that with its material and immaterial qualities promotes the complete well-being of the users" [6].

1.4 Responsibility of the Building towards Environment and Health.

Social, technological and scientific progress has already influenced building design and realisation. Consequently the building itself has recently become responsible towards Environment and Health. Private and public buildings have already been influenced by the introduction of determined measures for the prevention of risks related to environment and health. Renewable non-polluting products are more often used by designers and builders towards sustainable results. Building design is being directed to support people's health and well being (according to the policy of the W.H.O.) and to avoid or reduce the risks related to environment and health.

Energy saving has been promoted by the use of passive systems and 'clean' technologies in building. They imply non-toxic materials and techniques applied to specific building's components for heat storage and diffusion. The entry of natural light and sunshine is promoted in design by the introduction of appropriate structural components (like large glass-sheets and open spaces). Appropriate 'clean' technologies support the energy saving and the quality of our indoor environments (cooling and heating systems, illumination).
As we are more aware, the building is considered responsible of a number of situations. In practice, the building and its design become protagonist:

- *in the prevention of the risks dealing with environment and health*
- *in the policy of the W.H.O. taking the building as a mean to produce sustainable environments for the health and well being of its occupants*
- *in the policy against the depletion of resources and environmental pollution (taking into consideration the energy saving and the application of passive systems)*

2- CURRENT CONDITIONS OF HOSPITALS

2.1 Factors influencing Hospital Conditions:

2.1.1 Increase of Out-Patients

The number of day-hospital activities is increased in hospitals with an increasing number of out-patients visiting hospitals every day. This is also in the case of many surgical operations that do not require hospitalisation. The technological means applied in diagnosis and therapy have improved as well and new means are available (ultrasounds, laser therapy, etc.). For this reason it is now possible to cure a series of diseases that it wasn't possible to cure before. A recent round-table discussion, made by experts [29] highlighted today's most pressing issues in health care: regarding the construction of a new hospital based on innovative principles, it was specified: "this facility is dedicated to 60 percent outpatient instead of 10 percent". It was besides clearly stated, that hospital function is changing, and "health care has already gone to an ambulatory environment"[29].

2.1.2 Increase of Elderly People

The increase of day-hospital care and the change of hospital function is destined to change again in the future, according to the growth and change in population. In fact, at a meeting organised by the European Parliament of Strasbourg the 4th and 5th December '95 on "L'avenir de la vieillesse en Europe", it was stated that the number of elderly people is destined to grow [30]. This category of people will ask for appropriate care and assistance in the near future. Actually these forecasts and the continuous development of technology suggest caution in taking decisions in hospital planning, whose future may be very different from today's.

2.1.3 Functional Flexibility

The impact of the new technologies in recent years has completely transformed the old fashioned concept of the hospital. In an essay by Russell C. Coile Jr., published in 'Aesclepius' it is written: "Built to rigorous safety codes and building standards, hospital are long-lived, even if they become functionally obsolete after the first 15 years" [31]. The rapid evolution of hospitals and a new social background create, in fact, new needs and the necessity to modify the hospital's traditional configuration. Hospital buildings are in fact evolving continuously according to social development.

The new reality has actually already disorganised and dismantled the conventional management and configuration of hospitals. Designers report the existence of the many difficulties that have to be faced in order to adapt the conventional buildings to the new needs. They complain sometimes of the impossibility of renewing hospitals on the base of the limited flexibility of their technological systems and structure.

2.1.4 General Disorganisation and Way-finding

Other repercussions derive from plural consecutive structural changes and refurbishment made to old hospital buildings. The lack of way-finding is for example noted against the general disorganisation existing in hospital design after plural consecutive refurbishment.

The author of a recent research, the Chairman of Brighton Healthcare NHS Trust, complains about the following situation: "Look at the route through the Royal Sussex County Hospital at Brighton.....our maps don't say you are here...they are colour coded but we don't say how or why...we don't say which floor gives which access to other buildings...we don't tell people which floor they are when they are outside the lifts...we don't give directions as to what is on that floor...we don't tell the public they can go to the restaurant, though they can..." [32].

2.1.5 Revival of Traditional Therapeutic Principles

'Mens sana in corpore sano' expresses a Roman and Greek concept of rudimental medicine, sustaining the possibility of supporting our health condition by means of activity. This principle seems to be newly promoted in health care as well as the renewed use of natural therapeutic means. The application of physical activity and natural therapeutic means is currently supported in health care and in disease prevention. There are initiatives taken in this sense in the U.S.A. (9.1 Planned and Built examples) where special hospitals are being built to supply natural treatments and cures with the approval of doctors, politicians and designers [22]. Related initiatives have also been taken concerning the realisation of hospitals (9.1 Planned and Built examples) based on the performance of physical activity [26].

2.1.6 Introduction of Modernisation: Arts in Hospitals

People and medical staff take the initiative of changing the configuration of traditional hospitals towards modernisation. Initiatives like these have been taken for example in the U.K. where private organisations, approved by patients and doctors, have promoted the introduction of arts in hospitals. Hospital Design is gradually facing the issues which derive from the social development and welfare. The introduction of modern items and means implies also modern criteria in building.

2.1.7 The Transformation of Hospitals

The model of hospitals is clearly evolving in plural directions.

Experts in hospital design assert: "The driving force behind the healthplex was the fact that our industry is clearly moving from a focus on patient-specific and episodic incidents of care to taking care of populations and doing it in a way that maintains or improves health status" [29]. This statement supports the opinion that hospital design is going to change in order to support the individual conditions of health and well-being according to the new prevention policy. The improvement of the conventional standards in healthcare services is contemporaneously expected by the people. But to grant conditions of well being to patients and to create alternative functions, healthcare structures and systems need to be transformed on the base of new perspectives.

2.2 Complaints of Hospital Designers, Staff and Patients:

2.2.1 Experts assert that Hospitals become quickly Functionally Obsolete

American experts in hospital design assert that " built to rigorous safety codes and building standards, hospital are long-lived, even if they become functionally obsolete after the first 15 years" [31]. Based on the introduction of plural activities concerning diagnostic and therapy and modern technological equipment and systems, the conventional model of hospital now results obsolete in function and configuration. Hospital buildings are particularly influenced by the social, scientific and technological development.

2.2.2 Designers complain the Lack of Structural Flexibility

Many day-hospital activities have been introduced by hospitals and a large number of patients are discharged after treatment. The number of out-patients is increasing in the totality of patients. The increase of therapeutic means and activities create besides other difficulties in the refurbishment of traditional hospitals. Depending on these changes it is sometimes impossible to adapt the old hospital buildings to the new needs.

Hospital function is also susceptible to change in the future. If the number of elderly people is going to increase in the next years, hospitals should supply appropriate assistance to the elderly people and day hospital care.

2.2.3 Failings and various Situations at Risk are complained in Relation to Design

Different types of risk are present in hospitals that are often related to the maintenance and design of the building. Widespread use is made of dangerous substances such as gases and radioactive products. Discomforts and general symptoms related to health are reported by those people involved in the many hospital activities requesting the use of chemicals for disinfecting and cleaning, mechanical ventilation and artificial illumination. Failings in building and function of hospitals are recorded revealing poor quality of design.

2.2.4 The Sick Hospital Syndrome

The 'Sick Hospital Syndrome' [33] and the risks connected to hospital activities have been investigated by researchers who assert that building design and maintenance contribute to producing the poor quality of the air and the 'sick' environment complained of by people.

It is asserted for example in the final discussion of 'An outbreak of Sick Building Syndrome in a large Italian hospital: evaluation of the sick hospital': "This present study, dealing with a hospital-related SBS case, suggests that hospitals should also be accurately designed as to provide health personnel with a comfortable and healthy environment" [33].

2.2.5 The gap produced by the Social Change

The rapid progress of the social, scientific and technological context has recently created a new reality. The quality of hospital design results inadequate to answer the present needs and standards of life. Hospital Design should fill the gap produced by the recent changes in life and in health care. The changes reported in the social context also influence the evolution of hospital design. Health Care structures and systems are changing according to the social context. There are newly built American models of hospitals that correspond to the present trends in health care such as the policy of prevention

and the improved standards of life. The traditional model of hospital results obsolete also on the base of the functional changes applied in many newly built hospitals. Function and configuration of conventional hospitals have not kept pace with social evolution.

2.2.6 Patients complain General Discomforts

There are factors that are more generally complained by hospitals, concerning their function (lack of way-finding, lack of information, familiar assistance, etc.), their environmental conditions (patients and staff complain general discomforts and health disturbances) and conventional configuration of hospital design (cold institutional atmosphere, uncomfortable environment caused by). An article in U.S. News & World Report [34] states: "Most hospitals are dismally inhospitable. A weakened patient and traumatised family are greeted by harsh lights and cold stainless steel, labyrinths of white corridors, thumping equipment, and acrid mysterious smells. The sick rarely have access to information, privacy, or a place for quiet talk and grieving. The resulting sense of anxiety and helplessness is the worst imaginable to promote healing". Hospital function and configuration do not correspond to what people expect and the traditional hospital appear now to be obsolete from many points of view.

2.3 Consequences of the Policy of Prevention and the New Life Standards:

2.3.1 Design for the Production of Sustainable Buildings

According to the policy promoted by the W.H.O., new criteria of design support the health and well being of the people. The realisation of sustainable hospitals should include analogous criteria of design for the production of sustainable hospital buildings [5,6,28].

The complaints about hospitals in fact relate to the environment of the building and the well being of the patients. This fact supports the opinion that analogous criteria generally applied in the realisation of sustainable buildings should also be applied in hospital design.

2.3.2 A Sustainable Hospital should support Patient's Well Being

The quality of hospital design should be improved to fulfil this aim. As a public building and institution, a hospital should be able not only to provide comfortable environmental conditions but also a hospitable configuration and home-like assistance. Supporting the healing of the patients, it should practically 'give relief' to the condition of being a patient, facilitating and supporting therapies and assistance through appropriate design components and the configuration of the building. In practice, the quality of design should be improved by integrating appropriate items for the realisation of sustainable surroundings.

"Is there a difference between a hospital designed to care for the sick and one designed to keep people well?" is the question reported in 'Hospital & Health Networks' regarding a round table discussion on hospital design and new issues in health care [29]. The realisation of hospitals should support the assistance and the policy of prevention in health care; not only to cure the patients, but mostly 'to keep people well' is the principle that should influence the realisation of hospitals. The hospital itself should be a real means of supporting health and well being, but mostly it should be a means of prevention. Hospitals have the possibility of exercising prevention in the large social context and the prevention of diseases is often more important than therapy.

2.3.3 Improved Living Standards

Improved social welfare, improved means (for information, transportation, etc.) and knowledge (cultural standards, awareness about health, prevention, disease and so on) of the public has given rise to new standards of life. People are now living in better conditions than a few decades ago. They have comforts at hand in different circumstances, at home and at work besides those in their spare time. Changes are evident in the different activities of life implying new issues of modernisation. This is happening also in the activities of our life and the environments where we live and spend time. Modern structures now exist for private and public buildings such as large office buildings, large shopping centres, universities and airports. New issues have influenced the design and realisation of private complexes and modern public structures. Modern items have been introduced in their configuration and function (for example large spaces and vaults, skylights and colour) as well as modern means (for example for information and transportation). Indoor spaces of public buildings (for example entrance-halls, corridors and staircase) are assuming larger dimension.

2.3.4 Lack of Response to People's Expectations

The traditional configuration of hospitals doesn't reflect the new standards of life and people's expectations. Modern items and means should be applied in hospital design to support hospital function and patient's comfort. As this is happening in the realisation of other modern public structures, the quality of hospital design should be improved by assuming modern components of design and comfortable standards of life.

2.4 Faults of Hospital Design

From the general complaints of patients, staff and designers it looks as conventional hospitals are becoming obsolete buildings and that hospital design is inadequate to respond to social development.
From the state of hospitals today, it is possible to note that :

- *general complaints are recorded by patients, staff and experts in hospital design*
- *difficult situations exist in hospitals regarding environmental conditions, configuration and function*

The complaints of hospital designers, staff and patients concerning these situations can be briefly resumed as the following:

1) *Health disturbances are reported by hospital staff related particularly to scarce air quality and poor requisites of indoor environments (as for example scarce or strong illumination, 'offensive smell' and noise). Researches that studied the so called 'Sick Hospital Syndrome' sustained that the design and maintenance of the building have a relevant responsibility in determining these situations.*
2) *In the old traditional hospitals, people mostly complain about the presence of grey and inhospitable surrounding, emotionally cold atmosphere, the total absence of way-finding because of their obsolete criteria of design. Experts and designers find it difficult to refurbish and change the design of such buildings. In practice, their configuration doesn't suit modern standards of life and the introduction of structural, technological and functional changes.*
3) *The structure of traditional hospitals changed in management and function. Patients and personnel have acquired a higher level of awareness regarding knowledge of diseases and therapies. There is a prevalence of day-hospital activities and out-patients have greatly increased in number.*

Rapid social development has created a new typology of patients whose expectations have increased as a consequence of the new standards of life and the new policy of prevention in health care.

It is asserted by Russell C. Coile Jr., president of the Health Forecasting Group of Santa Clarita in California: "if they hope to survive in a managed care marketplace, hospitals and healthcare facilities must be 'reinvented' " [31].

On the base of the previous considerations it is possible to assert that determinant factors are recorded influencing hospital design and at the same time more generally the building design. They are:

- *situations related to building, health and environment that are taken into consideration in building design (implying the application of special criteria of design).*
- *the policy of the W.H.O. supporting the health and well being of the people is taken into consideration in the building design, implying the application of analogous criteria for different categories of buildings[6].*

The identical situations affecting the building design, regarding environment and health should be taken into consideration to ameliorate hospital condition and particularly the specific failings recorded in hospitals (concerning environmental condition, configuration and function of hospitals).

The responsibility recently taken by building design towards environment and health (1.3 Responsibility of the Building towards Environment and Health) should be also taken by hospital design.

3- THE NEED OF THE HOSPITAL SUPPORTING WELL BEING

Plural factors currently influence building design and condition. Buildings became recently protagonist of different scenarios as reported in 1 'Present background of building and hospital design'. On the base of these considerations, building design has taken on plural functions to fulfil plural aims. The responsibility is assumed by design of improving our quality of life.

It is particularly evident that the function of design is important:

- *in the promotion of sustainable design (the policy of the W.H.O. is promoting sustainable design for other public 'sustainable buildings' supporting health and well being of the people)*
- *to prevent the depletion of resources, environmental pollution and a series of risks related to environment and health*

Hospital design should improve the quality of life of patients and people.

3.1 Aim of the Thesis

The aim of this study is to formulate a new proposal for the design for a Hospital supporting Health and Well Being taking into consideration the recent facts influencing building design and, as a consequence, hospital design. 'Health and Well Being' is counterpoised to those defeating situations that produced a 'Sick Hospital' and 'Sick Buildings' from plural points of view.

To fulfil this purpose this study is aimed to identify:

- *the components to be integrated in design in order to overcome the critical failings recorded in the conventional design of hospitals*
- *the criteria towards the realisation of sustainable hospitals analogous to the criteria more generally adopted to improve building conditions by means of design -in relation to determined facts conditioning its environment and configuration, the health and well being of its occupants [6]*

Regarding the background of the above considerations, this study aims to improve the quality of hospital design (concerning environmental conditions, configuration and function of hospitals) by:

- *creating 'better conditions of life' for patients and staff of hospitals in relation to determined failings recorded in hospitals*
- *promoting health and well being in hospitals on the background of the facts which influence building design and the present condition of hospitals*

The result of this study consists in the formulation of guidelines for the design and framework of design of the model of the Hospital supporting Well Being. The indispensible components of design for the realisation of the model are given at the end included within four main categories.
The four main categories of components are the following:

1) *prevention of environmental risk,*
2) *modernisation of architecture,*
3) *improvement of the function of design,*
4) *introduction of methodology and systematic approach to design.*

A practical example concerning the application of these guidelines is given at the end in form of illustrations and design-aids for the realisation of the model. A design proposal for a Hospital supporting Well Being is sketched at last containing the requisites derived from this study and illustrated by drawings.

3.2 Purposes of the Design for Hospitals supporting Well Being

The pattern for the Hospital supporting Well Being integrates the items identified to ameliorate the present condition of hospitals (in relation of their environmental condition, configuration and function). New issues of modernisation and new needs (deriving from the rapid development of society, science and technology) are corresponded within a more modern configuration of the building that fills the gap actually produced by the progress. Criteria are contemporaneously adopted supporting the use of appropriate building technologies to reduce and to avoid the risks related to the environment. In addition the design of this Hospital is intended to provide the missing link existing in the realisation of sustainable buildings supporting the policy of the W.H.O. (the Healthy Offices, the Healthy Universities, etc. have already been studied).
In conclusion the design for the Hospital supporting Health and Well Being introduces criteria for:

- *prevention and reduction of the failings recorded in the current conditions of hospitals*
- *planning framework supporting the sustainability of hospitals*
- *prevention of the risks related more generally to building, health and environment*
- *promotion of the policy of the W.H.O.*

3.3 The Model of the Hospital supporting Well Being

The Hospital supporting Well Being aligns the production of hospitals with the production of Sustainable Buildings. The model of this Hospital is introduced in a framework of design that takes into consideration the strong correlation existing between design and function of a hospital building, both as a 'building' and as a 'hospital'. Three fields influence in fact hospital activity: health care, building design and the management of its function.

For this reason the type of approach to the design of this Hospital is considered valid for the different types, functions and classifications of hospitals. The model includes four categories of indispensable components of Hospital Design: Architecture, Environment, Function and Methodology of Design. Design-aids and practical examples illustrate the components of design in the final conclusions.

3.4 Specific further Research for the Realisation of Sustainable Hospitals

Focused on improving the environmental condition, configuration and function of hospitals and taking into consideration the recent facts influencing building design, this study contributes to ameliorate the present conditions of hospitals.

The model of the Hospital supporting Well Being identifies:

- *the general configuration of design for a hospital in relation to the background of the recent social developments and the failings recorded in hospitals*
- *the criteria for sustainable design*

Further researches to the production of Sustainable Hospital Buildings are for example the following:

- *on the base of the general criteria integrated in the design of the Hospital supporting Well Being, various typologies of hospitals should be studied and experimented with different medical specialisations.*
- *determined aspects proper of design should be developed (such as building regulation for hospital design, opportunities for the use of passive technological systems, specialisation supporting the function of hospital design, etc.) and aspects concerning the management of hospitals (individual contributions given to the management, support of technicians and information, specialised competence, etc.).*
- *the holistic collaboration of designers, builders, producers, staff and patients of hospitals should be integrated in the production and function of hospitals*
- *saving on consumes should be taken into consideration by researchers and producers for the numerous technological systems used in hospitals and the continuity of hospital activity (twenty-four hours per day)*
- *in the planning and realisation of hospitals as public structures, the choice of appropriate building techniques and structural components of the building, materials and systems, should be made with the perspective of saving on consumption, energy and building materials*
- *appropriate research should be carried out concerning the saving on consumes and resources in the maintenance of the building*

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METHODOLOGY

1. Aim and Methodology

The aim of this study is to formulate a proposal for the design of a Hospital supporting Health and Well Being overcoming the critical failings recorded in hospitals and supporting the production of sustainable hospitals on the basis of the new policy of Sustainability in building promoted by the W.H.O.(3.1 Aim of the Thesis).
To fulfil this aim, it was at first ascertained that:
- *the failings recorded in hospitals were related to their environmental conditions, configuration and function*
- *these three categories needed to be improved by the introduction of appropriate components of design*

These three categories were consequently taken as object of study in order to identify:
- *relative components of design supporting the production of sustainable hospitals and improving their quality in relation to specific failings*

To this end, the general development of hospital design and health care was studied in main lines (from the past until recently and in its future perspectives).
This allowed to ascertain:
- *factors influencing hospital design (at present and in the past)*
- *correlation existing between these factors and design*
- *components constantly assumed in hospital design and trends in the future development of hospitals*
- *factors which influence at present the building design and the production of sustainable buildings*
- *causes of the failings at present registered in hospitals*
- *possible remedies against these failings*

1) The history of health care and design made particularly possible to identify:
- *components constantly taken into consideration in hospital design*
- *factors which have constantly influenced the development of hospital design*
- *correlation of these factors to the introduction of specific components in design*

From this study it was deduced that:
- *the social development has always influenced hospital design on the basis of emergent new needs and for this reason it should still influence the production of hospitals*
- *the components which have constantly influenced the realisation of hospitals (constantly improved by designers)*

should be considered indispensible to give a positive answer to the needs of staff and patients of hospitals

2) On the base of the previous considerations, those factors have been analysed influencing the development of hospital design and health care, at present and in the future perspectives. This made possible to identify the components of design influencing positively the future development of hospital design (concerning environmental conditions, configuration and function).

The study revealed that:

- *the approval for the components which had always influenced hospital design was still confirmed in the design of the newly built hospitals*
- *additional components had been introduced in the newly built hospitals (on the basis of specific reasons)*
- *several failings registered in hospitals were attributed to the poor quality of hospital design (for specific reasons)*

In order to deepen the nature of these facts, the following material was besides analysed:

- *specific researches, scientific literature, specialised magazines reporting the comments of designers, managers, experts in health care about the problems affecting hospital design*
- *criteria and methods used in buildings to overcome analogous problems*
- *new policy of prevention promoted in health care and criteria used in design for the production of sustainable buildings (based on the policy of the W.H.O.)*
- *recent trends influencing the design of hospitals and other large public buildings (e.g.: which components support the adequacy to modern needs, improvement in comforts, architecture etc.)*
- *typology of the changes (resulting approved by public and patients and/or medical staff of hospitals) introduced in some newly built hospitals of different countries*
- *analogy of these changes to specific initiatives taken in the production of hospitals at present and in the past (e.g.: hospitals based for example on Steiner's theory or the Planetree Model, specific components already present in older hospitals such as statues, a small zoo, etc.)*

From this investigation it was deduced that the quality of hospital design can be improved by taking into consideration specific factors influencing the social development and the production of hospitals. In other words, this can be done by giving a positive answer to the needs constantly registered in our society and particularly to the failings registered at present in hospitals, mostly depending on specific needs produced by the progress.

From these considerations it was finally concluded that the quality of hospital design can be improved by the introduction of a number of components which support:

- *the further development of the requisites which have constantly influenced hospital design*
- *the introduction of functional changes based on the typology of the changes registered in hospitals and/or analogous components already present in older hospitals*
- *the adequacy of hospital buildings to new living standards in analogy to the components already introduced in the design of other public buildings*
- *the realisation of a patient-focused design according to the policy of the W.H.O.(which also means the improvement of comforts in hospitals on the basis of new living standards)*
- *the prevention of the failings registered in hospital design in analogy to components and methods adopted in the prevention of analogous risks in sustainable buildings*
- *the new frame of design and the co-ordination of many components by means of methodology*

2. Choice of the Method

The aim was the identification of the 'type' of enhancements necessary to improve the current conditions of hospital, by means of design, on the background of the flood of facts registered in hospitals and in

the production of sustainable buildings. For this reason the method of research was based on the application of all the possible means available at hand:

- *the literature existent on hospitals*
- *specific scientific items and comments of specialised magazines*
- *the history of hospitals and health care*
- *researches concerning very newly built hospitals*
- *investigations concerning other categories of sustainable buildings*
- *the study of other recently built large public structures*
- *the correlation of analogous criteria of design*
- *the comparison with analogous categories of public buildings*
- *interviews with the patients and technical staff of hospitals*

The peculiarity of the problems recorded in hospitals and the diversity in the field (environment, configuration and function) created difficulty in the validation of the final result. In fact, practical experiments and tests to be carried out in hospitals would have requested the competence of many individuals, appropriate equipment, specialised technicians (for testing specific conditions like for example air quality, parameters of microclimate, intensity of illumination, etc.). To experiment components of hospital configuration, specific functions etc. in the reality, would have requested resources and time. It was besides considered the impossibility of:

- *tasting specific remedies against the failings registered in the various hospitals, which resulted from the literature of different countries*
- *experimenting these components in a hospital realised to support Health and Well Being*

But it was considered the opportunity of having at hand the large structures and hospitals of three different countries (depending on the fact that when I started this study I was living in Germany, working in The Netherlands and I often visited my country which is Italy). In relation of this fact, it was possible to carry out interviews with patients and staff of different hospitals on the background of three different situations and social contexts.

The opinion of the patients was considered indispensable to producing a patient-focused design.. By interviewing the patients in fact, it could be possible to ascertain:

1) their approval about the 'type' of enhancement proposed
2) their eventual consent concerning the introduction of specific components

The opinion of the technical staff was also necessary to ascertain the validity of specific choices of design in relation to specific failings and a real situation.

The eventual approval of the people living in three different countries for specific changes and choices of design (like those proposed in the model of the Hospital supporting Health and Well Being) would validate the introduction of specific components in the model of Hospital which is object of this study. The proposal of this kind of Hospital would besides fit to different countries.

To fulfil this aim the possibility was taken into consideration of providing practical examples based on analogies to the questions of the interviews. For this reason it was taken the decision of asking people' s opinion about one or more components of design in hospitals having some analogy with the Hospital which is object of this study. Three large and 'peculiar' hospitals were chosen then, where it could be possible to formulate clear questions, based on an analogy of the component proposed to a real situation. In practice, the people interviewed could 'experiment' the component in the reality.

The results of these interviews confirmed:

- *the need for change of the traditional configuration and function of hospitals*

- *the typology of the change*

The choice of specific components of the Hospital supporting Health and Well Being (concerning environmental conditions and configuration) was based on their analogy to facts and situations taken in the literature and/or in other recently built large public buildings having analogous problems and aims of design. Methods and remedies proposed in the Hospitals supporting Health and Well Being for example, against specific failings, were similar to the methods and remedies used in analogous situations.
This concerned particularly:
- *components and criteria of design used in other public buildings supporting the sustainability of design and the policy of the W.H.O.*
- *methods applied in buildings to overcome the analogous inconveniences found out in hospitals (e.g.: environmental dysfunction, risk of diseases etc.)*

These components were validated by their current use in analogous situations as it is illustrated by means of practical examples given in form of sketches and pictures.
Other correlation is also made with the components of design found in the recently built large public structures, mostly having analogous purposes of function and/or design, like:
- *to serve different categories of individuals*
- *to be functional within large structures*
- *to adopt modern criteria of design*
- *to adopt criteria towards sustainability in building*
- *to be multifunctional public structures*
- *to be visited by occasional clients*
- *having people working and/or living within the building*
- *to provide activity and/or entertainment*

A number of examples was also given in form of pictures concerning the use of specific components of design in recently built public structures of different countries.

The sources of these researches were found in different libraries and by computer.
Specific libraries were taken into consideration:
- *the library of Eindhoven University of Technology (NL) concerning general subjects (like medical Care, Hospital History, specific authors etc.)*
- *the library of the faculty of Architecture by Eindhoven University of Technology (NL) for every other information inherent to building design*
- *the University 'La Sapienza' of Rome (I) was visited for general and specific research*
- *other investigations were made in the library of the faculty of Medicine by 'La Sapienza' and by the 'Università del Sacro Cuore' connected to the hospital 'Policlinico Gemelli' in Rome (I)*
- *the libraries of the Istituto Superiore di Sanità and of the Consiglio Nazionale delle Ricerche in Rome (I) were visited several times*

Specific books and peculiar scientific magazines were found by these libraries. Particularly the libraries of the Istituto Superiore di Sanità could supply large part of material concerning hospitals and health care, scientific journals containing the experiences of nurses and doctors, comments reported by hospital designers about hospitals.

An important part of the information was taken from the library of the Ises Italia (International Solar Energy Society). This was concerning the application of alternative energies and the relative technologic systems applied in buildings.
The American Center for Health Design (U.S.A.) was contacted by means of Internet. This supplied information about the development of hospitals and hospital design in the U.S.A.
Aimed investigation were carried out by computer, like inquiries through the databases of:

- *Medline*
- *Iconda*
- *Science Citation Index*
- *Social Sciences Citation Index*

Single key words (for example: hospital, design, health care, patient, social context, staff, environment, configuration and function) and their combination were used for this research. Useful information was supplied by Iconda.

Material like pictures and drawings of hospitals were taken from publications or directly from hospitals and from other public structures. This kind of material was obtained personally or by the courtesy of different people, mostly in other countries, to whom I addressed specific requests. They supplied for example some pictures and specific publications, like leaflets and brochures, containing information about the activity of hospitals recently built in other countries.
I personally realised the sketched drawings of the Hospital promoting Health and Well Being and the interviews carried out in hospitals (in the three different countries Italy, The Netherlands and Germany).

3. The Methodology

Plural failings occurring in hospitals are considered often depending on the building design. The environmental conditions, configuration and function of hospitals result mostly influenced by these failings. In this thesis, the current conditions of hospitals are analysed in order to deepen the nature of these failings and their correlation to design.
On the background of the facts influencing Building and Hospital Design at present, the following factors are taken into account:

- *problems nowadays affecting any kind of building, its users and environment, and the measures adopted in design to overcome analogous problems*
- *social changes and the policy of the W.H.O, supporting the sustainability in the building design*

On the basis of the previous considerations this research was therefore addressed to:

- *investigate environmental conditions, configuration and function of hospitals in relation to design*
- *identify appropriate components susceptible to overcome the failings recorded in the conventional design of hospitals (concerning environmental conditions, configuration and function) also by supporting the sustainability of design*

To fulfil this aim, the ***History of Hospital Design and Medical Care*** *was analysed, in order to identify the components of design and the factors influencing hospital design which could be considered valid over time. The correlation of their influence with the present conditions of hospitals was also examined as well as their possible impact on the future perspectives of hospital design. On the basis of this study, it was finally possible to consider over time valid:*

- *specific components of design*
- *the constant influence of the social, scientific and technologic progress on hospital design*

***History of Medical Care**:*

The history of medical care (main factors influencing its development) was studied and its correlation with the realisation of hospitals. This study revealed:

- *the constant use of natural therapeutic means and cures*
- *the strong influence of the development of society, science and technology on the realisation of hospitals*

The recent policy, including trends and initiatives taken in health care, was also investigated.
In particular it was noted that:

- *the presence of natural resorts and natural therapeutic means (including physical activity and amusement, a dietary regime, comfortable massages, the production of suggestion, etc.) were the means adopted to support the healing of the patients in the early hospitals*
- *the natural products were integral components in health care and in the realisation of hospitals until the scientific discoveries produced the prevalence of allopathic terapies and technologically sophisticated treatments*
- *in parallel with the allopathic medicine, the homeopathic branch of medicine has always received a significant number of consents of doctors and patients until today*
- *natural treatments have been until now a privilege of rich people (e.g.: specialised therapists, thermal baths, establishments for natural cures etc.) and have always received the consent of paying patients*
- *the natural cures are still succeeding in supporting the healing of the patients*
- *the renewed request of the people and approval of the doctors is recently registered in health care*
- *several initiatives are recently taken promoting the natural treatments and cures*

From the study of hospital design and medical care, a constant correlation came into evidence between function and design of hospitals. In fact the new emergent issues have constantly produced changes in hospital function and the introduction of relative changes in hospital design.
New requisites and components were gradually introduced in design on the base of:

- *new needs coming from specific events occurring in the society and/or new stages of the social growth*
- *the acknowledgement of new scientific principles influencing the application of new therapies and sanitary regulation*
- *the development of technology supporting the introduction of new sanitary principles in building and in the performance of hospital activities*

For these reasons it was concluded that social context, science and technology have always and evidently influenced the realisation of hospitals.

***History of Hospital Design**:*

The past conditions of hospitals was studied in relation to the three components of design which were object of study (environmental condition, configuration and function). In this study it was possible to examine the development of specific requisites over time influencing hospital design which produced the new introduction or further improvement of specific components. A number of components, resulting to be a constant object of interest for the designers of hospitals, were gradually improved by the time and.

On this base the following considerations were made:

- *if the designers had constantly recognised the validity of specific components, the same components should be considered ever valid to answer the needs of patients and staff of hospitals*
- *on the contrary, the lack of these requisites would determinate a lack in the accomplishment of hospital design*

The fact that identical components were always approved and improved in design would support:

- *the constant approval of patients and staff of hospitals for specific components*
- *the constant need and request of patients and staff of improving the same components*
- *the indispensability of these components for the performance of the activity of a hospital*
- *their validity and their indispensability in hospitals and design depending on their obvious respond to the needs of patients and staff*

For the reasons above, the lack of these requisites should be considered as a lack of design susceptible of producing dissatisfaction and some of the complaints recorded at present in hospitals. The renewed promotion of identical components is therefore supposed a possible 'remedy' to determined failings of hospital design.

Impact of the Social, Scientific and Technological Progress:

The relevant changes were studied, recently produced by the progress, in the social background of hospitals such as:

- *trends in the development of hospital and building design*
- *typologies of the very newly built hospitals*
- *social changes related to the quality the population*
- *improved living standards*
- *influence of the policy of the W.H.O. on building design and health care*

The impact of the progress produced:

- *specific typologies of hospitals recently realised in the U.S.A.*
- *new concepts concerning patient, health care and hospital*
- *renewed use of natural ingredients in every activity of life and natural therapeutic means in health care*
- *initiatives often taken by medical staff and doctors, patients and local authorities supporting the introduction of new components in the function and design of hospitals (e.g.: arts, natural cures, physical activity etc.)*
- *policy of prevention promoting the health and well being of the population (also by means of design and the realisation of sustainable buildings)*
- *'modern' components and means were introduced in hospital and building design (e.g.: computerisation, escalators and lifts, specific components in the building architecture etc.)*

At the end of this study, on the basis of these data, it was supposed that specific changes needed to be introduced in hospital design (responding to the changes recorded in the society and in health care) in order to correspond the social development.

Policy of the W.H.O. for Prevention and Sustainability:

The new policy of the W.H.O. particularly promoted:

- *sustainability in buildings (appropriate criteria in design, supporting health and well being of the people)*
- *supply of education*

- *diseases' prevention*
- *holistic collaboration*

Factors influencing the Current Conditions of Hospitals:

Considered that:

- *the social progress was always corresponded in the history of hospital design*
- *the improved standards of life and the policy of the W.H.O. are already reflected in life and in building design*
- *the inadequacy of hospitals to the social development is evident*

The following situations, compared to the new living standards, were considered responsible for the failings recorded in the current conditions of hospitals (concerning environment, configuration and function):

- *poor functional quality in relation to the components of design*
- *poor environmental quality given by the presence of several risks related to environment and building design*
- *poor quality of the building configuration*
- *need of a methodology supporting the design and maintenance of hospital buildings*

On the basis of the general inadequacy of hospitals to the social progress it was deduced that:

- *the quality of design should be improved in order to improve hospital conditions*
- *hospital design should correspond the social, scientific and technologic progress by means of the knowledge, experience and means available*

It was concluded that specific components should be introduced in the model of the Hospital promoting Health and Well Being in analogy with:

- *criteria adopted in the realisation of sustainable buildings (which respond to specific failings recorded in hospitals concerning environmental conditions and function)*
- *trend and social changes, criteria recently influencing hospital and building design (which respond to specific failings of hospital design concerning environmental configuration and function)*

On the basis of these considerations, a number of suitable components was identified, namely concerning the supply of:

- *remedies against the failings of design (as already described about environmental conditions, configuration and function) supporting the production of hospitals promoting Health and Well Being (as already described), which was the final purpose of the thesis.*

Criteria for the identification of the components of the Hospital promoting Health and Well Being:

The analogy and/or correlation to the following material was taken into consideration in the identification of the components (concerning environmental conditions, configuration and function of the Hospital promoting Health and Well Being):

- *measures applied at present in buildings for the prevention of analogous risks related to the environment and health*
- *analogous criteria adopted in the policy of prevention and in the realisation of other sustainable public buildings*
- *correlation to other experiences recorded in hospital design and function, at present and in the past, suitable to answer the aim of the thesis*
- *correlation to other experiences recorded in the design of other categories of public buildings*

- *correlation to the means generally used in every policy of prevention*

A policy of prevention is supported by the methodology and framework of the design of the Hospital promoting Health and Well Being. *Supporting the opinion that 'to prevent is better than to cure', the W.H.O. promotes the health and well being of the people before than diseases. The prevention of the risks affecting our environment is also supported in building design. From the analogous point of view, a methodology is introduced in the Hospital promoting Health and Well Being, in order to prevent misfits and failings of design (concerning environment, configuration and function) before they might occur.*
For this reason, at the end, four categories of components are introduced in the model of the Hospital promoting Health and Well Being, which are Environment (about the environmental conditions of the building), Architecture (about the building configuration), Function (about hospital function) and Methodology (about the methodical approach to design).

About the Environmental Conditions
A previous research about the 'Healthy Buildings' (carried out personally in the three years I worked as a guest researcher at the University of Eindhoven) suggested the use of the analogous criteria already successfully applied in building design and against the risks related to health, building and environment. For this reason, the components for the Hospital promoting Health and Well Being were identified by taking into consideration the analogy of the S.H.S. and the S.B.S. and other specific countermeasures applied in buildings in analogous circumstances.

About the Building Configuration
Since the social progress produced specific changes in the building design, specific components of design are also integrated in the Hospital promoting Health and Well Being, according to researches made in the literature and in the reality of different countries. The choice of the components introduced in the Hospital promoting Health and Well Being (e.g.: escalators, building/furnishing decorations, large halls, etc.) was based on the systematic application of analogous components in other 'modern' public buildings (e.g.: large entrance hall, large glass-sheets, skylights, etc.), and in different typologies of buildings and countries.

About the Function of Hospitals
It was considered that hospital design should correspond traditional needs and specific relevant facts (such as the new living standards, the prevention policy and the criteria adopted in building according to the policy of the W.H.O.) For this reason, specific components were taken from the hospital history since considered respondent to the needs of patients, designers and staff (Privacy, Home-like Assistance and Familiar Atmosphere, Positive Global Configuration, Presence of a Natural Environment, Increase of Natural Ventilation, Logical Indoor Circulation and Lay-out of Hospital in Relation to its Functions, Structural Flexibility). Other components were integrated in design for corresponding the social changes and supporting the realisation of a patient-focused design (according to the aim of the W.H.O.). The analogous level of comfort of other categories of large public buildings (considered analogous to hospitals as large public structures), was besides introduced in hospital design, by the use of specific components, which are for example: the increase of activities focused to support the health and well being of the patients, the use of modern means of information and transportation , shopping

centre, restaurant etc. Specific analogies were also found with the increased comforts of the very newly built hospitals and with some components adopted in built hospitals at present and in the past.

About the Methodology of Design

A systematic approach to design was finally integrated in the design of the Hospital promoting Health and Well Being for the prevention of the critical failings occurring in the design and maintenance of hospital buildings (e.g.: poor maintenance, inadequacy of technological systems, structural misfits, defeating lay-out of the building, uncomfortable illumination, risks related to air conditioning etc.). This is focused:

- *to improve the quality of environment, configuration and function of hospitals*
- *to prevent the failings related to hospital design, function and maintenance*
- *to support the policy of sustainable design*

Addressed to integrate Design Methodology, Building Technology and Maintenance, it is based on the analogous principles and means adopted in our society and in other activities of life to support 'prevention', that is by means of:

- *the supply of information and education as means for the prevention of disease*
- *the holistic collaboration which improves the quality of design by means of different contributions given by experts and users*
- *supporting the opinion that 'it is better to prevent before that a damage can occur'*

On the basis of the previous considerations, it includes the following components:

- *holistic collaboration of different categories of people contributing to the design and function of hospitals*
- *forecasts about the need of patients and staff and social development*
- *integral co-ordination of different components of design*
- *closer correspondence between design, maintenance and function of the building*
- *supporting the use of easy solutions and multifunctional components to improve the quality of design*
- *supporting the education of the people and mostly of designers, builders and technicians about the several health risks related to building and environment*
- *revisiting of the issues concerning design, maintenance and function of hospitals*
- *integral up-grading of design and function*
- *systematic approach to hospital design*

3.1 Final Result

A strong correlation exists between health care, facility management and building aspects. For this reason the components of the Hospital promoting Health and Well Being are finally included within four main categories which are:

- Architecture (improvement of the building configuration mostly by means of the adequacy to new living standards)

- Environment (improvement of the environmental condition mostly by means of sustainable criteria of design)

- Function (improvement of the function of hospitals mostly by means of a patient-focused design)

- Methodology (improvement of the function of design mostly by means of the systematic approach to design)

The components of design for the Hospital promoting Health and Well Being, included within these four categories, are reported into a final representative prospect. The possible use of these components is illustrated by means of practical examples given in form of sketches and drawings. These show how the application of these components can be put into practice for:
- promoting the positive perception of hospital
- supporting the well being of the patients
- increasing the contact with natural ingredients
- producing a familiar atmosphere
- supporting the assistance
- increasing the privacy
- supporting the adequacy of design to the new living standards and its 'identity'
- supporting the assistance
- supporting flexibility and modularity
- supporting the use of passive systems by means of building technologies
- the integration of local prerogatives, green spaces and natural ingredients
- the functional distribution of hospital activities
- the introduction of 'special activities' for the patients
- the increase of privacy in patient rooms

3.2 Validity and Reproducibility

The validity of the components integrated in the design of the Hospital promoting Health and Well Being is supported by the following facts.

The Experience Coming from the Past
From the study of the history of hospital and health care, it came into evidence that:
1) a series of components has:
- constantly influenced the realisation of hospitals
- been constantly improved by designers until now
Depending on the relevance specific components assumed in the history of hospital design, these were considered necessary to answer the needs of patients and staff of hospitals. The constant intention of designers to support and improve their quality validate the integration of relative components of design. On the basis of these considerations it was concluded that the following components should be still supported by designers: PRIVACY, HOME-LIKE ASSISTANCE AND FAMILIAR ATMOSPHERE, POSITIVE GLOBAL CONFIGURATION, PRESENCE OF A NATURAL ENVIRONMENT (INCLUDING INCREASE OF NATURAL VENTILATION), LOGICAL INDOOR CIRCULATION AND LAY-OUT OF HOSPITAL IN RELATION TO ITS FUNCTIONS, STRUCTURAL FLEXIBILITY.
From the history it was also found out that:
2) the development of health care and social progress has constantly contributed to the development of hospitals

3) emerging new issues (in health care and in the social) have been punctually reflected in the development of hospital design
4) having the peculiarity of changing needs according to the progress of the social context, hospitals should be considered by designers as 'dynamic' structures.

The Experience Coming from the Present or Recent Past
New components have been gradually introduced or improved in hospital design, depending on objective needs of the users (e.g.: easy-to-be-cleaned furniture, technologies increasing the natural ventilation, comforts and assistance of the patients, sanitary measures, therapies and therapeutic means etc.).
The social development has recently introduced improved technological means and comforts in every activity of life, such as computerisation and mechanisation. The improved living standards gave rise to a widespread use of products and items of any kind improving our level of comfort (e.g.: various equipment at distance which modulate the intensity of illumination or switch on lights, use of mobile phone, electro wave oven, alarms against thieves, etc.). Specific components increasing our well being are also used in buildings (e.g.: living standards and comfortable atmosphere given by means of various components of design and furniture, illumination and decoration, green plants and paintings in private and public buildings, improved comforts given by the use of modern means for communication, transportation, information etc.). Improved technological means and components of design (for example computerisation, way-finding, escalators, large glass-sheets etc.) are now adopted in newly built public structures (a series of examples was selected in this study and presented in pictures, showing the use of these components in the recent large public buildings). Our generally improved living standards suggest the introduction of analogous components in hospital design which support function and configuration of hospitals.

The risks for the health of the people are also increased, owing to the widespread use of industrial products and technological means. A new policy of prevention is addressed to reduce and abolish plural risks present for the health of the people nowadays recorded in many activity of life (e.g.: several products on trade must include instructions for use and conformity to specific regulations, people using dangerous equipment or material at work assume specific information and means for protection, etc.).
Specific measures have been already introduced in design for the prevention of the risks related to health and environment (as described in Part I). The components of design are besides responsible for many risks the occupants of the building are exposed to (e.g.: air conditioning systems, technological systems, risk of fire, hazards concerning the use electricity, gas, etc.) as described in Part II. Since design is strongly responsible for many risks related to the health and the environment, the quality of design can affect positively the quality of our environments, inside and outside the building. The Hospital promoting Health and Well Being assumes analogous criteria and measures in relation to analogous factors affecting the current conditions of hospitals and generally the building design.
Information and education are frequently supplied for the prevention of plural risks related to the health of the people in various activities of life (e.g.: information is given for the use of chemical/radioactive products and sanitary equipment, information is also given about biological risks related to food products, instructions are given for the correct use of various products such as toys, ladders etc., hygiene propaganda is made by the sanitary service which supports diseases' prevention and so on). The supply of education is also integrated in the Hospital promoting Health and Well Being, owing to the use of the analogous criteria and measures generally adopted in the policy of 'prevention' influencing every activity of life. On the basis of these considerations, the failings recorded

in hospitals support the introduction of a systematic methodology supporting the quality of design, maintenance and function of the building.

The methods above illustrated to validate the final results of the thesis were making use of material taken from the literature and specialised journals cited in the bibliography, the study of newly built public buildings and hospitals. Specific interviews were also carried out in hospitals, aimed to ascertain the approval of the patients and the technical staff for specific components of the Hospital promoting Health and Well Being.

Interviewing the Patients

The interview, carried out in the years 1997-98, was focused on wishes and preferences of the patients in matters of hospitals.
The questions prepared were asking the opinion of the patients about:
- *the opportunity to introduce changes in the traditional design of hospitals*
- *the typology of these changes (on the base of concrete proposals)*
- *their eventual preference for specific components of design*

The questions were mostly concerning the items individuated for the design of the Hospital promoting Health and Well Being and therefore related to environment, function and well-being-feeling.
The opinion of the patients was asked in hospitals of three different countries, chosen on the base of their peculiarity of having some expected analogy with the Hospital promoting Health and Well Being. This fact consented to give the patients concrete ideas about the questions of the interview on the base of practical examples.
The following hospitals were chosen on the base of the following specific characteristics:

1) *Klinikum Krankenhaus in Aachen (D) was a typical example, among other aspects, for the application of colour indoor and modern components of design. Its peculiarity was the green colour dominating indoor (walls and floor) against the usual 'white walls' of the conventional hospitals.*
   Its two-levels high, large entrance-hall was supplying shops and escalators. The tables of the Cafeteria were over-viewing the entrance-hall from a prospicient balcony.
   The assistance was supported by the supply of comforts like: physical activity for the patients in specific circumstances; different types of meals were served (dietary, vegetarian, normal) according to the preference of the patients; coffee and various types of tea were available at any time.
   Several patients were usually walking in the hall and shopping area. When the weather consented, many patients were usually seating and walking outside the building, mostly in front of the main entrance of the building and in the open cloisters situated on the ground level.
   The building structure and technology had other peculiarities reported below ('Interviewing the Technical Staff').
2) *Diaconessen Ziekenhuis in Eindhoven (NL) had been partly renewed just in the time of the investigation (1997). The renewed large entrance hall, two-levels high, was made of different building material and a variety of colour was applied in its building and furnishing components. The presence of large glass-sheets was given as well as green plants. A sort of 'window-shopping' had been realised in the middle of the reception where different goods were displayed to be seen by the patients and visitors of the hospital. A display of brochures was placed close to the main entrance.*

Large glass-sheets were realised overlooking the large entrance, the renewed part of the building was made partly in plaster partly in bricks, coloured furniture and illumination created a comfortable atmosphere. In practice this part was appearing completely different from the old part of the building (looking like an obsolete and conventional hospital) mostly depending on the presence of modern building components, variety of building and furnishing material, colour and green plants.

3) *Ospedale Villa S.Pietro in Rome (I) was taken for the large green spaces surrounding the building sloping from the gate towards the main structure. Coloured flowerbeds and a cave with religious statues were located in front of the entrance. A few marble statues had been situated in the park according to the design of passageways and small squares. Aside, a small zoo with a few animals (mostly goats and chickens) had been realised in the green surroundings of the building to give the opportunity for a walk reaching some different places.*
   The patient rooms were facing the green spaces, but the structure had not yet been renewed though the renewal was planned.

Fifteen people were interviewed for each hospital object of the study. The aim was to know their opinions about eventual changes to be applied in hospital design and their eventual preferences about the introduction of specific components concerning environment and function of the hospital. The aim was besides to register the answers given by the patients in order to compare the possible correspondence of the results coming from three different backgrounds and cases.
Eight complexes of questions were asked and the respondents were asked on their opinion about the eventual presence or absence of a series of activities and circumstances.
The patients were also asked what they thought about the use of colour in the building and about the presence of images (like pictures, printings, photographs etc.) in hospital environments. It was further asked their opinion about an eventual change of the traditional image of the hospital and which could be the eventual positive/negative effects deriving from the increased environmental quality within the hospital building. A correlation was made between the 'traditional' model of hospitals (that is conventional for us in function and configuration) and an eventual more 'modern' model (that, integrating modern components in function and configuration, would give an alternative image of the hospital).
The scheme of the interview is reported in the pag.129-131.

Summarised Results of the Interview to the Patients

At the end the majority of the people interviewed, though living in three different countries, was confirming the existence of a common sense and a will for change. Their approval was almost unanimous for the 'change' and for the 'typology of changes' proposed.
All people, in the three different countries interviewed, were sustaining in a very large proportion that the image of traditional hospitals should be changed to assume a modern configuration (only very few negative answers were collected: 3 in Italy, 3 in Germany, 2 in The Netherlands).
The majority of the people interviewed, considered positive the presence of colour in furnishing and building material (negative answers: 1 in Italy, 2 in Germany, 2 in The Netherlands) resulting both 'satisfying at your sight' and 'more relaxing'. The feeling of confidence about the presence of colour introduced in hospitals was approved by the majority (only the total of 3 people were sustaining that

the presence of colour could disturb and could result in less relaxation for the patients). It was considered to produce a 'more confident', 'more hospitable and familiar' atmosphere.
People considered the presence of pictures and images also positive (negative answers: 3 in Italy, 3 in Germany, 4 in The Netherlands) supporting the increment of hospitality and familiarity.
The three groups of people were contemporaneously according the opinion that the improved environmental quality of hospitals would generally suggest higher respect and consideration for the environment.
About the introduction of activities, a variety of answers was given.
This only testifies that the patients wish to have some comforts at hand, though every single individual has his/her own preferences.
Looking at the first question of the interview including a list of thirteen items (asking their preference about 'optional' items to be introduced by hospitals), the answers show that all the items were singularly checked by the people (not even one of these items was excluded). The individual preferences though, were particularly concentrated on privacy and information reported in n. 9 and 13 (of the first complex of questions). For this reason, beyond the approval for the presence of more opportunities, it was possible to deduce that people ask particularly for more privacy and information.
A slight difference was noted about the proportion of requests between the three groups of people. People, interviewed in Italy, were asking for more privacy and information (number 9 and 13 of the list above mentioned).
People living in The Netherlands gave preponderantly the same result with additional answers about number 1 (additional privacy).
People living in Germany, besides number 1, 9 and 13, were asking also number 3 and 7 (window with 'view' and activity).
In conclusion this study is mostly confirming the existence of a common will supporting the change of the traditional hospital in its configuration and function, appearance of the surfaces of the components of a building technology concept. Hospitals are expected to move towards more modern schemes in function and in the configuration of their environments. This could be done by introducing in design components like those suggested by the interview. The same items would give a positive answer to the disappointment recently denounced by the patients of hospitals (2.2.6 Patients complain general discomforts).
The approval is given in this study for the introduction of:
- *colour and decoration (already introduced in some newly built hospitals)*
- *components of design increasing assistance and comfort (already approved in history)*
- *supply of information (already supplied in other modern buildings)*
- *activities (already promoted in the realisation of 'sustainable buildings')*
- *a window with view (already approved in history)*
- *familiar atmosphere (already approved in history)*
- *increased privacy (already approved in history)*

Components like colour and decoration, a window with view are besides approved in the literature. Relative studies carried out in hospitals and including interviews were made by researchers. They are reported in the thesis (7.2.2.1 Colour and natural light, 8.1.3.3 Multipurpose window).
Components like assistance and comfort, familiar atmosphere, privacy and a window with view are also approved in history as well as the application of colour for therapy and mostly for relaxation (the use of colour, music and soft light is introduced by new relaxation systems to be applied in hospitals, as reported in 8.2.2.2 High stress reducing formula).

Components like colour and decoration are supported in the realisation of newly built hospitals and special hospitals as reported in the thesis (9.1 Planned and built examples, 10.2.1.3 Assumption of 'identity' against 'anonymity', 5.1.4 Life standards, 5.1.4.1 Quality of life and hospitals).
Components like supply of information are more often introduced in the design of modern large public buildings. The lack of way finding is lamented by patients and experts (5.3.2 Lack of modern items of design). It was supported in the history as soon as the increase of the activities of hospitals created this need and it is recently introduced in newly built hospitals (10.2.1.4 Combination of information and images, 7.2.1.1 Way-finding and circulation systems).

Interviewing the Technical Staff

An interview was made, addressed to the technical staff of the Klinikum Hospital in Aachen (D), based on the fact that the Hospital promoting Health and Well Being:
- integrated the analogous requisite of the building flexibility
(positive experiences have been registered about the application of structural flexibility and modularity in the case of the Klinikum Hospital in Aachen (D) mentioned as a winning model of flexibility by G. Martinazzoli in 'Gli Impianti Ospedalieri'- published by La Nuova Italia Scientifica 1995
- made large use of natural ventilation against the large use of air conditioning made in the Klinikum (the aim was to ascertain the validity of air conditioning against natural ventilation)

The interview conducted in the Klinikum was investigating about the validity of flexibility and natural ventilation. For this reason a number of questions were asked to the engineer Mr. Filios Basile -chief of the technical administration of the hospital- about the:
- *effective utility of flexible building systems*
- *specific system applied in the realisation of the Klinikum*
- *real efficiency of air conditioning*

The interview confirmed that the typology of the building helped to realise numerous adaptations in the lay-out of the building motivated by many consequent requests coming from the different medical doctors consecutively working in the Klinikum. "The structural flexibility of the building was the key to reach new needs in reasonable time", says engineer Mr. Filios Basile, confirming that various structural changes have occurred by the time in order to satisfy the needs of different doctors and the requests of the staff.

He explained besides that the flexibility of design in the Klinikum hospital is supported by:
- the modular distance of the columns
- the modular dimensions of the functional spaces resulting in more easily adaptable configurations (contrarily to spaces varying in size)
He asserted then, that the modular square grid existing between the pillars of the hospital consented to apply methodical adaptations in the lay-out of the building and agreed that the structural modularity gives the possibility to apply modular building and furnishing systems.

Filios Basile stated besides that the frequent presence of air conditioning indoor was responsible of producing lacks in the requisites of the air.
These were mostly depending on:

- the lack of air moisture
- the difficulty of balancing the parameters of the air adequately to weather conditions
He asserted that for these reasons patients complained the lack of fresh air indoors.

It was concluded from this study that modular building systems should be taken into consideration in hospital planning, not only in reason of their application through the history, but also on the base of the following facts:
- the changing needs
- the easier application of refurbishment
- the possibility of applying also modular furnishing systems
It was further concluded that the following reasons support the choice to adopt (whatever possible) natural ventilation in hospitals:
- the difficulty of adapting, constantly and properly, the parameters of the air to the different weather conditions in order to grant physical comfort
- the lack of air moist often depending on the use of ventilation systems, producing physical discomfort
- the request of the patients for fresh air
The relevance assumed by the use of natural ventilation is stressed by the model of the Hospital promoting Health and Well Being not only for these reasons, but also for:
- the constant need of increasing natural ventilation in hospital history (in the thesis: 4.1.1.4 The issue of increasing indoor ventilation, 4.1.1.8 Constant issues: familiar configuration, structural flexibility, ventilation)
- the presence of plural delicate situations affecting the environmental conditions of hospitals (2.2 Complaints of hospital designers, staff and patients)
- the presence of plural risks including the risk of disease depending on air conditioning systems (in the thesis: 5.2.1 Risks affecting the Environmental conditions)
- the existence of failings related to the design and maintenance of air conditioning systems (in the thesis: 5.2.1 Risks affecting the Environmental conditions, 1.1.1.1 The role of ventilation)
- the relevant effect of the abundant natural ventilation against different causes of pollution (1.1 Causes of health risk in buildings)

Part I

Current Hospital Conditions

Hospital design is at a critical stage owing to the situations that influence hospital condition: on the one hand the hard relationship between buildings and environment and, on the other, the various changes currently occurring in health care and in the social background of hospitals.
The Principal for Healthcare N.B.B.J Architects in Washington D.C., J. Michael Currie stated: *"designers have a responsibility to create buildings to meet these new challenges and to continue to support the medical practice within"* [1].

Health, Environment, and Building Design
Chapter 1

Summary

A variety of health dysfunctions originate from our environmental conditions on the basis of factors [2,3,6] that also influence today building activity. These factors will be illustrated in this chapter as the background to the present condition of hospitals.

1.1 Causes of Health Risks in Buildings

Summary

Environmental factors indoors were found by researchers to produce health disturbances and diseases [12,23]. Researchers found that some of these factors are also related to building design. These factors and their correlation to design are illustrated in the following paragraphs.

1.1.1 Sick Building Syndrome

A number of health disorders has appeared connected to the increase in indoor air pollution [2,3,4,5,6,7]. A growing consciousness of the connection between health problems and every-day reality was created a general interest in people and researchers. Building, finishing and furnishing material, faulty maintenance, the use of noxious household products, were investigated as potential causes of these problems [2,3,5,7]. But perception of discomfort and diseases, irritated eyes or nose, breathing problems, dry or sore throat, irritation of the skin or headache were found by researchers to depend on factors mostly connected to the building. These symptoms were therefore attributed to the Sick Building Syndrome (S.B.S.).
This appeared to be not an isolated or rare phenomenon originating from one definite source. Different causes determined a similar effect and various kinds of symptoms might occur in affected individuals. Human reactions varied from individual to individual [7,11,12]. At first this situation created serious difficulties identifying the precise causes, but a strong correlation appeared to exist between S.B.S. and indoor air quality [2,3,5,7].
Office buildings were the object of investigations not only because people spend a large part of the day at the office, but also because the presence of a large number of individuals made it easier to verify and to compare health disturbances. The Department of Building Services Engineering and the Department of Building and Surveying in the Hong Kong Polytechnic carried out one of these investigations [7]. Nine buildings, including the polytechnic library and offices of five modern commercial buildings were the object of this study. The opinions of occupants (fig..) on the "sickness" of the buildings were taken into consideration. Occupants were asked about air quality, thermal comfort, lighting, noise and other environmental aspects, as well as differences in discomfort between work/home and job satisfaction.
Health complaints appeared mostly related to the quality of indoor air at work, but they were not always related to low-standard work-places. It was noticed that only some of these buildings did not properly conform to international building standards. For this reason some

of these buildings were described as "sick" and others as "problem" buildings. It was also concluded that the same *'uncomfortable and unsatisfactory'* conditions were more *'varied and complex'* in air conditioned buildings. Assessing the building's "sickness", the air quality was determined to be the most influential factor. The causes of the S.B.S. were considered to be various and complex. Other researchers sustained that contributing factors to the poor quality of the air included building structure and systems, finishing and furnishing materials, man-made and synthetic materials [2,3,6,7].
Another study was carried out in a total of 15 offices in Copenhagen [11]. It showed that a high concentration of people and smoke, the use of varied electrical equipment also contributed to producing poor air quality. Inefficient ventilation systems also increased the presence of polluting agents (fig.). Air quality and ventilation, the presence of concomitant factors were thought to produce the perception of discomfort and even disease in people.
Similar studies were carried out in hospitals. They are reported in chapter 2 (see 2.1.1 Sick Hospital Syndrome).

1.1.1.1 The Role of Ventilation

Several investigations carried out to study the S.B.S. assert that the air conditioning systems are responsible for poor air quality [3,7]. Lack of fresh air and inadequacy of temperature, air moist and ventilation produce uncomfortable conditions in buildings. But determined conditions are sometimes also responsible of supporting the development of biological agents and diseases. Air humidity and heat facilitate for example the proliferation of micro-organisms and the distribution of volatile organic compounds into the air [6]. There are pollutants distributed by recycling of air, micro-organisms that live in humidifiers, scarce hygienic conditions of air filters or air conditioning tubing which produce diseases. Researchers often assert that buildings with mechanical ventilation should be planned properly and that the air conditioning systems should be regularly maintained and cleaned [3,7].
S.B.S. is therefore only one of the causes which produce health disturbances and diseases. It isn't responsible for diseases such as Legionellosis and other health disturbances produced for example by inadequate microclimate or noise level, structural imperfections derived from the project and realisation of the building, poor maintenance or inadequate cleaning.

1.1.2 Polluting Materials

Health dysfunction emerged from epidemiological research [11,13,16] on the many toxic components used in the building sector [15,16,23]. This sector is considered responsible for a significant impact on the environment and public health [15]. Technology and industry have recently increased the number of products on the market. There are new products with better properties and improved qualities, but made of mixtures of biochemical/synthetic material. There are components of manufacture and final products that are dangerous for individual health. There are products that continue to be dangerous also after their application [14,21]. Widespread use is made of building, finishing and furnishing material in buildings such as oils, waxes, dyes, lacquers and other products including chemical compounds [2,4,5,7]. But paints releasing chemical emissions or phenol formaldehyde used to make plywood represent an insidious risk to human health also after the use of the product.
There are chemicals used in the manufacture of building and furnishing products - for example formaldehyde, nickel, chrome- that are dangerous to health. In 1967 the Hygiene-Institute Dusseldorf found that formaldehyde could be dangerous to lungs, central nervous system, liver, kidneys and skin [13]. It can also produce headache, tiredness, vertigo,

irascibility, breathing disturbances, skin rash [13]. Benzene produces leukaemia, chrome and nickel produce allergies and in high concentration are poisonous. Beyond the chemicals already known to be dangerous, there are many other components just 'suspected' responsible for diseases. According to the National Research Council (N.R.C.), there is no information on the effect of almost 50.000 industrial chemicals in use in the U.S.A. [16].
The damage produced in man by polluting material varies from simple health disturbances to real diseases [14,15,16,22]. There are building materials and components known to be responsible for cancer (for example asbestos). There are several allergenic, toxic and symptomatic reactions that are more frequently reported by those persons who are more sensitive to specific substances or to a number of different components [2,3,5,6]. An individual physical reaction to the interaction of different pollutants has been reported, known as multiple chemical sensitivity (MCS) [16].
Materials and technologies should combine ecological and biological benefits [15]. Producers, designers and builders should avoid or limit the use of chemical products in building.

1.1.3 Radon Radiation

Radioactivity exists everywhere on earth. Depending on the composition of the earth layers, radon may accumulate indoors and become dangerous to people's health. Building materials can themselves be radioactive as happens for example in the case of granite from radioactive earth layers.
In buildings constructed on soil emitting radon, the level of radioactivity can be much higher than that outside in the open air where the level varies from 5 to 20 Bq./ mq. Depending on gas concentration and time of exposure to this radioactivity can produce cancer [9, 17,18,19,20].
In an E.P.A. report it was estimated that in the U.S.A. radon radioactivity causes about 14.000 deaths per year [17], quite a high number if compared to other causes of death (fig.). Therefore the risk of radioactivity should be considered in construction. Measures against this risk have been taken in building [9,10,17,18,19,20] and the areas have been identified that have critical radon problems. Appropriate instruments can measure radon within buildings.
The lowest level of the building is the most affected by this risk (fig.). At the same time, fissures and cracks in the structure, chimneys, different materials or porosity of building products can also facilitate its distribution to the upper levels of the building [8].
Countermeasures and building techniques to adopt in buildings affected by this problem consist of barriers to keep the gas underneath the building. They mostly include systems to increase indoor ventilation. The ventilation of indoor spaces is considered by experts particularly important against radon accumulation [17,18,19].

1.1.4 Electrical Pollution

A link between radiation and cancer was already found out in the 30's by the German researcher Freiherr von Pohl. To study this correlation, he made a map of the village of Vilsbiburg and identified the areas which were potentially cancerous. Further on he obtained a list of those people who died of cancer during a period of 10 years and ascertained they had slept in those areas. An analogous study was carried out by the Dutch J.G.Mierermet in The Netherlands. He carried out this kind of research in the same period of time, obtaining analogous results in the county of Friesland [2].
Research still asserts that people, animals and plants react to electromagnetic fields [2]. Health distresses seem to be produced in the individual, varying from simple stress or symptoms such

as insomnia, headache, depression or dizziness. Other disturbances are also attributed to electromagnetism such as defects of circulation and serious diseases such as leukaemia in children [2,17,24,25]. It looks as if the effects produced in man by this radiation may depend on factors like individual biological activity and personal physical response in relation to types, combination, polarity of electrical radiation.
Types and effects of electricity floods have been studied by the German physician Hubert Palm who created a formula to establish appropriate measures for keeping buildings at a distance from electrical conductors [2]. This distance was taken into consideration also by the researchers Wertheimer and Leeper [25] sustaining the existence of a correlation between childhood leukaemia and electricity ducts situated near houses.
According to the theories of the physicians Hartmann and Curry, a more or less regular grid is present on the earth surface, a 'net of electricity floods' with electromagnetic variations [2]. This is made of a diagonal and perpendicular network considered able to interfere with human biological activity.
Some experts advise a number of specific measures to be taken in order to avoid the possible risks from electromagnetic fields. They derive from physical and biological considerations. According to this advice, for example, the bed should be placed out of the 'net of electricity flood', our body being particularly receptive during rest, the head towards North, South being the pole which attracts electricity [2,6,17,24]. Electrical equipment stays out of the bedroom where a bio-switch device excludes the circulation of electricity [6]. Constant presence of moist air is created to avoid the accumulation of electrostatic charges [2]. The presence of materials that collect electrostatic charge as for example synthetic products and metal, is excluded in furnishing and building [2,6].
In countries like United States and in Germany specific organisations work on the problems related to electromagnetic fields, supplying consultancy and assistance in planning and building [2,17].
Several studies continue to be done by the experts not only concerning the assessment of serious risk of diseases but also the possible dangerous effects produced on man by electromagnetic fields.

1.1.5 Resource Utilisation

The large scale use of resources recently seen in industrial production and the presumed increase of the world population up to 2100 -mostly if compared (fig.) to the energy demand pro capita referred to 1990- give the perspective of an alarming situation.
The abundant use of energy and chemicals in industrial production created conspicuous repercussions on the environment and on people's health. Many international organisations have been created -such as Greenpeace and World Wild Fund for Nature- which by means of information have encouraged the world population to support choices for the health of the people and the balance of our ecosystem. Different means have been used to involve the participation of the international scientific research and governments. Individual responsibility was solicited at any level in order to guarantee safe conditions of life at present and in the future (fig.).
This policy is particularly encouraged in the building sector, since building production represents the greatest consumer of resources in industry [15]. Many national institutions have started to support initiatives using ecological technologies in building activities.
The highest percentage in the use of raw materials and energy is spent in the manufacture of building materials (*"...buildings account for roughly 40% of the materials entering the global economy each year..."* [15]). A negative impact on the environment is also made by realisation of buildings.

The share of energy consumption in building activities goes *"from 36% to roughly 45%"* that it is *"more than any other use..."* [15]. The impact produced by the building sector on the environment is evident in Europe as well where *"...construction and demolition activities produce 50% more waste than municipal garbage.."* [15]. The repercussions of building activities on the environment invite designers and builders to take specific measures by containing the consumption of energy and resources and by supporting the use of recycled products.

1.1.6 Industrial Production

The industrial production often proposes sophisticated items employing raw non-renewable materials, chemical compounds and high energy consumes in their manufacture. In the industries, a significant increase in the use of chemical products was recently seen in response to people's request for materials with improved characteristics. The result is now the total of single 'contributions' that each person gave by the use of whatever the producer proposed, without weighing the possible ecological and individual return or damage. This was translated into a non-quantified series of poisonous increments from the industry and into the existence of the large scale consume of 'throw-it-away' products. The same thing happened also in the use of building and furnishing materials, as for example finishing products, items for decorations and paints. This situation created false perceptions and habits in consumers. The consumer was encouraged to buy any kind of ready-to-use, short-life products. People have been looking for quick-to-use products without paying attention to the cost-benefit on a larger scale. But the higher cost of a product does not always means quality. On the contrary, it often represents a loss of raw (expensive) materials and high energy consumption. The relationship of price/quality suggests that consumers should be careful in the evaluation of products. To improve this situation, support and co-operation is expected from users and producers. These are expected to make appropriate choices, proposing energy saving products and the use of environment-friendly materials.
The refusal of anti-ecological expensive and superfluous materials, should correspond with the choice in planning of natural and renewable products. Designers and builders should use convenient products from the point of view of manufacture and application, including the cost of maintenance and delivery. Local products should hence be preferred, avoiding high energy consumption and expensive components in manufacture.

Conclusion of Health, Environment, and Building Design
Chapter 1

Various sources of pollution are related to Building and Environment. Specific measures have already been taken by different countries against the risks of indoor pollution. The use of natural energy and renewable resources, building techniques and systems that contribute to avoiding environmental pollution should be preferred in the realisation of the building. Long-term considerations should be made also to save on energy consumption.
Toxic components of building materials and cleansing products, geological phenomena like gases from the earth, electrostatic and magnetic fields are liable to undermine our health. The modest disturbances or chronic diseases people suffer nowadays testify that the proper level of tolerance has been exceeding and people's immunity system is attempted. Appropriate building technologies are applied in buildings and the increase of ventilation is advised by the experts against different causes of pollution (as in the case of radon radiation and of the

S.B.S.). Analogous advantages should be gained in hospitals by adopting appropriate building technologies and materials, and other proposals made recently (such as placing beds towards north or increasing natural ventilation indoors). These can only improve the results obtained in the realisation of hospitals as in other categories of buildings.
Designers, builders and users became more aware of the benefits available in the matter of individual health by making appropriate choices in planning. Long-term considerations should be practically made by designers and builders also to support the realisation of hospital buildings promoting Health and Well Being by applying the same measures recently adopted in design.

Summary of chapter 1

RISKS RELATED TO THE ENVIRONMENTAL CONDITIONS
SICK BUILDING SYNDROME
MATERIAL POLLUTION
ELECTRICAL POLLUTION
RADIATION

ASPECTS INFLUENCING BUILDING ACTIVITY
ENERGY SAVING
SAVING ON NATURAL RESOURCES
REDUCING CHEMICAL PRODUCTION
INCREASE OF NATURAL VENTILATION

Health, Environment, and Hospital Design
Chapter 2

Summary

The general complaints of patients and hospital staff of hospitals mostly concerning Environmental conditions of hospitals. Health disturbances, at first attributed to the S.B.S., not only depend on the analogous factors which affect the indoor environment in buildings [10,11,12], but also on the design and function of hospitals.

2.1 Environmental Conditions of Hospitals

Summary

The 'traditional healthiness' of hospital environments is affected by a number of factors [10,11,12]. They are the following:
- the Sick Hospital Syndrome,
- the plural risks related to hospital design and function,
- the staff responsibility in the management and performance of hospital activities

2.1.1 Sick Hospital Syndrome

The health discomforts of staff and patients were investigated by researchers in relation to the environmental condition of hospitals. Plural factors were investigated as responsible for the S.B.S. Chemical substances (products used in work such as regular disinfecting and cleansing) and other polluting factors (building materials and components, pollution from road traffic) were identified among the number of the polluting sources which affect the quality of the indoor air [10,11,12].
The researchers noted the responsibility of function and design of hospitals. A complex situation emerged from this study depending on the combination of plural components: *"indeed its complex structure and function make a -sick hospital- a -problem patient- while it proves very difficult to make the correct diagnosis and prescribe the appropriate cure"* [10].
A new hospital was the object of research in Italy. This study was focused on identifying the causes of health disturbances complained of by the staff [10]. In response to non-specific symptoms reported by workers, the origin of these disturbances was attributed to multiple items including design and maintenance of the hospital. In this case, plural components affected the quality of the indoor environment, the researchers asserting: *"as a wide range of different indoor environments is found in hospitals, the design, construction and maintenance of the whole building had to be carefully reviewed, especially focusing on materials, ventilation, thermal conditions, physical, chemical and biological pollutants, and such hospital-specific issues as the disinfecting procedures*" [10]. Sustaining the implication of design misfits, the researchers concluded at the end: *"this present study, dealing with a hospital-related SBS case, suggests that hospitals should also be accurately designed as to provide health personnel with a comfortable and healthy environment".*

Another study investigated the causes of the general symptoms reported by the staff of a large new hospital [11]. Various factors were considered again as *"the most probable cause of discomfort and of symptoms which are indicative of the SBS"* [11]. Also, the researchers sustained again the responsibility of hospital design asserting: *"structural factors in the new hospital, which have played a part, include insulation and synthetic materials in building and furnishing, a ventilation system which did not ensure a comfortable micro-climate, and strong lighting in some units."*
In another study carried out in hospitals the researchers reported that the presence of roads nearby the building increases the number of pollutants indoors. They asserted in fact: *"the quality of inside air is strongly dictated by outside pollution, the latter mainly depending on hospital position with reference to automotive sources..."* [12]. At the same time they stated again: *"..indoor pollution from volatile organics can be traced to peculiar sources and is characteristic of hospital activities, with respect to other collective buildings, mainly due to the extensive use of cleaning products and sanitary auxiliaries"* [12].
The environment of hospital buildings is generally supposed to support patient's healing and well being. On the basis of the previous considerations, designers should create the appropriate conditions to support the health and well being of patients and hospital staff.

2.1.2 Presence of plural Risks

Recent studies have noted the variety of risks present in hospitals. Hospital activities and the plurality of technological systems imply the responsibility of managing sophisticated technological installations and dangerous substance. Chemicals, radioactive products, gases beside the presence of biological agents represent various potential hazards in hospitals. For example the biomedical laboratories imply *"..exposures to chemicals, radioactive materials, and biological agents as well as safety hazards such as fire, explosion, and electrical injuries.."* [8].
Some researchers express their concern to find measures of prevention against the plural risks found in hospitals. In the final conclusion of a recent study they state: *"exposure to chemical substances deriving from biomedical activities in hospital should not be overlooked, since individuals other than health care workers could be involved, such as patients, relatives and other hospital visitors"*.
There are studies pointing out the potential hazards in hospitals related to building design. In one of these studies, the risk of pests infestation is attributed to the characteristics of design and to the refurbishment of the building [9]. The researchers sustained in practice that consecutive structural changes mean partial alteration of the building's features and components. These structural compromises (as for example resulting voids) resulted responsible for supplying suitable harbourage to pests. The frequent adaptations in hospitals would be the cause of the many infestations recently recorded. Various structural compromises would also increase this risk for two reasons: the production of suitable harbourages and the difficulty of applying treatments against infestations. It was asserted in the 2nd International Conference on Insect Pests in the Urban Environment [9]: *"an unfortunate consequence of functional changes within the structure may be the introduction of features (such as voids or suspended ceilings) which may facilitate the proliferation of infestations and hamper effective treatment strategies"*.
The combination of risks related to medical activities and other risks deriving from the many installations and security systems of hospitals, in addition to these facts, confirm the opinion that hospitals are concentrating 'real' and 'eventual' hazards. The experts assert that *"hospitals are likely to fall within the highest risk category"* of buildings [9].

2.1.3 Individual Responsibility

The quality of the indoor environment is also due to poor maintenance and design [6]. The many technological systems require assiduous control and maintenance in order to guarantee

the regular performance of hospital activities. In a recent study, the researchers suggest applying regularly *"materials substitution, engineering controls, safe work practices, and use of protective equipment"*, asserting that against several risks *"emphasis must be placed on primary prevention strategies"* [8]. Elevators and lifts, the network of telephones and televisions, the connection of monitors and data transmissions, the presence of plural medical equipment imply the constant assistance of specialised personnel. Maintenance and assistance is needed also for the many installations and systems: heating and steam, air conditioning, electrical units, sterilisation and laundry, medical gases, fire prevention and so on.
The researchers assert that the inadequate performance of hospital activity, such as for example in disinfecting, increases the risks for health [8]. Sanitary applications and treatments often include the use of medical equipment, chemical and radioactive products, the need for regular cleaning and disinfecting which imply potential hazards. Personnel and technicians of hospitals are supposed to be aware of the risks related to the performance of their activity.
Skill and experience of staff and technicians is required in the performance of the functional activities, design and maintenance of the building, the researchers asserted that "*...lack of integrated decision making between different professions (architects, engineers, and health personnel) may occur when hospital buildings are being planned"* [6]. The same opinion is often repeated but plural components of design are indicated as lacking.
More often the presence of risks implies the responsibility of designers and of those people involved in the function and maintenance of these buildings. Potential risks of different nature are identified, produced sometimes by 'not-prevented inconveniences' in design. Many delicate situations and the presence of different types of risks connected with the plural activities of hospitals invite designers and builders to be aware of the origin of these risks. The expert in hospital design, Seymour Remen, states the following: *"we see many projects that are wrongly and wastefully conceived: engineering systems that fine engineering talent would never recommend; nursing units so separated either horizontally or vertically as to leave no hope for efficiently utilising nursing and support personnel over three shifts. As planners, we invariably inherit some of those problems which are recent, and which cannot be reversed. But, perhaps they can be ameliorated"* [7].
The above reveals the lack of collaboration and co-ordination of different categories of people (designers and builders, staff and technicians working in hospitals). The personnel of a hospital should be aware of these risks in order to improve the quality of hospital environments. The quality of hospital design should be improved on the basis of the previous considerations. Specific information should be given to the people working in hospital realisation and function in order to make technicians and personnel aware of the risks connected with their activity. Scientific and technical knowledge, awareness of technicians and medical staff is needed to give a positive contribution to the realisation of hospitals and to the performance of its function.

2.1.4 Conclusion of 2.1 'Environmental Conditions'

Excessive use of cleaning products, faulty/poor ventilation systems and a series of insidious components affect the quality of the indoor environments of hospitals already investigated in relation to S.H.S. Failings of design, poor maintenance and unappropriate work performance are also considered to affect the environmental conditions of hospitals. The series of items reported in 1.1 'Buildings and Environment' and already ascertained or just supposed to be responsible for the S.B.S. may be added to the list of the causes actually producing the so called 'Sick Hospital Syndrome'.
The increased presence of particular activities, sophisticated installations and many technological systems require the collaboration of expert designers, competent personnel and

technicians. But scarce awareness of several risks in hospitals is evident amongst designers and technicians. Consciousness and collaboration of designers and builders, medical staff and technicians should improve the quality of hospital buildings from the different points of view. According to researchers, appropriate measures should be taken to ameliorate the quality of hospital design. In the article 'Healthcare Design 1996-2000' by Russell C.Coile Jr., it is asserted: *"Hospitals and healthcare facilities will have to become high-performance workplaces"* [1].

2.2 Environmental Configuration of Hospitals

Summary

Designers complain of the difficulty and sometimes the impossibility of carrying out refurbishment in the old hospitals [2]. Aspects concerning the configuration of design are considered responsible for the critical condition of hospitals.

2.2.1 Limits of Design

Hospitals result inadequate to respond to new functional issues, the increase of therapeutic means and the recent increase in activities. In 'Healthcare design 1996-2000' it is stated that: *"built to rigorous safety codes and building standards, hospital are long-lived, even if they become functionally obsolete after the first 15 years"* [1 chap2]. In many countries the same problem has been noted [2,5]. The difficulty of adapting the traditional structure of hospitals creates critical questions. A meeting of experts in Chicago declared: *"it is extremely difficult to take an old building and make it profitable in a managed care system on a reuse basis"* [2].
The structural deficiencies of conventional hospitals are becoming evident and 'typical' situations which occur in hospital design. It seems impossible to fulfil coherence in design when the original plan of the building has been manipulated by many consecutive changes. It was reported in a recent essay: *"typically, the physical growth is architecturally not compatible with the initial project, and later additions have served to mostly destroy the architect's original concept for the hospital building"* [5]. Social development is punctually reflected in hospital structure and the problems related to its refurbishment are typically perpetuated over time. The need is evident to take measures against failings considered 'typical' of hospital design. Different stages characterise the growth of the hospital building due to the consecutive introduction of new activities and means, new issues emerging from the social development. Scarce 'structural coherence' derives from this situation. Further more the starting idea of the whole is often denied by the interpretation of different designers. Finally, their 'institutional' model doesn't allow hospitals to take on their own 'identity' of design.
The same problems are found in different countries due to the recent rapid social development which has introduced new activities and new technological means into hospitals. The need is evident to take initiatives in hospital design to overcome numerous failings of traditional design. *"The aim of this paper*" states an item by Emanuel Mikho, specialised in hospital design, *"is to propose a planning framework which offers a contemporary methodology for the accomplishment of reasonable and virtually fail-safe goals for the design and construction of Arab hospitals"* [5]. The call for *"virtually fail-safe"* models of hospitals is clear not only in the Arab countries but all over the world.

When large hospitals undergo many consecutive transformations, the lay-out of the new functions is disorganised and the lack of way-finding is evident. Lack of clear information is also complained of by the patients. It is reported by R.L.Miller (AIA) and E.S.Swensson (FAIA): *"among the most intimidating aspects of large hospitals are the obstacles they present to way-finding"* [3]. Hospitals should be able to combine the old and the new activities supplying comfortable assistance and information to the general public contacting a hospital for different reasons.
It is noted by John Spiers, Chairman of Brighton Healthcare NHS Trust: *"Look at the route through the Royal Sussex County Hospital at Brighton.....our maps don't say you are here...they are colour coded but we don't say how or why...we don't say which floor gives which access to other buildings...we don't tell people which floor they are when they are outside the lifts...we don't give directions as to what is on that floor...we don't tell the public they can go to the restaurant, though they can..."* [4]. The total absence of way-finding is evident in many large old hospitals.
Way-finding systems have become an integral component of modern life style. They are ever more frequently applied in large public buildings. The conventional models of hospital results in practice old fashioned and should be re-invented from many points of view in order to be competitive with other public structures. Hospital buildings need to be re-designed according to modern criteria and to modern reality.

2.3 Function of Hospitals

Summary

A crisis of identity affects hospital function and design. Specific changes now occurring in the social context are considered capable of influencing this situation.
The new social background and the improved quality of life mostly produced new needs influencing the development of hospitals, which are reported in this chapter.

2.3.1 Social Background

The new Social, Scientific and Technological background influence the recent evolution of hospitals. Rapidly evolving needs, the social growth and the new prevention policy promoted by the W.H.O. (influencing health care and building design) produced relevant changes affecting hospital function and design. The need of re-establish new issues in hospital design for the production of new models for hospital buildings is evidently motivated by the following reasons.

2.3.1.1 Scientific Progress

The impact of recent technologies have rapidly made hospitals obsolete. Computerisation has completely transformed the organisation and configuration of hospitals. The development of diagnostics and therapeutic means have given rise to the need of a new lay-out of hospital activity. The inadequacy of the old structures is emerging from this situation. It is sometimes impossible to modify the conventional configuration of hospitals when the effective spaces of utility are inadequate for the introduction of new activities and means.

The evolution of medical treatments has produced an increase in day-hospital activities and a larger number of out-patients contact the hospital. The experts consider that *"...health care has already gone to an ambulatory environment"* [13]. The construction of a new hospital was discussed in a recent meeting of experts who asserted that this hospital would be *"dedicated to 60 percent outpatient"* instead of 10 percent (percentage of traditional hospitals) [13].
Management and staff of hospitals have changed. Great responsibility is given to the personnel, which is also more expert than before. A number of persons with individual more specialised functions belong to every department. Higher responsibility is implied in the practices of routine and increased education of the single individuals is requested in the performance of their activity. Various levels of contribution are given by hospital staff producing more functional hospitals. Greater scientific knowledge is more frequently found at every level. The growth of the personnel is evident in number and education. On the one hand improved functions are given, on the other the increased work turns. Compared to the management of conventional hospitals, greater assistance is globally given to the individual. Hospitals have grown in many directions, improving in functions and personnel, and in their numbers. The quality of medical care has gradually improved.

2.3.1.2 Social Changes

According to the meeting organised by the European Parliament of Strasbourg in December '95 about 'L'avenir de la vieillesse en Europe' [14], the number of elderly people will increase in the near future. Hospital design should include flexibility of spaces and functions also in view of this fact. Technological development on the one hand and a bigger demand of elderly care on the other, suggest that the future of hospitals may be very different from today. New day hospital activities will be created to give assistance and care to elderly people. A series of new needs will emerge in hospitals on the basis of the new social background (not only an increased number of elderly people but also of the population). Due to their continuous need for adaptation to social changes, hospital buildings should be considered dynamic structures.
A second important change now occurring in the population is the improved consciousness of people. Their knowledge about diseases and therapies is nowadays higher than in the past. A quite different relationship is now evident between patients and doctors in every-day life. In hospitals, patients ask for detailed information about their health condition and disease. It is clear that today's public is more conscious in the subject of health problems. Due to the increased awareness of the patient, a larger supply of information should be given in order to answer his grown interest and participation. Closer collaboration of the patient could be established with doctors and nurses, presuming a new relationship between patient and hospital. Hospital configuration is going to change in order to supply more information and closer assistance to a large public whose needs have increased in parallel with social welfare.

2.3.1.3 The W.H.O. and the new Prevention Policy

Hospitals are clearly evolving in function, while structures and systems supporting health care are going to be further transformed as clearly expressed by the following: *"The driving force behind the healthplex was the fact that our industry is clearly moving from a focus on patient-specific and episodic incidents of care to taking care of populations and doing it in a way that maintains or improves health status"* [13].
The population increase of the last decades influences health care structures and the traditional forms of assistance. The issue of establishing a policy of prevention before medical care is emerging.

Awareness of health and diseases has increased amongst the population. Patients are thought *"taking responsibility"* for their health condition [16]. The policy promoted by the W.H.O. is not only focused on curing disease, but mostly on preventing disease and improving health in the population. 'Health' is defined by the W.H.O. as *"not merely the absence of disease or infirmity, but a state of complete Physical, Mental and Social Well-being"* [15].
The level of awareness achieved by people about health and disease, and the greater well-being seem in many activities of life have introduced new needs among the population. Traditional standards are improving in health care systems and the standards of health care structures are also expected to increase and improve in order to correspond to the improved welfare. Identical conditions should be introduced in health care structures like those already introduced in other areas of public services and life.
Modern typologies of hospitals should be identified which include prevention and support the '*Physical, Mental and Social Well-being*' of the patients*"* [15].

2.3.2 Quality of Life and Well-being

The correlation between well-being and health has been taken into consideration more often in recent years. An essay about the quality of life was written by Anthony F. Lehman, professor of psychiatry and director of the Centre for Mental Health Services at the University of Maryland School of Medicine in Baltimore. This sustained the existence of a close correspondence between health and quality of life. Here he asserts: *"looking at quality of life as it relates to mental health care serves as an example 'within the broader context of any chronic and debilitating illness that persists over many years and that detracts from a person's productivity and economic status'."* [22]. Lehman states further that there is a *"recent upsurge in interest in quality-of-life concerns"* and asserts besides that quality of life *"is the fundamental question about what difference medical treatments really make in people's life, reflected by the well-known medical aphorism, 'The surgery was a success, but the patient died'."* [22]. The closer relationship now seen between health and well-being is clear in many activities of life. The concern of the W.H.O. to improve the quality of life also by providing well-being to the people is coming to prominence.

2.3.2.1 Patient Well Being and the Policy of the W.H.O.

Conventional hospitals seem to disappoint patient expectations. The configuration and atmosphere of hospitals are generally 'anonymous and institutional'. Their spaces appear cold in content and appearance, sad and unwelcoming in their white walls and corridors which are said *"dismally inhospitable"* [17]. It is asserted in a specialised magazine: *"most hospital are dismally inhospitable. A weakened patient and traumatised family are greeted by harsh lights and cold stainless steel, labyrinths of white corridors, thumping equipment, and acrid mysterious smells..."* [17]. If the negative opinion patients have of hospitals depends on the combination of plural factors, what patients expect is showen in following statement: *"consumers want healing environments, less-stressful homelike settings, like your birthing centres"* [13]. Excessive light, unpleasant smell or noise, have been recorded as being disturbing factors in hospitals. In Aesclepius of Summer '96, it was asserted that *"noise in healthcare settings can be distracting to staff as well as patients"* [18]. Many situations recorded in hospitals generally testify to the existence of a 'sick' hospital where even relevant aspects concerning their environmental conditions and patient well-being are missing. One of the studies carried out in hospitals reports: *"a more comprehensive, occupant-oriented design is therefore required to avoid building-related problems in hospitals"* [19]. It seems that different categories of public buildings reflect the same disappointing situation. The case is reported here of office buildings. Here in fact a large number of people spend the day as well as in hospitals. An

interesting study was carried out, on the basis of general complaints about offices, to identify the goals of design towards the realisation of 'Healthy Offices' [15]. Here a modern approach to design is suggested in the planning of these building and the occupants of the building become substantially the object and focus of design. The aim of design for the 'healthy' offices is to ensure the 'well-being' of the individual. The researcher asserts that people working in offices *"miss the comfort and variety of home"* and they *"would like to 'feel at home' at work"* [15]. The following definition of the 'Healthy Office Buildings' is reported at the end: *"a healthy building therefore is surely one that promotes the complete well-being of its occupants"* [15]. It is also reported that: *"office building should provide space for activities, other than work, but that support work"* [15]. The well-being of the occupants is supported by means of psychological and physical factors, for example, a home-like atmosphere and suitable activity. This is more or less what happens in the Mall type of hospital (see 5.1.1.1 'Mall' type of Hospital and Activity within Health Care) where the patient takes on the alternative role of 'customer'. Other examples can be mentioned of other public structures built as 'healthy' on the basis of analogous criteria. This happens for example in the case of a study carried out on Universities. To produce 'Health Promoting Universities' is a W.H.O. issue. The aim of the 'Healthy University' is to support '*health promotion'* and to improve the *'health of populations'* by *"protecting the health and promoting the well-being of students, staff and the wider community"* [20]. The W.H.O. seeks to provide for the 'complete' well-being to the 'occupants of the building' -at home, in offices, at school, in hospitals-. This point of view was already supported by the W.H.O. in 1961 when it defined 'Health' as *"not merely the absence of disease or infirmity, but a state of complete Physical, Mental and Social Well-being"* [15]. At the Third International Conference on Health Promotion (Sundsvall, Sweden) the W.H.O. finally asserted: *"environments are not just the visible structures and services surrounding us but have spiritual, social, cultural, economic, political and ideological dimensions as well. Furthermore, all the different facets of life are interwoven and inseparable"* [21].

Conclusion of 'Health, Environment, and Hospital Design'
Chapter 2

Excessive use of cleaning products, faulty/poor ventilation systems and a series of insidious components affect the quality of the indoor environment of hospitals producing the so called 'Sick Hospital Syndrome'. The factors reported in 1.1 'Buildings and Environment' may be only added to this list. Failings of design, poor maintenance and inappropriate work performance are also considered responsible for this situation. The collaboration of expert designers, personnel and technicians is needed in design to overcome a number of failings recorded in design and to prevent plural risks in hospitals. Not only should the quality of hospital design be improved, but also building maintenance and the performance of hospital activity. The presence of particular activities, sophisticated installations and plural technological systems increase the risks related to hospital design and function. Consciousness and collaboration of designers and builders, medical staff and technicians are needed to ameliorate the quality of hospital conditions from many points of view. The above reported situations and the present crisis in building activities reveal the urgent need to re-invent building components and methods suitable for the realisation of appropriate Environments and Configuration of hospitals. The background of hospitals has changed due to progress and social development. New day-hospital activities, the use of modern technologies and means have been introduced in hospitals. Experienced personnel works in these buildings. To combine traditional issues, modern needs and criteria supporting the future development of hospital buildings, 'modern' components should be integrated in design. A new prevention

policy is emerging and a new relationship exists between doctors and patients. Owing to the increased awareness of diseases, the patients now ask for more information and they are expected to 'take responsibility' for their health. An occupant-oriented design in the realisation of office buildings and universities promotes home-like atmosphere, physically comfortable environments and the presence of activities. General protests of staff, dissatisfaction of patients make it evident that the standardised level of comfort of traditional hospitals is inadequate if compared to the current standards of life. Psychologists maintain that the well-being of the patient is promoted also by improving the quality of life. The physical and psychological well-being of the occupant of the building is integral in the design of other public buildings and institutions. Improved welfare should also be reflected in hospital design and function.

Summary of chapter 2

RISKS RELATED TO ENVIRONMENTAL CONDITIONS
SICK HOSPITAL SYNDROME
RISKS DUE TO HOSPITAL FUNCTION
RISKS DUE TO BUILDING ACTIVITY
RISKS DUE TO ENVIRONMENTAL SITUATION
RISKS DUE TO INDIVIDUAL RESPONSIBILITY

LIMITS OF THE BUILDING CIONFIGURATION
LACK OF FLEXIBILITY
LACK OF WAY-FINDING
LACK OF MODERN ITEMS
LACK OF IDENTITY

ASPECTS INFLUENCING THE CURRENT REALISATION OF HOSPITALS
INCREASE OF POPULATION
FUTURE INCREASE OF ELDERLY PEOPLE
INCREASE OF DAY-HOSPITAL ACTIVITIES
POLICY OF PREVENTION IN HEALTH CARE
IMPROVED QUALITY OF LIFE AND WELL-BEING
IMPROVED MEDICAL KNOWLEDGE
QUICK EVOLUTION OF SCIENCE AND TECHNOLOGY

Conclusion Part I

Current Hospital Conditions

A. RECENT POLICY INFLUENCING BUILDING ACTIVITY
ENERGY SAVING
SAVING ON NATURAL RESOURCES
REDUCED APPLICATION OF CHEMICAL PRODUCTS

B. RISKS AFFECTING THE INDOOR ENVIRONMENTAL CONDITION OF HOSPITALS
RISKS DUE TO ENVIRONMENTAL SITUATION
RISKS DUE TO BUILDING ACTIVITIES
RISKS DUE TO HOSPITAL ACTIVITIES

C. FAILINGS CONCERNING HOSPITAL CONFIGURATION AND FUNCTION
LACK OF FLEXIBILITY
LACK OF WAY-FINDING
LACK OF MODERNISATION
GENERAL FUNCTIONAL MISFITS
GENERAL MISFITS IN DESIGN

D. SOCIAL FACTORS INFLUENCING HOSPITAL DESIGN
QUICK EVOLUTION OF SCIENCE AND TECHNOLOGY
INCREASE OF POPULATION AND MOSTLY OF ELDERLY PEOPLE
INCREASE OF DAY-HOSPITAL ACTIVITIES
POLICY OF PREVENTION IN HEALTH CARE
IMPROVED MEDICAL KNOWLEDGE
IMPROVED LIFE QUALITY AND WELL-BEING

Environmental condition, Configuration and **Function**
need to be improved
Aim of the **Hospital promoting Health and Well Being** is to improve **Environmental Conditions, Configuration and Function** against the **Failings affecting the Current Hospital Conditions (A, B, C, D)**

Final Considerations

General situations which at present influence any type of building also influence the condition of hospitals. Against these factors affecting the indoor environment of private and public buildings (1 Health, Environment and Building Design), specific measures can be taken in planning and building and the analogous measures should be taken in hospital design.

Researchers investigating the Sick Hospital Syndrome (S.H.S.) reveal the presence of numerous risks and failings related to design, such as misfits of design, poor maintenance and inappropriate performance of hospital activity. Situation that is mostly due to the complexity of hospital function and design in relation to the recent quick development of hospitals (several risks are related to the presence of many technological systems and activities). Potential risks are also due to the frequent use of chemicals and other dangerous substances, and the numerous types of equipment. Higher awareness and responsibility of the personnel working in hospitals is needed to improve this situation.
Other risks have recently been noted owing to the poor maintenance of technological systems, while many structural renewal taking place in hospital buildings also supported the development of pest infestation and misfits of design. New means and the presence of new activities have created new configurations of hospital buildings. The buildings' inadequacy to evolution is evident in the lack of the building flexibility, the total absence of way-finding, the lack of modernisation in the indoor environments.
The prevailing technology corresponding the 'hard' face of healthcare is at present emerging. Hospitals are actually far from their traditional image of 'healing places'. Patients complain that the traditional human dimension of hospitals has been lost and *'consumers want healing environments, less-stressful homelike settings'* [1]. To fulfil patients' and people's expectations appropriate modern criteria should be introduced in hospital design according to the principles introduced by the W.H.O. Building Configuration and Environment should be changed in content and improved in function. Patients' and people's well-being should be considered as in the realisation of other categories of public buildings. It is evident that health care services and structures should be renewed according to more modern criteria of design. Traditional and modern aspects of health care should be combined for the fulfilment of a sustainable hospital promoting Health and Well Being.
Environment and Function should be improved in hospitals, establishing a new relationship between:

Hospital/Patient and Hospital/Health Care
Hospital/Building Design and Hospital/Environmental Conditions

Designers and builders, medical staff and technicians, the patients themselves should be conscious of the problems affecting hospital condition and function.

Part II

Hospital Design: Past and Present Considerations

"The challenge of great innovators is not how to get new ideas in your mind, but how to get old ideas out. Innovation is how you keep things fresh" is stated by Barry Wishner corporate consultant of The Center for Health Design, Lafayette (CA) U.S.A. Other experts in hospital design said: *"architects can help clients develop buildings that efficiently use space, adapt to change, support the technology of the future and improve on the age-old relationship between health care and its buildings"* [1].
Hospital design should answer the present needs and the issues of modernisation. There are however some traditional issues that have lasted over time on the background of different scenarios. One of the tasks of designers is to combine these two aspects together.

Hospital Building and Health Care in History
Chapter 3

Summary

In the early hospitals, the quality of the therapy and treatments mostly depended on a close relationship between medical care and environmental quality. Building site and configuration, the presence of comforts and activity were themselves components of the therapy and factors contributing to the healing of patients. A strong connection existed in the past between hospitals, social context and religion. Hospitals deserved hospitality and devotion. Natural therapeutic means were applied in the therapy that would be approved through time by different countries and cultures notwithstanding the existence of allopathic therapies.
At first, the building and the site of the Askleipeia were considered the 'healing place', where the positive influence of the natural environment and the suggestion, the interpretation of patients dreams represented almost the only effective means of therapy. As scientific knowledge grew, hospitals changed their original aspect of buildings dealing with empirical therapies and suggestion to comfort the patient. Nowadays, sophisticated methods of diagnosis and therapy, the multipurpose equipment have transformed the configuration of the original 'hospital', intended as an image of 'hospitality', into a product of progress and technology almost without a 'human' dimension. The goal of hospitals is however still the same: to make patients recover by creating a more positive and relaxing approach to therapy, giving them confidence and comfort.
Hospitals now correspond with multifunctional buildings where the technology has in practice taken the primary rate. Hospitals look like a product of technology and seem to have completely lost their primary goal, that is by tradition to support the healing of patients. The complexity of these buildings is given by the presence of many activities and systems: *"hospitals can be considered micro-environments, responding to a common goal..."* [2] sustains the expert in hospital design Costas Xanthopoulos.
At present designers have the delicate task of connecting all the relevant components which influence the quality of hospital design, in order to formulate the best plan for a hospital. Past and present considerations about Medical Care and Hospital Buildings allow the identification of the relevant components of design which have been constantly adopted and improved over time by designers.
This investigation focuses on the components of design developed over time in relation to Environment and Function of hospitals which result responsible of the failings recorded in the current conditions of hospitals (Conclusion of Part I).

3.1 Hospital Building in History

Summary

The hospital building has changed over time in its configuration and typology, though the continued presence of dominant components has been constantly recorded in design. This fact is supposed to depend on the existence of constant needs and objective necessities

connected to hospital activity and to the wish of the public. Configuration and typology of hospitals are investigated to identify these items since they are considered basic requisites in the realisation of hospital buildings.

3.1.1 Environmental Condition and Configuration

Summary

The developments in the Configuration and Typology of hospitals is illustrated in this chapter, taking into account the relevant aspects influencing their changes also in relation of Environmental conditions and the Function of hospitals.

3.1.1.1 Temples & Healing Places

The Greco-Romans Asklepieia were built in places with natural beautiful scenarios, close to streams of water. They always included a temple annexed to patients' lodging and a series of conveniences such as treatments and baths, physical exercises and amusements, etc. Large halls were supplied for the patients where they could lay down and dream. A kind of 'oasis' was created comprehending both therapy and activity. The introduction of fine architectural requisites, the magnitude of the environmental situation represented a necessary positive ingredient consenting the sick to recover.
The complex of buildings and free spaces of course included the best supporting services: latrines for the two sexes and bathing facilities. In Pergamon for example (the second century A.D.) there were tubs and mud baths with radioactive water from a sacred spring (six round bath basins and the related arrangements for drawing up water were found here on the second floor of an outstanding two-storied circular structure with six apses). The materials adopted to produce the decorations of the pleasant indoor environments were marble and stone taken from the site [5].
Later on the so called 'valetudinarium', that were Roman military hospitals, were placed far from the city but near its surrounding walls. Here, the Greek open hall where the patients slept was transformed into single private rooms remarkable for the privacy they offered. A little vestibule between every two rooms was even realised (as for example in the valetudinarium of Vindonissa) in order to reduce dust and noise from the corridor and the construction of a 'clerestory' admitted natural illumination [5].
Other technical prerogatives demonstrate the high level of social development occurring at that time. In the case of the valetudinarium of Novaesium (first century A.D.), a latrine with a brick floor was found with a real sewer system running out of the building. In the valetudinarium of Carnuntum (second century A.D.), probable kitchens and a small room with hearth were created in the corridor. Other hearths close to the patients rooms and a hypocaust heating (subterranean furnace producing heat delivered within the walls to the rooms) were also realised [5]. The functional characteristics of the early hospitals did in fact correspond to a high level of comfort compared to the standard of life of the time.

3.1.1.2 Hospital: hotels belonging to the Church

The early hospitals were built often according to *'derived plans'* [5]. This means that buildings previously constructed for other purposes were later transformed into hospitals. *'Designed plans'* [5], that would have been deliberately created for health care purposes were to come much later.

In the first centuries after Christ, the prevailing health structures started to be connected to Christian charitable foundations. A close relationship existed between church and health care. The monasteries built at that time usually had an annexed infirmary (this was the model of the hospital). Assistance was supplied by the monks. In these hospitals, there wasn't yet any distinction between the infirmities treated: the aged, diseased, idiots, paupers and pilgrims were cured in just one large open space. This was called *'open ward'*. It was built all over Europe until the eighteenth century as well as the *'cross ward'* which was the sum of two open wards.
In the same period Almshouses, Leprosaria and Pest Houses were created out of town in order to determine territorial limits for the contagiously sick.
Monasteries with the annexed infirmary were built near streams of water, feeding the fountains and flushing the sewers. According to rudimentary sanitary principles, a distinction was sometimes made between different branches of water pipes: one serving the kitchen and another the baths. Rainwater was collected in gutters from the roof and directed to flush the infirmary's 'necessarium', whose water was consequently carried away by sewers towards the city moat. The infirmary was usually located on the first floor. This consented both to avoid dampness and to have the drain situated below the 'necessarium' built on this floor.
The 'open ward' was a common hall with patient beds usually separated by curtains (fig.1). These formed cubicles to grant privacy and warmth to the sick in their beds. Enclosing the bed area they protected the sick from the air drafts. On the same floor there was an altar, put in a position that consented the sick in bed to hear Mass.
The windows of this ward were intended to flood the interior space with light, and particularly with air. More windows on the bay located at the end were supposed to increase the air supply to the ward. The area of the bays itself was intended also to facilitate the circulation of people. The two bays at the opposite ends of the ward served also to locate the supporting services, that at that time only consisted of the surveillance and the toilets. On the contrary the kitchen was detached from the building.
The model of the *cross ward* was later applied. The form of a cross consented both to give a central position to the altar and to establish a better surveillance to supervise the patients. This typology allowed the extension of the hospital space by the multiplication of the cross-module. The contrast of the illumination between the altar and the remaining space was emphasised. The level of light was relevant in the altar area to create the presence of the analogous light that could be expected in heaven. "*The chapel was built in an architectural mode as distinct from that of the ward as heaven is from earth"* is in fact asserted by D. Thompson and G. Goldin [5].
The size and shape of windows then, the height and vaulting of the room, the level of the floor, all together represented the means to create this difference. For the same reason, the building material adopted for the chapel was finally stone and never wood. Building material and illumination together represented relevant tools of design to produce a suggestive atmosphere.
At the end of the Middle Ages, it was not uncommon for people with the financial possibility to give their property to the church, in return for assistance and lodging for the rest of their lives. In the same period of time in fact some private accommodation started to be offered in this model of hospital in order to satisfy the requests of rich people. The growing attention given to the 'paying' patients produced the disadvantages of other cases of really sick but poor people. Under one roof there were on the one hand 'group wards' for paupers and on the other hand single rooms for the rich, sometimes with an 'anteroom' for a private attendant.

3.1.1.3 The Hospital of the Renaissance

In 1656 the Hopital Général was founded in Paris to absorb the cases sent from different charitable foundations. This model of institution which dealt with problems of poverty and disease was soon adopted by other European countries. It would still deal with any kind of illness. Venereal diseases, old people, epileptics, mentally ill and so on were treated in the same ward. This type of hospital would be able to hospitalise even up to 4000 patients.
In accord with the knowledge of the time, the supply of supporting services became adequate to the number of sick people. A distinction between men's wards and women's wards started to be made. A wing was also created for the incurables. As a development of the monastic 'necessarium', the latrines of the wards were situated over a diverted stream.
The introduction of new sections suggested also to introduce symmetry in the design of the building, corresponding to the criteria of proportions and perspective in the architecture of that time. Proportions, perspective and symmetry were in fact the new principles introduced in architecture by Brunelleschi. Designed by means of rhythmically distributed elements, hospital buildings presented an important front door and were realised according to a symmetrical plan, their windows equally spaced horizontally. The dominant component was corresponding the main entrance of the building. Other architectonic components were integrated into the whole.
The model of the *'block hospital'* [5], where all functions were packed under one roof, was separated from the church. The ground floor of the building was generally used for services and offices: reception, storage, pharmacy, kitchen and morgue. The wards were often on the second store, but often still opening into the chapel with a balaustered walk. The top floor, usually the third, was mostly reserved to the paying patients thus supplying the privilege of privacy.
The presence of a ventilation system now emerged and started to assume relevance. There was a row of windows high above the beds and a second opposite row gave onto a corridor. The ventilation was sometimes increased by the addition of chimneys on the ceiling or on the top of the vault. Fireplaces started to be used by the wards. They had two functions: to warm the room and to draw out stiff air.

3.1.1.4 The Issue of increasing Indoor Ventilation

The need to increase the air change in the wards started to be taken seriously as an issue. In the Hospital of Notre Dame des Fontenilles of Tonnerre (built in France in 1293), a rudimentary ventilation system was realised to increase the ventilation of the already considerable volume of the hall (fig.2). Clover-shaped holes were created with this aim by perforating the barrel vault in order to improve the quality of the air.
The conviction of producing forced ventilation indoors started to become stronger. Many episodes are reported in the literature testifying that this was the will of the authorities and experts of the time. John Howard for example, visiting Bethlehem Hospital in London in 1788, remarked on this need asserting that while the patient rooms were *"quite clean and not offensive"*, there was a *"very offensive"* vault in the privy [5].
In St. Luke's Hospital for the Insane, a *"semicircular grille"* above the door of the cells was also created in order to draw cross ventilation from the window. But this technique didn't appear sufficient to introduce enough fresh air. In the 15-foot corridor, patients were in fact *"helping out with washing and rehabilitating beds, mattresses and quilts"* [5].

Similar difficulties arose simultaneously in different countries. In Paris, the Hospital Salpetrière was supplied with a ventilation system as well. This was based on air currents drawn through doors, windows and other openings created in the ceiling.
In 1785 the first book was published about hospital 'sanitary regulation' (the *"instructions on the manner of governing the insane"*). This regulation called for pure air and water in insane asylum... [5].

3.1.1.5 Emerging Needs: Familiar Configuration and Structural Flexibility

An attempt was made in Massachussetts General Hospital to create a familiar atmosphere within the building environments. Rooms of different size were created, *"fitted up quite luxuriously"*, in such a way that *"very little about them suggested a 'sick room'."* [5]. Here the presence of an efficient ventilation system improved the introduction of fresh clean air.
Awareness about the advantage of increasing the air change was growing, mostly depending on the evident alteration of the unhealthy conditions of the patients. In fact, when in winter or at night the windows of the wards were not allowed to remain open, not only did the air *'grow foul'*, but also *'cases of erysipelas'* increased [5]. The increment of the risk of contagion was clearly understood, though it was according to the belief and theories of the time. It was written for example by the medical practitioner living in London Richard Mead: *"a corrupted State of Air is without doubt necessary to give these Contagious Atoms their full Force"* [5].
The possibility of contagion caused by rodent and insect vectors raised. For this reason the furniture of the hospital started to be necessarily very simple, suitable for a better cleaning and fitted so as to avoid the harbouraging of pests. Old wooden bunks were substituted by iron bedsteads both to consent easier cleansing practices and avoid the proliferating of bugs. Only one movable bench was given near the beds and one or two fireplaces within the whole ward. Marc Antoine Laugier in fact wrote: *"hospitals should be solidly but simply built..."* [5].
In the nineteenth century, Dr. Benjamin Golding in his 'Historical Account of St. Thomas's Hospital' appreciates the simple characteristics and easy appearence of St. Thomas's Hospital, writing: *"it bears a striking similitude to an agreeable private mansion.....instead of that heavy sombre appearence which is so frequently complained of as making an hospital resemble a prison..."*. He was thinking about the connection between environmental conditions and health...[5].
In the same period of time the need to increase rapidly the number of wards was emerging. It was due to the unavoidable and unexpected increase of patients depending on wars and epidemics. Depending on the need to have prompt assistance, barns and granaries were sometimes used to healthcare purposes. This fact determined the production of quick-to-be-assembled flexible structures.
Here the people seemed to recover with astonishing rapidity and, in these circumstances, the evidence proved the importance of ventilation, since it is written that those *"exposed to cold and inadequately attended, were the ones who recovered"* [5]. The patients in hospitals died, in fact, more frequently than the patients in the barns. This fact reinforced the opinion that fresh air more than warmth was the real requisite for a hospital.
Military hospitals and barracks were more often built at that time. The Turkish village of Renkioi, built in 1855, represented a type of prefabricated hospital that would later be taken as a model, called the 'barrack hospital'. In fact, its site was particularly appreciated for the gradual slope seaward consenting easy transport by sea and for its sewage disposal. Its basic unit consisted of a wooden hut for 50 patients, was a light and cheap construction, flexible to answer every need. The advantages of its structural flexibility started to be appreciated in the realisation of hospitals.

3.1.1.6 The Pavilion Hospital in the Nineteenth Century

The superintendent of the Massachussetts General Hospital sustained that a model of 'pavilion hospital' was better than a barrack hospital [5], particularly if the pavilion were well-built and made of fireproof material, its walls made of double brick with an air-space in between. Long lasting and renewable, its surfaces would need only to be periodically repainted.
When limited to one floor this new model consented the realisation of a ventilation system through the ceiling. The building of a series of blocks conveniently distanced also let the air circulate in between, producing better ventilation.
The Herbert Military Hospital in Woolwich was built in 1861. It was the first large-scale pavilion-hospital completed in England. Behind the main building, that corresponded to administration, a multipurpose block included a chapel and a library. Single and double ward-blocks were orientated north-south in six lines to allow sunlight to enter the building the whole day, on one side or the other.
The ward itself was according to the model of the so called 'Nightingale Ward'. This was proposed by Florence Nightingale, a nurse considered an excellent expert in the design of hospitals. This woman, in fact, took it as a mission to reform hospitals according to the principles she gained through her experience. She illustrated her criteria in "Notes on Hospitals", introducing severe principles of hygiene in hospitals. Promoting nursing as a respectable profession, her advice in matters of hospital planning would be incontestably adopted for a long time.
In her book she emphasised the advantages of the 'Nightingale ward' by asserting: *"no ward is in any sense a good ward in which the sick are not at all times supplied with pure air, light and a due temperature"* [5]. She also particularly approved of the realisation of single blocks of buildings built at proportioned distances so that every ward could have *"a large end window, commanding beautiful views"* [5]. Her theories support design to increase fresh air and light, and to give a comfortable temperature and positive contact with the natural environment.

3.1.1.7 The Hospital as 'Machine à guérir'

Hospitals had been places with a high risk of contagion until then, either due to still scarce scientific knowledge or to the fact that different typologies of patients were living in the same ward. A transformation took place in this century: from the realisation of hospital *"mouroir"* hospital design went on to assume the new type of hospital *"machine à guérir"*[9]. This happened according to a series of new principles introduced into hospital design. From then on hospitals started to have a real 'therapeutic' function.
Regarding the realisation of the ward: the number of beds and the proper distance between contiguous beds were studied and calculated according to the medical belief of the time. Attempts were made to define the 'measure' of fresh air necessary to healing the patients. The concept of *"espace hospitalier"* was also developed in relation to the two parameters of *"aération"* and *"isolement"* [9].
The level of surveillance was improved by shortening the distances between nurses and patients. The patient would hence be kept permanently within the sight of the nurse. Terms like 'therapeutic space' were introduced in hospital design for the first time. Solutions were studied for the creation of the proper typology for a ward. They were dealing with the shape of design and ventilation in addition to the number of patients. The separation between the various categories of patients started as well as the separation of the rooms where various phases of the therapy took place. The model of a hospital substantially 'contributing' to the healing of the patients was taking shape according to a series of acknowledgements integrated in design.

3.1.1.8 Constant Issues: Familiar Configuration, Structural Flexibility, Ventilation

Over time hospital design changed to take on new sanitary principles and respond to the needs deriving from the growth of population. The rectangular ward assumed a square format. The opinion of the experts sustained that it would provide a more *"home-like character"* compared to the *"long narrow wards"* built until then [5]. Well-off and middle-class people preferred home assistance and this typology was closer to patients wishes, producing a familiar atmosphere.

This format was adopted for John Hopkins Hospital, which was built in 1875. In its realisation other adjustments were produced, as for example a room oriented to the south and towards the sun. It was built in communication with the ward. The traditional fireplace assumed a central position.

Types of quick-to-be-built pavilions were predisposed. One of these pavilions had the advantage of being *"erected in one hour without the aid of a carpenter"* [5]. Built in the surrounding area of hospitals, they would be used either to avoid contagion in case of epidemy or to achieve better flexibility of space. Consisting of prefabricated structures *"made of pine wood, the different parts of which fasten together by hooks and bolts"* [5], they could be stored after use in a suitable pavilion, to be repaired, aired and revarnished as necessary [5].

Flexibility of the hospital was also required from a practical point of view. According to the theory of Joseph Jones, professor of chemistry and clinical medicine at the University of Louisiana, 'one-twelfth' of the ward space should be left vacant. This would consent rotating of wards, in order to clean and disinfect their spaces.

Medical knowledge continued to be sensitive to the problem of ventilation: *"air is one of the greatest disinfectants"* [5] it was asserted. More sophisticated systems, which increased ventilation, were applied to the hospital structure. While cross ventilation was still adopted by the realisation of counterpoised windows, large corridors were built to create a system of air drafts. The air blew in this way from the corridor into the wards.

In 1884 the engineer Casimir Tollet studied a typology called the 'Tollet ward' (fig.2) in order to create a more efficient ventilation system. Some air pipes were built in the ground floor of the building taking the air from the basement up into the ward above. Several chimneys on the top of the ceiling drew this air upward like the ventilators of the French projects. The ceiling, shaped in the form of a pointed arch, facilitated the emission of the air.

Growing over time in dimension and receptivity, the need to separate different departments emerged as a necessity so as to create a right distribution of patients. These were separated into categories according to their age, colour, sex, ability to pay and possibility of contagion.

A system of circulation of persons and means connected the various pavilions. The lower floor of the building was used as *"a general highway, completely ventilatable, with central tramway or railroad, for the conveyance of the food, medicines, patients, clothing and dead"* [5].

Dr. Stephen Smith of New York, physician and expert in health and welfare, sustained that the flexibility of barracks could solve different problems including patient distribution. He supported the use of prefabricated structures in order to modify the availability of space according to different needs, asserting that new spaces would be created *"as circumstances require"* [5]. Barracks for example would have been able to respond to the problem of contagion (when infective patients could be lodged in a different pavilion) and to the complicated division of wards in case of infectious diseases. These kinds of structure would also supply a higher level of ventilation and isolation.

From the middle of the nineteenth century to the beginning of the twentieth century, re-organisation and enlargement of existing hospital buildings represented the main activity concerning the realisation of hospitals. Their buildings were evidently influenced by the growth and change of population.

3.1.1.9 The two Opposite Tendencies of Architecture by the Early 1900s

At the beginning of the 1900's the hospital became *"austere and istitutional"* as is stated by J. Thompson and G. Goldin [5]. New typologies of hospitals would be realised made of materials like steel and cement. This was the material used in the now industrialised building activity. Modern technologies would be used and often put into discussion in the future. One expert comment referring to the emerging architecture of this period: *"the expensive multistoried investiment was as frozen in steel and cement as the monumental philanthropies of the eighteenth century had been frozen in stone"* [5]. This statement expresses the advent of a submissive not at all incisive architecture. Regarding the hospitals built in that period, it is for example asserted by R. Miller and E. Swensson: *"though the hospital building of the 1920s is likely to look very different from that of the 1950s, a casual observer -or user- is apt to describe their architecture with the same word: istitutional"* [1].
The truth is that two branches of architecture influenced the design of buildings at that time and two opposite tendencies were alive. One was according to the principles of romanticism and idealisation, the revival of classicism and the triumph of nature. The second sustained the principles of rationalism and functionality, having for objectives the appropriate use of materials and the study of the layout of the building.
A definite range of criteria, according to sanitary regulations, was already introduced in hospital design. But the two tendencies were however influencing the achievement of contrasting aspects. On the one hand rationalism and technology triumphed in the realisation of hospitals like Zonnestraal in Hilversum (NL). On the other hand hospitals were planned leaving space to the 'imagination and idealisation'. The first hospitals were built according to the theories of Rudolph Steiner and concentrated on items such as nature and comprehension. More general and idealistic projects were studied as in the case of the hospital planned by Tony Garnier about 'La cité industrielle'.

3.1.1.10 The first skyscrapers in the twentieth century

Until the end of the nineteenth century hospital buildings had been built mostly outside the cities, according to what was asserted by the authorities in the matter of hospitals, that is: *"all modern scientific inquiries into the conditions under which the sick recover, tends to prove that hospital sites should be selected where there is ample area, and hence in suburban rather than in urban districts"* [5].
But, due to the growth of the population, very soon demand emerged for city hospitals. These would be built according to the principles that regulated the growth of the city itself, that means they were developed mostly in a vertical direction. The circumstances obliged this choice and a multi-store hospital was also preferable for many good reasons. On the one hand, economic profits would be granted by a centralisation of services and assistance. On the other hand a two-store hospital would give the opportunity to keep away unwelcome visitors, as well as keeping patients from escaping. The isolation of contagious cases was finally more easily guaranteed. Those reasons justified however a choice that would *"sacrifice the comfort, and elegance, and superior advantages in relation to health, of villa and suburban dwellings"* [5]. Notwithstanding the good reasons, decisions made regarding this matter would have sounded like the following: *"so must the sick and wounded of such a population submit to similar concentration in order to secure advantages which cannot be had without sacrifice..."* [5]. The abolishment of the natural resort where hospitals were built by tradition was considered hence a 'sacrifice' to be suffered by the population.
In the 1800's patients were still accommodated in hospitals according to their social level and in diminishing order. Home treatment and privacy still remained a privilege of the rich. The Nightingale ward would be changed over time to favour the aspect of privacy. However, as it was impossible to adopt criteria of privacy on a large scale for economic reasons, privacy was still a benefit reserved to the paying patients and the *"expensive commodity of privacy was offered to the many in a relative form"* [5]. What could be done at that moment was only to establish a more

direct contact between the patient and the nursing station: a simple bell was supplied on the pillow corresponding to the light over the door. This choice, which further confirmed patient's need for contacts and familiar assistance, was motivated by the opinion that *"the sick are often terrified by loneliness..."* [5].

The application of flexible structures persisted, as asserted by Goldwater in 1924: *"no hospital can escape its future.....When concentration and simplicity are carried too far, the hospital is forced either to live in a strait jacket or to cast off its original garment and acquire a new and more appropriate one"* [5].

In the realisation of modern hospitals with new functions and services, articulated on more levels, several choices were made. In the attempts to find new solutions either plural pavilions were built and a separate 'main block' with centralised services, or vertical arrangements were constructed where a series of wards could sometimes be annexed to a perpendicular structure locating the supporting services in the shape of a T. This would be called the T-shaped typology of hospital.

Very soon the vertical extension of the building was losing points, while the request of a higher structural flexibility was newly confirmed in the plan of the building. *"For the thoughtful hospital planner"* Goldwater wrote in 1929 *"the most significant contrast is not one between hospitals with vertical and horizontal lines of communication, respectively, but between hospitals in which interdependent departments are conveniently and those in which they are inconveniently grouped"* [5].

The expert and consultant Billings would assert in other circumstances: *"no matter what plan is adopted, when the Hospital is completed and put into practical operation, it will appear that it can be improved in some particulars..."* [5]. Confirming his sceptical opinion of identifying definite criteria for a hospital plan, he also added: *"the general principles which I have tried to state in this paper are in accordance with the present condition of our knowledge of the subject, but that knowledge is imperfect, and too much of the teaching of books on the subject of hospital construction is theoretical only"* [5].

To be re-adapted to ever evolving needs and sanitary principles -but also to respond to the requests for higher receptivity- older hospitals have punctually been the object of continuous structural changes over time. A complicated modernisation of hospitals was carried out in 1970-71 to Bridgeport Hospital in Connecticut (Fig.3). In this case an older multistore building was transformed into a tower, set upon a podium to be adopted for services. This was one of the several attempts made to renew a hospital into a functional and modern building. It would however be a model of hospital extended in a vertical direction actually quite far from present realisations.

Plural solutions have been invented, through time and more recently, in order to combine a series of requisites and to fulfil the best requisites of design for a hospital. They actually testify to the variability of the components influencing hospital design and to the difficulty of finding a definitive winning solution. It is evident that hospitals have to be continuously adapted to the times according to Social, Scientific and Technological progress.

The experts assert that *"square, round, rectangular, and hexagonal wards have been proposed, built, debated, and defended in recent years and we are still in the toes of the argument..."* [5].

A similar opinion was also sustained by the designer of hospitals E. Mikho who underlined the fact that hospitals are susceptible to continuous changes saying that: *"typically, the physical growth is architecturally not compatible with the initial project and later additions have served to mostly destroy the architect's original concept for the hospital building…"* [10]. These opinion confirm that it is not possible to define the proper typology for a hospital. On the contrary it is possible to identify preferable models on the base of indispensable requisites for a hospital as for example structural flexibility.

3.1.2 Building Typology

Numerous studies were carried out over time to identify the proper typology for a hospital. Attempts have been practically translated into a huge number of plans according to any type of geometrical form. Quadrangles, triangles, pentagon, circles (fig.4 e 5) as well as modular components of design have been experimented with, as for example a cross or a T, suitable for multiplication. However there is no special typology to be preferred for the building. Though designers have often had the same objectives, every kind of format and lay-out was adopted and identical aims of design have been fulfilled in different ways.
The original typology was the rectangle of the Asklepieion. From this rectangle hospitals would develop towards more complex configurations by the gradual addition of ever more sophisticated technologies. The Asklepieion was a kind of rudimentary 'ward', where the patient used to lie down together. Its portico, built on one side, gave the patients the opportunity to contemplate a natural, beautiful environment and the temple. The open structure facilitated the circulation of the air. For quite a long time this was the first and dominant format. This would be slightly changed throughout the introduction of sanitary principles and building technologies, according to the evolution of various social needs and to the addition of other medical functions.
The rectangular format was still adopted in the hospitals of the Middle Age. But here a chapel and the 'necessarium' were annexed to the rectangle of the ward. Later on four rectangles assembled together created the form of the cross-ward typology. This configuration allowed the sick of different wards to have a view of the altar situated in the centre. This format would facilitate the surveillance exercised by the personnel moving from the middle towards the four corridors. The form of the cross was considered advantageous also because it was easy to multiply in order to extend the hospital. It was the first attempt to produce modularity in the hospital planning.
In the Renaissance, the rectangular format of the ward was still maintained. According to criteria introduced by Brunelleschi in architecture, the building assumed its own identity and was now detached from the church. Only the general configuration of the hospital was changing, meeting rules of symmetry, architectonic proportions and perspective as well as a new functional distribution. Preference was given to the model of the 'block hospital' where all the functions took place under one roof.
The same easy rectangular format was later repeated in the 'Nightingale ward'. But the distribution of the annexed services changed in an attempt to find a new configuration. The need to increase the supply of fresh air was achieved by means of various technical expedients. At first, a double row of windows faced one another in order to produce air drafts. Diagonal cross-ventilated lobbies were built later on connecting the towers including services and the wards.
At the end of the nineteenth century, the intention to create an atmosphere of 'familiarity' in hospital's environments made the ward assume a quadrangular format. This shape gave the possibility of having a central space where to locate the surveillance and a fireplace. A more comfortable atmosphere resulted by avoiding a straight corridor and by assuming a configuration where the sick were located round a central space. In this way they could speak with one other and see what was happening in the central area (fig.2).
Until the Renaissance, the main services and wards had been situated in one block. The proportion of space between hospital's functions and wards was now taken into consideration in hospital planning. Central services and wards were actually distinguished, each having its own weight in the hospital project. Now for the first time they would be distributed in different 'pavilions' assuming a configuration that would last from the eighteenth until the nineteenth century. The realisation of 'barracks' supported flexibility which was needed in

different circumstances. The study of the circulation of people and means was started in the pavilion model and the attempt was made also to create modern means of connection (mechanical and structural, see previous chapter).
At the beginning of the twentieth century the rectangular ward was still present in hospitals. The traditional request for privacy was taken into consideration more closely. The ward now contained a reduced number of beds against the 25-30 included in one ward in the previous century. The increase in ventilation was achieved by more sophisticated air conditioning systems that were at this point integrated in the design of hospitals. The functions of the hospital were increased in proportion, representing a self standing 'functional block'. This was sometimes annexed to the rectangle of the ward. The hospital format assumed in this case the shape of a T.
The vertical extension of the building was proper to the twentieth century, in the design of hospitals. In this period the 'barracks hospitals' started to disappear since wars and epidemics were diminishing in Europe. The new increase in population gave rise to less flexible structures, growing only in height. The centralisation of functions was now evident in the new building configuration.
Until then, no doubt had existed regarding building the hospitals out of town, profiting from the generous availability of free natural environments. With the growth of population, the choice was obviously made in favour of hospitals extended in a vertical direction and situated in towns. Though, this choice would be considered a *"sacrifice* [of] *the comfort, and elegance, and superior advantages in relation to health, of villa and suburban dwellings"* [5]. However no other alternative was given and only this type of solution would be taken into consideration at that moment.
Two opposite tendencies developed at the end of the nineteenth and at the beginning of the twentieth century, romanticism and functionalism. The two different ways of looking at reality were reflected in the architecture of the time, sometimes giving prevalence to idealistic aspects or sometimes to the realisation of extreme functionality. The philosophy of Rudolh Steiner suggested a series of considerations that could be applied also in architecture regarding the influence of colours and environments and about the positive contact with nature.
In the 1920s, tuberculosis was a common disease and hospitals were mostly built in order to allow the patients to take full advantage of sunlight and fresh air. The architect Duiker designed one of the hospitals built for this purpose, Zonnestraal in Hilversum (NL). This architecture was strictly 'essential' and extremely functional. According to the initial brief of his project, the layout of the hospital, materials and architecture, *"allowed for optimum penetration of sun and fresh air"* [11] . The facade of the building was thin as a skin. By the large scale use of glass-sheets and a steel frame for the building, its *"only function was to separate the indoor space from the outdoor climate"* [11]. This was one of the many rational buildings produced at that time, where the building architecture focused on functionality.
A clear distinction between central services and wards was finally established in hospital plans. The two components now corresponded to two separate parts of a hospital. Several solutions were provided on the basis of this distinction in the following decades.
In the 1980's, the so called 'Pillbox on a Pancake' represented the preferred configuration for a hospital [13]. The centralised services were situated in a kind of 'podium' at the base of the building extended in height for a large number of floors. Functional models of buildings would be designed, over time introducing ever more sophisticated criteria for the circulation of patients, personnel and means. The plan of a hospital started also to include systems of circulation focused on answering to new sanitary principles. For example a distinction was established between two different circuits concerning the movement of 'clean' and 'dirty' material mostly interesting the areas of the laundry and sterilisation [12]. The same thing

happened regarding the movement of personnel, materials and patients within the area annexed to the operating theatres [12].
Different beleives existed in the matter of hospital design: contrasting considerations were made about the vertical extension of the building, alternative typologies were adopted as well as various geometrical forms. Designers were particularly interested in the relationships between ward and services in the matter of dimension and distribution.
But the relevance of establishing criteria for the circulation of people, means and materials within the building was still increasing. Three fundamental factors influenced this fact: the growth of hospitals (the necessity of making separations between functions, of identifying various destinations); the improving knowledge of sanitary principles (specifically sanitary measures); the increase in the population (the higher demand for hospitalisation producing the increase of in and out patients). The operating theatre became a department made up of several sections. Depending on the sequence of the surgical operation, the design of these sections facilitate the correct movement of materials and means, the introduction of the patient, the preparations of the surgeons and personnel [12]. Specific criteria were introduced in design to be applied from then on. The same thing happened more recently also in other sections of hospitals. According to the consequential phases of diagnosis and treatments, the patient must move from the entrance of the building towards his destinations and way-out, according to an established circuit [12].
In the 1990's hospital took on the so called form of a 'Pillbox in a Waffle' [13], with a decentralised distribution of its functions. The existence of mini-units now granted a higher level of privacy. Every single mini-unit in fact corresponded to a cluster comprising a few patient rooms with a number of 2-3 beds and annexed basic services. Each cluster was also studied so as to be assembled into a structure of bigger proportions which is in fact synonymous of modularity and structural flexibility. This configuration allowed extending the building horizontally. The patients would finally have closer contacts with the environments and the site.
The preferable typology for a hospital is still under discussion. But, if on one hand it is nonsense to say that there is only one valid typology for a hospital, on the other hand it is possible instead to identify some indispensable characteristics of the modern hospital. To this end it is necessary to consider that hospital design has always been influenced by social, scientific and technological progress. For this reason, since hospitals are expected to grow and to change in parallel with the social context, they should consequently be planned in order to allow gradual structural growth, their changes being regulated by methodical planning consenting to answer the needs of the future.
Though there isn't a preferable format, a hospital typology should reflect determined requisites, such as the structural flexibility and the horizontal development of the building (supporting flexibility and the avoidance of mechanical transport, consenting immediate contact of the out-patients with the hospital). The circulation system should be definitively integrated in hospital design, depending on the more complex structure of hospitals.

3.1.3 Conclusion of 'Hospital Building in History'

There are certain requisites that have persistently been pursued in hospital design, though their achievement would sometimes be postponed to other emergent factors influencing hospital history (e.g.: the limits given by financial possibilities, sanitary and technological means, knowledge of the time, etc.). For these reasons the impact of these requisites on building design sometimes appeared more concretely evident and sometimes resulted less incisive.

These requisites are as follows:

1) PRIVACY
2) HOME-LIKE FAMILIAR ATMOSPHERE
3) POSITIVE GLOBAL CONFIGURATION
4) PRESENCE OF A NATURAL ENVIRONMENT
5) STRUCTURAL FLEXIBILITY
6) INDOOR CIRCULATION SYSTEM
7) LAY-OUT OF HOSPITAL ACTIVITIES

Final considerations are reported below, concerning the introduction of these requisites during history.

1) PRIVACY

Private accommodation has always been provided in hospitals. Single hospital rooms were built even in ancient Rome. The sick were cured at home by means of private assistance also in the Middle Ages, when hospitals were built for a public of poor people and pilgrims. Later on at the beginning of the Renaissance, when hospitals started to include a larger number of people and cases, the introduction of curtains allowed the patients to remain in private cubicles realised in the large hall of the ward.
In the period of the Renaissance hospitals started to be built on more levels and private alcoves were realised on the last floor, destined for the use of rich people. This configuration granted privacy and the use of special assistance and cures.
Later on hospitals changed progressively according to the social circumstances. Their characteristics adapted over time to the needs of different social levels though the constant request of patients was always for 'familiar' assistance and privacy. While hospitals were assuming more modern typologies, private rooms have continued to be realised in hospitals until more recent times. At the beginning of this century there was still a distinction between single rooms, destined for paying patients, and wards containing a large number of beds (from 12 to 24). The number of beds was gradually reduced in hospital wards. This fact confirms a constant will to increase the level of privacy. In this way the privilege is given to the majority of the patients. The old fashioned, extremely large wards have now finally been abolished. Hospitals are finally taking into consideration the historical request for privacy that patients have always manifested by paying for it.
Many private clinics have been built so as to offer private accommodation to those who can afford to pay for it. Privacy has always been in practice a privilege reserved for the paying patients, always determined throughout the history to pay for it. This is another fact underlining the importance of this requisite for patients.
In recent built hospitals, there are wards of smaller proportions impartially supplying a higher level of privacy to the various categories of patients: from two or three to a maximum of six beds. To supply the benefit to a larger category of patients, the typology of the ward has been reduced to a number of smaller appendices as in the case of the 'Pillbox in a Waffle' taking the

form of a cluster (3.1.2 Building Typology). The centralised station of the nurses is situated in the middle of this cluster. Not only a higher level of privacy but also a closer assistance is definitively achieved by this new model of hospital (see also the next item).

2) HOME-LIKE FAMILIAR ATMOSPHERE

Various attempts have been made in order to create a home-like familiar atmosphere in hospitals, either by improving the requisites of the indoor environments or the assistance. This happened of course only when hospital buildings became real institutions, which means since the Renaissance (until then in fact, the rich were cured at home in order to receive more assistance and comfort while hospitals were places for poor people and pilgrims). Only at the end of the Middle Ages did people with the financial possibilities start to get an ante-room for a private attendant annexed to their private accommodation. The last floor of the hospital would be reserved to the rich to give them a better assistance.
For many years the attention of designers was focused on improving other aspects of design, such as ventilation, separation and distribution of patients. When hospitals started to include plural wards, other requisites of design were achieved by the architects, introducing new acknowledgements in hospital design. The preferable lay-out of the beds was studied and the format of the ward would be the preferred object of designers. The aims of design were focused on to producing a home-like and familiar atmosphere. To this end appropriate components were introduced into the ward such as a fireplace and an apposite space for the nurses. The fireplace was put in the middle of the ward for a concrete reason: in this way in fact, the attention of the patients would be concentrated on a comfortable and central point of interest.
Many attempts were made later on to ameliorate the vigilance and control of the nurse on the patients, beside to supply a familiar assistance to the patient. This was achieved by establishing a more rapid communication between patients and nurses (for example by the closer position of the nurse's station, by the direct sight of the patient from the nurses' station, by the introduction of a bell near the patient's bed, by the light above the door of the patient's room). Familiar atmosphere and assistance are also granted by the recent typology of the 'cluster' consenting the centralised assistance of few patient rooms in a home-like atmosphere.

3) POSITIVE GLOBAL CONFIGURATION

In the early hospitals, many components of design were thought to support the healing of patients. The hospital configuration itself was considered a direct component of the therapy and every kind of comfort was supplied to the patients in terms of cure and environment. The building was built in a wonderful resort, nearby a source of water, its site close to a stadium or a theatre. The indoor spaces were made of precious materials and arts. Patients were cured by means of massages and baths. They were finally assisted also by means of psychological suggestion.
The diminished financial possibilities and the influence of the church in the management of hospitals in the Middle Ages produced a completely different type of hospital, dealing mostly with charity and poverty. Until the Renaissance the sick were usually cured at home and hospitals were considered places where people went almost to die. In fact, means and medical knowledge didn't yet allow to fight and debate properly diseases. To think of a hospital as a building realised for healing (3.1.1.7 The Hospital as 'Machine à guérir'), the patients had to wait until the eighteenth century. Despite this fact, designers have always tried to do their best towards the realisation of comfortable environments. In the Middle Ages specific

acknowledgements were achieved in design for the comfort of the patients. Curtains, for example, were introduced in the array of the wards. These curtains served to separate patients beds and also to protect them from the air draughts.
Designers concentrated their efforts on determined requisites of the indoor environments. In the Middle ages they cared for example about the realisation of a suggestive atmosphere in the hospital wards. This was achieved by means of appropriate components of design (such as the altar, the modulation of the intensity of light by building of appropriate windows and by the presence of vaults).
To give a suggestive influence, the altar was one of the most important element of the designer. It was built in the middle of the ward, its presence emphasised by the use of appropriate material and light. It represented a crucial point, where the attention of the patients would be concentrated for the celebration of the holy mass. For a long time, it remained an important component for the environmental configuration of a hospital. Even later on, when it was built separately from the ward and situated on the ground floor, the patients could still see it from the floor upstairs by means of an apposite scenographic balustrade.
Other items were over time taken into consideration and included in design to ameliorate hospital configuration and to improve the level of comfort. In the renaissance, the building of alcoves, more comfortable than simple beds, was introduced in hospitals and intended for rich people. The furniture of the patients room started to be the object of study. The preoccupation was emerging to use appropriate furnishing material against the pest infestation. For this reason only the 'essential' furniture was allowed in the patient's room. This kind of acknowledgement represented all the best that could be offered to the patients. Modest improvements were made, corresponding to what the patients could expect according to the available resources, technological means and knowledge of the time.
Specific items were included indoors to create better conditions of life. They were mostly intended to improve the quality and temperature of the air of the ward, such as curtains at first and later a fireplace. The position and the number of the fireplaces to be built in the wards then became the object of discussion, as for example, when different systems of ventilation were invented and used in hospital design.
Over time, aspects such as the building configuration became less important being superseded by other more urgent items of design. More importance was given in fact to new factors emerging from the prevalence of modern scientific principles. The building configuration became consequently almost a 'superfluous' component of design.
In the seventeenth and eighteenth centuries, pest infestations sometimes created problems connected to the type of furniture and mattresses. The growing consciousness of the connection between lack of fresh air and disease gave a new impulse to the important and already known problem of ventilation. A series of circumstances, and most significantly the introduction of the allopathic medicine, became at last responsible about the postposition of some components of design (as for example the hospital configuration) to other more relevant aspects.
New technological and scientific discoveries promoted the prominence of determined interests mostly concerning the use of new sanitary knowledge. At this point, the study of the risk of contamination made the efforts of the experts converge on other aims, as for example the separation of patients affected by different diseases. Depending on the situation, emergent primary needs and interests influenced the several complex components of a hospital. For this reason designers concentrated their attention on objectively relevant facts, such as the need to create efficient natural ventilation. This has been focus of hospital design for a long time, of course interesting the designer more than hospital appearance.

Despite these facts, designers continued to give a 'sense' to the hospital configuration. Even though they were distracted by other issues and even thought it wasn't their direct object of design, in many circumstances they continued to show their interest and perplexity regarding the global configuration and layout of hospitals. For example, experts have often discussed the requisites of the ward, its function and the disposition of its furniture. As a result, the number of beds was reduced over time in hospital wards. Private toilets were introduced in wards. Gradually assuming a new and more human dimension, wards could at last be called 'patients rooms' instead of wards.
Hospital environments were slowly improved according to more recent standardised models. At first comfortable items were introduced into patients rooms, such as television and telephone according to the age-old intention of creating a home-like atmosphere. Other benefits in this direction have been more recently achieved, concerning for example environmental components of design, furniture and building material. While hospitals have mostly attended primary needs and function, there are numerous private clinics built in this century testifying to the request of patients in the matter of image. Built in the better quality and supplied with modern equipment, they are more comfortable and brilliant in their appearance compared to the standardised traditional hospitals built in this century.
The same kind of emphasis was more recently given also to the design of special hospitals. This has happened, for example, in the case of the hospitals built according to the Planetree Model or Stainer's theories, actually promoted by the relative organisations (4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree Model). These kinds of hospital support the opinion that the environmental configuration of their buildings is a fundamental component of hospital design.
Some recent hospitals built in the United States also propose comfortable home-like environments and the comfort of a hotel. They suggest the image of a patient who is a client and a guest of the hospital as was the case in ancient Greece (4.3 Hospital Design and Function). These new categories of hospitals further confirm the positive influence of a comfortable, appropriate environmental configuration in hospital design.

4) PRESENCE OF A NATURAL ENVIRONMENT

The benefits given by the natural environment were particularly appreciated by the Greeks and Romans, where the beauty of the site played an important role in hospital realisation. The choice of a natural resort had the aim of promoting the healing of the patients and was considered an indispensable component for a hospital.
For a long time, the availability of the land and the scarce population consented keeping alive the privilege of the contact with nature in the building of hospitals. That is, until the age-old privilege of building a hospital in a natural context would fade away as a consequence of the increase of the population and the building activity. This aspect was in fact consciously recognised only when the growth of the cities obliged building hospitals within the city and this was the first time that the real benefits given by the contact with nature, light and fresh air were lost and regretted. The natural context that had been present in hospitals until then was finally seen as a loss and a sacrifice necessary to satisfy other impelling interests. Until then in fact, the importance of the natural environment had always been widely accepted, not only by the Greeks and Romans and later on in the Middle Ages, but mostly in the Renaissance. Gardens were considered indispensable ornaments of design, in private and public buildings.
But also other facts had given relevance to the contact of a hospital with the natural environment. In fact, in the first Regulation created for the realisation of hospitals, that was

about the 'insane asylums', the patients' need to walk in open spaces and to breathe fresh air was underlined.
The benefit given by this contact would later be sustained by the expert Florance Nightingale. She had already perceived that the presence of a window with a 'natural view' in the patients' ward would give a positive contribution to their healing, before this fact would be recognised by other experts and by the patients themselves (see also 7.3 Patients Rooms).
The same opinion would be supported by other designers. Tony Garnier promoted, for example, a plan for a hospital based on contact with sunlight and fresh air (this was included within the plan for 'La cité industrielle' at the beginning of this century). Numerous realisations of hospitals and private clinics adopted the siting of the building in natural surroundings, due to the objective advantages given by the presence of a natural environment and by the contact of the individual with nature (7.3.2 Contact with Nature).

5) STRUCTURAL FLEXIBILITY

It is impossible to think of a hospital in terms of flexibility when the specific need didn't exist yet, as it happened in the case of the early hospitals. But since the demand for hospitals started to grow, the difficulty of creating a quick correspondence between structure, function and necessities became evident. This happened already in the Middle Ages when already existing buildings were adapted to become hospitals in the case of necessity. As 'derived plans' (3.1.1.3 The Hospital of the Renaissance) though, these hospitals would soon be considered inadequate to fulfil their function and 'designed plans' started to be realised.
It is therefore from then on that hospital buildings would be planned as 'real' hospitals. This means that to plan a hospital would really mean to develop its design in terms of conveniences. From that moment on designers would think in terms of requisites towards various ends. Objective aspects, such as structural flexibility of the building, would be faced quite soon. The increase in population, wars and epidemics started to highlight the 'instability' of hospital buildings regarding structural adaptation according to different circumstances occurring in society.
At the beginning of the Renaissance the cross ward was already an attempt to produce a modular structure capable of being multiplied. Later on, the model of the barrack hospital was invented in response to the urgency and the inconveniences produced by epidemics and wars (3.1.1.5 Emergent needs: Familiarity and Structural Flexibility, 3.1.1.8 Constant Issues: Familiar Configuration, Structural Flexibility, Ventilation). This model of hospital gave rise to the development of analogous systems. Adopting prefabricated units, a new pavilion could be built in a short time to keep part of the patients isolated as for example in the case of infectious diseases. These models suggested the realisation of the Pavilion Model of hospital. This was built on a large area with sufficient space to build new pavilions.
The need for flexibility became more evident with the growth of the cities. In this case hospitals were built within the city and extended in a vertical direction. If necessary, it was possible to build a further over-elevation of the building. Centralisation of activities and detachment of wards in the 'Pillbox on a Pancake' model concerned the alternative for a vertical distribution of the typical arrangements built in the 1980s.
Due to the increasing activity and needs, beside the greater request, hospitals would become over time the object of plural consecutive re-adaptations (3.1.2 Building Typology). Activities and services on the one hand and wards on the other started to request more space. The individualisation of their lay-out and identity became the focus of design in the building configuration. For this reason, structural flexibility would be later fulfilled also in other forms by means of various typologies (fig.4-5) based for example on standardised module (e.g.: a

series of 'T' added to form a 'comb') or schemes capable of being extended according to a modular grill (6.1 Typology and Design).
Consecutive re-structuring was usually carried out on the same building in order to respond to the constantly growing needs in hospital activity (fig.3). Other kinds of attempts have more recently been made to establish modern criteria in hospital design. While attention was focused on the general distribution of functions and wards in hospital plans, preference was given to the horizontal distribution of the building. The hospital building often corresponded to a complex of buildings.
The recent rapid changing of therapies and means introduced new necessities and initiatives supporting the need for flexibility in design. To this end, some recently built hospitals fractionate the building into single units as in the case of the clusters (3.1.2 Building Typology). The typology of the 'Pillbox in a Waffle' (3.1.2 Building Typology) offers for example a double possibility. On the one hand this model allows extending the surface of the hospital building (since it is made of a series of units capable of aggregation). On the other hand, the single units having the shape of clusters are capable of being themselves developed just by adding single departments. The structural flexibility is possible either on a large or on a smaller scale, offering wider opportunities to realise even gradual structural changes.
The functional flexibility is finally finding correspondence into modern structural models over time valid. A renewed requirement for structural flexibility of the building is now evident, as it was in the nineteenth century. At that time, pavilion hospitals and barracks were built either to create new wings to the original building or to build rapidly military hospitals. New structures and wards were created according to the varying number of patients who needed hospitalisation, due to the presence of wars and epidemics.
The modern requisites for a hospital should take into consideration the existence of traditional issues in hospital design, such as the necessity of maintaining hospitals alive over time. If structural flexibility has been previously taken into consideration by the experts in hospital design for other reasons, the same need is currently motivated, for example, by the recent increase in activities and therapeutic means. On the one hand, hospitals have to modulate their admission capacity according to numerical needs, constrained to advance at equal rate with medical progress and scientific technology. On the other hand, they have to deal with the unavoidable qualitative changes in health care, in society and in living standards in order to survive over time (2. Health, Environment, and Hospital Design, 2.3.1 Social Background, 2.3.2 Quality of Life and Well Being).

6) INDOOR CIRCULATION SYSTEMS

The need to introduce this item emerged only recently. Its relevance in hospital design was growing parallel to the development of the building itself, due to the need to create fluent circulation within the building.
The problem of indoor circulation was taken into consideration for the first time in the pavilion model of hospital introducing excellent solutions to connect different pavilions (3.1.1.8 Constant Issues: Familiar Configuration, Structural Flexibility, Ventilation). It is from the beginning of this century on that the aspect of indoor circulation started to gain real consideration in hospital design.
At the beginning of this century, soon after the growth of the cities and the increase in hospital activity, the necessity emerged to create easier, faster movement of persons and means within hospital buildings (3.1.2 Building Typology). For the first time, plans were studied to create an efficient system of circulation to be used in hospitals. By means of design and lay-out of the building designers would regulate the movement of personnel and means,

patients and visitors. But the importance of establishing criteria of circulation within the building increased rapidly over time, due to the growth of hospitals, improved sanitary principles and to the increasing population and activities. In time hospital plans introduced appropriate criteria of circulation for patients, personnel and means in relation to determined activities and sections of hospitals. This kind of acknowledgements was gradually integrated in hospital design (3.1.2 Building Typology).
The introduction of way-finding systems in hospital design was recently claimed mostly in the large hospitals. The frequent situations in which this lack is complained (4.2.2 Need for Modern Components of Design: case-studies, 6.2.1.1 Way-finding and Circulation System) supports the need to integrate a detailed plan regarding the circulation of people and means in the realisation of hospitals.

7) LAY-OUT OF HOSPITAL ACTIVITIES

The separation of different activities in hospitals and the need for flexibility were mostly responsible for the realisation of new typologies of hospitals. For quite obvious reasons the 'easy' format of the rectangle was pre-eminently adopted at first. But later on this rectangle became a cross, either for the purpose of distinguishing different wards, or of extending the building according to the module. Only a few functions existed: the toilets gathered into groups, the surveillance station, the chapel and the kitchen. These services were separately annexed to the wards.
In the Renaissance, the functions were placed in one building. However they were distinguished into separated sections on different floors: the reception and services such as the laundry and kitchens were usually on the ground floor. The wards were on the upper levels.
Therapeutic functions and services started to be clearly separated from the ward only when the pavilion model of hospital was adopted in the nineteenth century. Later on, the building of vertical structures with a 'platform' at their base allowed the extension of the building vertically, while including a larger number of levels increasing the number of patients' rooms. Hospital functions were still placed apart. They were always situated in this 'platform', while the patients' rooms were on the upper levels.
Vertical solutions would be adopted until recently to allow the hospitalisation of a larger number of patients. The combination of the two possibilities was also taken into consideration. This meant extending the building horizontally and vertically. The distinct separation of the various sections would be mostly maintained on the ground level. The departments of the patients' rooms would still be situated on the upper levels.
The choice most recently prevailing was to extend the functional areas horizontally, mostly due to the development of day-hospital activities dedicated to a large number of out-patients. The diminishing number of in-patients produced the consequent reduction in the number of floors. The latest solution of design concerning patients' rooms is the creation of a cluster with single units including a maximum of four beds and a nurse station. Hospital structure is fractionated first into clusters and second into smaller units. This solution not only allows flexibility, but also supports the evident distinction between different parts of the building, which makes for greater and easier identification of the functions within the structural context.

General Final Considerations

Over time, the hospital configuration, typology and function changed proportionally to the development of medicine and therapeutic means on the basis of social development. On the basis of the development of hospital buildings and health care through the history it is possible to make the following considerations also concerning the present condition of hospitals:

1) According to a few rudimentary concepts of medicine, the first healing places were restorative sites: here the sick were consoled by the religious interpretation of their dream and comforted by a peaceful setting. Hospices and hospitals in the Middle Ages were built for poor people, orphans and pilgrims. The hospital was considered an unpleasant place: here people went when nobody could care for them. The idea of the hospital as 'unpleasant' was besides sustained by the fact that those therapeutic means did not always allowed recovery and leaving the hospital alive. The concept of a hospital as a *'machine a guerir'* instead of as a hospital *'mouroir'* started to be taken into consideration only in the nineteenth century by Fucault. The negative impression given by hospitals has been maintained until more recent times, as it is expressed by the following assertion: *"ask somebody -anybody- how he or she feels about hospitals. Our prediction is that the vocabulary of the answer will resemble 'harm' and 'discomfort' rather than 'pleasure'."*[1]. Even today in fact a residue of that feeling is still in people's minds. Hospital designers should think of a hospital in positive, as a place 'supporting the healing and well being of the patients', instead of a place only for the 'cure of diseases'.

2) The level of comfort in hospitals was always linked to the economical possibilities of the patients. Rich paying patients were the privileged ones while patients' requirements were mostly focused on always identical types of benefits, particularly privacy and familiar assistance. Home assistance was a privilege. Rich people would be cured at home and assisted by their familiars and servants until about the nineteenth century. Plural solutions have been studied through history in order to combine a familiar atmosphere and comfortable assistance, to increase the level of privacy in hospitals wards. On the basis of the improved standards of life, improved comfort should be given to the patients by granting the same requisites of design always included in hospital design.

3) R.L. Miller and E.S. Swensson sustain that hospitals don't look like comfortable places, while on the contrary they should be in harmony with modern time [1]. We are going to assume nowadays a more positive behaviour in matter of diseases and to have more trust in health care. Depending on improved means of diagnostics and therapy, patients have much more opportunity to recover. To associate the hospital building with a place of 'discomfort' is only nonsense toady. Ever more frequent concern for prevention rather than cure should encourage people to think in a more positive way. In this optic, to give the patients a positive and comfortable impression of the building should be seen as a positive ingredient of hospital design.

4) On the base of the considerations above it is possible to assert that a strict connection has always existed between hospital design and **Social, Scientific and Technological Progress**. Individual needs, scientific knowledge and technological means have been translated into concrete choices made through time in hospital planning. Designers should take into account the consciousness that hospital buildings are 'dynamic' structures susceptible of change in relation to Social, Scientific and Technologic progress.

5) Designers should take into consideration two important facts: on one hand the existence of traditional issues in hospital design; on the other, the present influence of Social, Scientific and Technologic development. A number of requisites should be included in design on the base of their constant presence in hospital design through history. These requisites should be only re-considered on the base of the modern standards of life.

3.2 Health Care in History

The religious influence on medicine had great success throughout Greece for all of the fifth century B.C. and empirical medicine (dealing also with magic) was still practised until the fourth or fifth century P.C. Castiglioni asserts that *"Medicine was variously instinctive, empirical, magical, priestly or religious"* [3] to underline the component of mystery and mysticism included at first in therapeutic methods.

At first the cure consisted of expedients derived from natural resources and experience. The usual method of therapy is described in this way: *"the treatment, in addition to suggestion and magic practices which contributed in a very important way to its success, consisted in dietary measures, baths and massage"* [3].

The environment and the comfort of the hospital had a relevant therapeutic function. They were considered in practice fundamental elements for the healing of the patients; *"a very important aid to treatment was conferred by the marvellous situation of the temples and by the conveniences by which the patients were surrounded"* [3]. For this reason the early forms of hospital as for example the temple of Aesculapius were realised according to definite characteristics. Indispensable condition for a hospital was the wonderful natural environments. Hospitals were built close to a source of water, their indoor spaces were artistically decorated. Later on, the temples would be built not only by natural resorts, but also in proximity to places able to supply fun to the patients. These could be "*theaters, gymnasia, stadia and even hippodromes*" [3].

The patients slept in apposite living quarters introduced within the same peculiar context. They would regularly be given massages and gymnastic exercise, baths and injunctions. At the beginning of the stay, every patient had to be given preliminary treatment. This is described as follows: *"all those who came to the sanctuary to invoke the intervention of the god underwent a preliminary treatment, purgative in every sense of the word, which consisted in a series of baths, and abstinence from wines and a certain sorts of food. It was only after this preliminary period that they were allowed to enter the temple and begin a strict dietary regime that lasted several days. Then the sick persons were admitted to the ceremonies of the cult, with suggestive prayers by the priest, accounts of formal cures, and so on. Finally the patients spent one or more nights in the 'abaton' of the temple at the feet of the statue of Aesculapius, awaiting the healing dream"* [3].

"Essential part of all practices was the dream or the hypnotic state, during which the cure was produced" [3] it is asserted by the literature where the following comment of the experts is also reported: *"this is easily understood when one considers the specially favourable conditions that the dream and the hypnotic state offer for suggestion therapy"* [3]. That dream was in fact relevant for the patient as the component of suggestion implied in medical care. Suggestion would produce such a positive effect on the patients that the priest even helped with a direct intervention, appearing during the night in the mask of the God. Today this seems ridiculous, but what is certain is that the sick needed confirmation and that the positive answers expected did not come from the conscious. On the contrary, the patients derived confidence from the use of 'suggestion'. These means gave in practice a real contribution to the healing of the patients.

The therapy consisted of suggestion and empirical expedients, such as the natural environment, the presence of arts and activity. Without scientific means, it was the dream, the comfortable environment, the favourable contact with nature, the special conditions granting amusement to promote the healing of the patients. Until later on in fact, the interpretation of patient's dreams was still part of the cure. To this end, experts sustain that *"the dream, in sacred places, is still today regarded as highly curative in various Oriental countries"* [3].

Based on natural therapeutic principles Hippocrates (460-357 B.C.) *"paid great attention to diagnosis, not only of outward symptoms, but also of the diet and the mental condition of the patient"*[4]. He established a school of medicine on the island of Cos in Greece and was acclaimed throughout the country as a brilliant physician. Great consideration is still given to his methods of therapy including psychosomatic healing since his success was later perpetuated by the famous books he wrote.

In ancient Rome, the medical schools inherited Hippocrates' knowledge about medicine. The medical therapies here also consisted of natural herbs and baths and psychosomatic treatments. Claudius Galenus (a.d. 130-201), the famous herbalist and scientist, was particularly influenced by Hippocrates work.

Monasteries and Arab schools of Medicine were accustomed to the same tradition and inspired by the Greeks. The Muslims established the first universities and their 'philosophy of medicine' was professed by Ibn-Sina who we call Avicenna (979-1037) and Averroes (1126-98), both famous Arab physicians. They founded the medical school of Salerno, which was the first European University.

Only in about the fifteenth century, was medical knowledge split into two categories: the herbalists (protected by Henry VIII in England) and the physicians who adopted other substances believed to be able to heal (for example minerals and metals).

The first scientific discovery came quite late: this was the circulation of blood and was due to William Harvey's (1578-1657). Against the new background of discovery, subjects like physiology were just *"neglected in the rush to find new drugs"* [4]. Initiatives to discover the secrets of anatomy and physiology were still discouraged by the attacks from clerical and medical authorities.

Two branches of medicine could be identified: one sustaining the relevance of strengthening the patient's natural defences and the other concentrating upon the abatement of disease. From then on they supported the mechanism consenting the progress of medical knowledge. The healing of the patient would from now on be the object of contributions from many directions.

In time, many discoveries from all over the world influenced medical attitudes. Ignazius Semmelweiss (1818-65) introduced the practice of disinfecting, Marshall Hall (1790-1857) worked on reflex actions of the spinal cord. Other theories about sterilisation and cleanliness were starting to be practised as well.

In 1882 Robert Koch discovered the tuberculous bacillus and later on the cholera bacillus. In the meanwhile Louis Pasteur (1822-95) received a Nobel Prize for having proved the existence of micro-organisms in the air. In addition, he demonstrated that our tissues are healthy when protected from these micro-organisms. This fact took the experts' attention towards the study of bacteria and of their growth in the patient, declining their attention and strict responsibility from the health conditions of the patient.

Research and discoveries were still producing confusion. Sometimes they were considered ridiculous and for this reason they were even rejected, even in the face of the positive recommendations. This happened for example in the case of the reformer Bodington. He sustained that tubercular patients needed fresh clean air as part of the treatment, but at that time he was called a charlatan. Only later on, his opinion and belief would be accepted as *"logical and correct"* [4].

In the nineteenth century, the attitude of the experts was to doubt the positive effects of medical chemical substances and the attention was addressed again to the patient. It is reported in the literature that in this period of time *"there is an increasing tendency for the side effects of man-made drugs to become irreversible -all the more so if the patient as a whole is studied less than the disease"* [4].

During the First World War, practices like surgery and blood transfusion were improving by necessity, since then *"the adoption of techniques such as massage, heat treatment (ultra violet, infra red, etc.) and nutritional science, have all made a powerful impact upon medical world"* [4].
Alexander Fleming, who won the Nobel Prize for Medicine in 1945, discovered that Penicillum notatum was able to produce Penicillin, a substance inhibiting the breeding of harmful bacteria in the bloodstream. As he pointed out new scientific means for healing, other research started to be carried out. Later on Gerhard Domagk (1895-1968) found a similar mechanism for producing Sulphonamides.
Around mid-twentieth century at last *"the pharmaceutical industry was fully geared for the domination of the medical profession…One miracle drug has followed another..."* [4] and the consequence was the quick development of pharmaceutical production.
Later on, contrasting opinions emerged again about the effective benefits of the chemical products widely used by the population. It was found that many of the chemical substances in the pharmaceutical products often have side effects which damage the human body. This happened in the case of Aureomicyn (responsible for damage to the liver and internal bleeding) or Cortisone (cause of kidney disease, insanity [4]) and so on. The increasing suspicions regarding several pharmaceutical products in use recently solicited an investigation into the effects produced by other chemical products. Research has regularly been carried out since then to find the advantages and disadvantages produced by chemicals applied in medicine.
In the meanwhile, empirical expedients and natural remedies have constantly been used until the present time to support patient's healing. In parallel with scientific therapies, they have constantly received people's consent. Many natural treatments and cures have been and are often applied by the people who can afford to pay (this happens for example in the case of thermal baths and connected treatments).

3.2.1 The influence of Natural Means of Therapy

In 1785 a book of *"instructions on the manner of governing the insane"* was written in order to establish principles about insane asylums. This was the first time experts referred, in terms of regulation, to the environmental conditions of hospitals. The book *"called for pure air and water"* and made a claim for *"promenades with trees to give them (the insane) some sense of freedom yet protect them from the sun..."* [5].
Natural expedients had been always used until then, continuing to have success also when science started to take advantage. Because of the relevance taken on by them, some types of cure are briefly reported below, including expedients and methods of therapy applied throughout the history.

3.2.1.1 Psychosomatic Therapies

"One of the world's greatest authorities" [4] and sustainer of psychosomatic therapies, Dr. Flanders Dunbar, showed how emotional behaviour can influence our health. He realised that our attitude in relation to our emotional condition can lead to a series of health dysfunctions such as *"to constant tensing of the muscles, and this to fibrositis, rheumatic and arthritic complaints..."* [4].
Experts in this type of therapy assert that *"the relationship of mind and body is very closely interwoven"* [4]. They sustain that *"people who are frequently sick should study this approach to healing"*. D. Law, expert of alternative medicine, sustains that *"every problem solved brings its own glory, and the more we succeed, the better equipped we become to succeed further"* [4].
This consideration is commonly verified in every day life. In fact, everybody has at least a minimum of experience concerning the benefit that a positive attitude the individual can make towards recovery and rehabilitation. This should be taken into account in hospital design.

3.2.1.2 Colour Therapy

Colour therapy was already in use in the Middle Ages. It is for example reported in the literature that *"mediaeval churchmen would lay sick people in the area below the coloured glass windows of their cathedrals, which usually represented one saint or another..."* [4]. Then, the fact that the sick would recover was considered a matter of religion and *"the saint was given the credit for the healing that took place"*. *"Most coloronic physicians"* sustain that the positive and relaxing influence of colour and light act on the usual *"mental stress and tension"* [4] generally affecting a sick person. The beneficial effect produced by the 'coloured glass' on the patient was later attributed by these physicians to the atmosphere created by the colour and intensity of light.
There are specialists who apply colour therapy, but the positive or negative influence of the colours on human behaviour is still debated. Experts are sustain that the use of determined colours should be avoided in determined circumstances (like red in relation of psychiatric diseases). In relation to this, the expert D. Law makes an interesting observation: *"if then there are colours which must be avoided, it is logical conclusion that colours may have therapeutical and helpful effects"* [4]. Objective question about the choice of colours in hospital design emerge regarding the possibility of positively affecting the attitude and mood of the patients. Research has been done also about this matter.
One of the studies carried out in hospitals tried to identify the effects of colours on the patients in order to decide which colour could be used in hospitals [6]. An investigation carried out to verify the effects of single colours on the individual patients of hospitals. These colours were used for the indoor environments and particularly the building and furnishing material. In this instance it was ascertained that various effects are created by different colours. Their influence on an individual also depends on personal preferences. In the end, no single colour resulted particularly relevant in producing a positive impression in the patients, though the researchers did reach an important conclusion. Asserting that the presence of a variety of colours is the key to satisfy the broad public, they suggested using different colours in the creation of hospital environments. Supporting in practice the opinion that the presence of colours produces more 'familiar' environments, it was finally stated that: *"a constantly changing environment as natural and desirable for human habitats suggests the need for variety in patient accommodations, as well as in areas of general use in the hospital"* [6]. In these circumstances the researchers also recommended avoiding the presence of strong artificial lights in the design of hospital environments because they produce unpleasant effects to the sight.
A similar opinion has been expressed by other experts as well. For example Vernon writes that *"normal consciousness, perception and thought can be maintained only in a constantly changing environment"*

[7]. On the basis of these considerations and the complaints recorded in hospitals (5.3.4.1 Quality of Life and Hospitals: case-studies) it is possible to deduce that the introduction of a variety of colours in hospitals corresponds to the best choice to be adopted in design. This is also because there hasn't been any disagreement regarding this solution.

3.2.1.3 Music Therapy

A lot of literature has been written about music therapy. Often applied through the history, *"some of the earliest work was done at Horton Hospital, Epsom, Surrey, a large mental home"*. Here many patients *"found their first steps to recovery by listening to concerts"* [4].
'A Guide to Alternative Medicine' reports that music therapy is more commonly used against *"mental stress and tension behind illness"* [4]. This means that music should help patients to feel relaxed. In relation to this, the specialists assert: *"it is surmised that the area of the brain, first discovered by Dr. Gall, through which music is expressed and registered blocks off the sensation of pain and discomfort"* [4], *"...music breaks down the nervous tension, helps the patients to forget shock memories that have been intruding into their everyday waking life"* [4].
Music therapy is currently used in particular cases such as for terminal care and for determined aims such as making the patient relax before surgical operations. But its use is also the object of numerous debates and the experts state: *"it is very remarkable that the staid, allopathic branch of healing has come to recognise that in many cases music has a beneficial effect upon patients"* [4].
Though its application is not commonly adopted by hospitals, these premises suggest combining music with systems of relaxation in hospital realisation. In fact a 'Psychic Break Room' -where patients listen to music in combination with the perception of particular images- was already presented by the Symposium on Healthcare Design held in Boston in Nov.'96 [8]. The use of systems of relaxation, including music should be introduced in hospital planning in order to create a 'de-stressing' home-like atmosphere.

3.2.1.4 Water Therapy

The method of water therapy was developed by plural physicians in the history and in particular by the famous Sebastian Kneipp (1821-97) who came across the work of Priessnitz'school. *"In order to asses how effective Kneipp's work was"* it is written in the literature *"we have only to look at the fact that within his own lifetime, in spite of primitive, almost non-existent transport conditions, every year 20.000 patients travelled to his little village of Weorishofen, and made it into a world-famous health resort"* [4]. But *"Kneipp did not limit himself to the beneficial effects of cold water and other developments of Priessnitz'study"* … *"he established a whole new school of therapy based upon water cures, light, fresh air and herbal teas"* [4].
Many testimonials and applications are given concerning Kneipp's theory. Germany, Austria and Switzerland still remain centres of this culture, but Kneipp's methods are finding large application in different countries (for example in Ischia, Italy).

3.2.1.5 Natural Cures

Natural methods of therapy have been always practised by the numerous Nature Cure establishments flourishing all over the world even today. The success achieved by these types of cures is confirmed by the following words reported in the specific literature: *"one thing most of the establishments have in common, apart from the broad general principles of dietetics and fasting...is a good record for cures and healthy patients"* [4]. Their methods *"adhere to different theories"* [4], Law states, the

broad public *"preferring one type of fast, some another; occasionally (especially in Germany) baths and suntreatments are favoured"* [4].
These therapies have always had general approval, not only by the Greek and Roman cultures, but also by the numerous people who still approve this kinds of therapies even today. For this reason natural means, supporting therapy and prevention, should be promoted in health care structures.
The use of natural materials and systems should be introduced in hospitals to produce relaxation and a sort of 'gratifying feeling'. This doesn't mean integrating expensive items of design. This aim for example could be fulfilled by combining items like scents, soft light, music, the presence of plants and the possibility of relaxing by laying down in a comfortable space, the choice given of different kinds of teas to drink…
Donald Law states: *"the existence of different types of healing should be a source of hope and comfort to the patient, never a source of anxiety to the practitioner of any form of healing"* [4].

3.2.2 Conclusion of 'Health Care and Medicine'

Natural means of therapy have been always used in history, either parallel or not to allopathic medicine. Even after the firm establishment, the prevailing of scientific principles in medicine, this type of treatment not only continued to receive the approval of a large public, but they became even the privilege of those people who could afford to pay for them. Not only the well-off in the past, but today there are many people willing to pay for the benefit given by this kind of treatments.
The approval gained by these methods and the contribution they make to healing, suggest applying these benefits on a larger scale. The most relevant types of cure and other similar alternatives essentially represent an opportunity given to the patients not only to relax from tension, but also to find an alternative 'interest' out of the regular routine of a hospital. The patients would in practice be 'activated' by the presence of 'something special to do' and 'gratified' by the presence of modern complements. To introduce these kinds of items means practically to 'add' to the institutional atmosphere of hospitals which has often been complained about by patients (4.3.4.1 Quality of Life and Hospitals: case-studies).
This could be immediately done concerning at least the relaxing effect of such an approach and simply by promoting contacts with nature and natural ingredients, by creating almost cost-less de-stressing 'activities'. Few initiatives should be taken by designers in this sense (see 5.1 Hospital & Function), mostly focusing on the realisation of relaxation systems based on the application of natural means and ingredients. This kind of initiative would have a double function. The first would be to de-stress the patients from the natural anxiety deriving from pain and disease. The second would be to increase the standards of comfort proper of traditional hospitals (2.3 Function of Hospitals).
On the one hand they would improve the standardised level of comfort proper of a hospital. On the other hand, the patient himself would be supported by a kind of 'closer assistance' and by the traditional confidence suggested by ever existent 'methods of cure'. These initiatives would also answer the increased request for natural products today seen in various fields of life. The world-wide interest of people in a return to the 'natural' is in fact properly justified as being the right reaction against industrial sophistication and environmental pollution (3.3.4.1. Quality of Life and Hospitals).
A wide choice is available in the possible application of products and treatments, natural expedients and methods of cure that it is possible to meet any preference of the individual. The same type of contribution to healing can obviously be given in different ways, as the following suggests: *"Nature Cure is a very broad philosophy, and like the Hindu religion in which one may be monotheist or polytheistic, the label hides a wide variety of emphases"* [4].

3.3 Health Care and Building Design

Hospital buildings, historically responding to criteria of therapy and sanitary principles, reveal the existence of a strict correspondence through the ages between building and medicine. This correspondence is clearly shown by the use of the medical expedients, sanitary principles and scientific knowledge over time introduced into hospital design and mediated by the unavoidable influence of the social beliefs and therapeutic means.

When no scientific concept of medicine was given, the building configuration reflected empirical therapeutic expedients based on a dietary discipline and natural cures. That model of hospital promoted mostly the psychological and physical well-being of the patients by means of suggestion and religion, physical activity and general comfort (quality of the environments, presence of amusement). Hospitals were realised as comfortable places. The Greek Asklepieia was thought as if was itself component of therapy: its configuration and the comforts available -according to the Hippocratic principles of medicine- were part of the treatment.

In the case of the medieval open ward, the hospital resulted from a combination of medical care and mystic beliefs. The components of suggestion and religion were still making part of the treatments (3.2.1.2 Colour Therapy). Hospitals were going towards the age of charity and mysticism, influenced by the new social context, financial means and religious attitude. Few sanitary principles were applied in this period of time. The principal change concerned the increase of comfort given by the improved services of hospitals (e.g. toilets would be separated from the wards and increased in number). Criteria of ventilation were established and an increase of fresh air was permitted by the realisation of counterpoised windows inside the ward.

Later on the first scientific discoveries started to be made. The new intellectual convictions would discourage the application of the traditional therapeutic criteria applied until then. They would be reputed to belong to mass believes and popular behaviour. Hippocrates' theories and psychosomatic treatments would be placed apart. Then, corresponding sanitary measures were applied to the new hospital buildings, now reflecting the binding medical principles of the time. In the construction, the importance of aspects concerning its environmental configuration would be neglected in the growth of scientific interests.

New emerging questions were reflected in the building components that would be adopted as instruments of 'scientific' solutions. Against for example the risk of contagion (deriving from the discovery that diseases could be transmitted by air), an increase of ventilation was immediately introduced. The techniques applied to this purpose would be improved by means of ever more sophisticated mechanisms.

Now the risk of epidemies, due to pest infestation, would be controlled by the use of easy-to-clean furniture, made of compact materials, able to resist the harbouring of pests.

From now on the hospital building would assume the task of giving a 'positive' contribution to healing. It would be seen as a 'machine à guérir'. This means that its design would be thought as in terms of convenience in contributing to the healing of the patient as well as improving the performance of hospital activity. Studies were done to create appropriate environmental conditions for the patients, primarily ensuring suitable temperature and ventilation according to new theories that were developed.

Later on, when the knowledge of these principles was integrated in hospitals, the object of design moved towards the aspect of patients' accommodation. Various attempts were made for example to create a familiar configuration of the ward (fig.1) or to establish closer contact between the patients and the natural environment (given for example by having a 'view' from

the window of the patients' room, as Nightingale strongly sustained). The Pavilion hospital was built on a large surface and surrounded by green spaces, its context assuming again some importance in the design of hospitals.
The large ward was substituted in time by new smaller wards with smaller number of beds and improved comforts (such as a bell to call the nurse, telephone, etc.). Some other requisites have been consolidated over time into new modern typologies of hospitals. They focused on patients' accommodation assuming now the aspect of 'patient's room'. The nurse station was equipped to be functional and comfortable. The study of proper sanitary principles suggested the application of circuits for the circulation of dirty material. The movement of personnel and material started to be studied according to criteria of hygiene and safety.
Numerous private clinics were built, particularly in the 1950's and 1960's for paying patients, offering comfortable environments, privacy and green surroundings. Their realisation was due mostly to improved welfare and the increased demand of the paying patients for closer assistance and better comfort.
By the introduction of new technologies into hospitals, the regulation in matter of security and hygiene was gradually increased. This has happened until now. Storage and distribution of gases, for example, now require particular security measures. The presence of sophisticated air conditioning systems also requires assiduous maintenance and periodical checks. A series of risks emerged (2.1.2 Presence of Plural Risks) such as the risks of disease and explosion that are taken under control by means of appropriate regulation.
The choice of furnishing materials and building products (for example those concerning floors and wall surfaces) became decisive in interior finishings against the risk of contamination and pest infestation. The manufacture and method of application of materials have to answer particular characteristics (e.g. focused to eliminate a number of risks, mostly related to health, and to improve the quality of the building, mostly in relation to produce physical comfort and health of its occupants). Appropriate building technologies should be used for different purposes as well (e.g. against the risks of disease, biological contamination, radiation, fire and so on). For these reasons, the choices made by designers and experts imply a new scientific as well as technological consciousness. This is supposed to be not only based on general principles adopted in building, but mostly on the delicate function of hospitals and the risks deriving from their peculiar activities.
Hospitals are also victims of the same hazards now affecting any other category of building and they are currently influenced by the same problems concerning health and environment, common today all over the world (1 Health, Environment and Building Design).
The renewed use of natural materials and means has been seen in many areas of life, including the increasing demand for natural means of therapy [14]. The world-wide consciousness regarding a series of risks related to the environment has changed people's attitudes. Today's offers on trade of natural products and natural therapeutic treatments are consequently really numerous (4.3.2 Renewed Request for Traditional Therapeutic Means: case-studies). Since the development of **Social, Scientific, Technological context has always influenced the realisation of hospitals during history,** it is possible to conclude that the needs deriving from the present Social, Scientific, Technological background of hospitals should also find positive respond in hospital buildings through the appropriate design solutions.

Conclusion of 'Hospital Building and Health Care in History'
Chapter 3

Factors such as scientific discoveries and wars, different social economic situations, have always conditioned the realisation of hospitals. At different stages, various components were integrated in design according to different needs emerging over time. *"The traditional hospital is the product of ever-evolving ideas of society, science, and the status of the medical community"* [1] it is asserted by experts in hospital design. As this statement suggests, hospitals are the final product deriving from many factors such as culture and economy, tradition and religious attitudes. The design of such buildings is also influenced by events in the different stages of Social, Scientific and Technological Progress. For this reason what is currently happening in **Social, Scientific, Technological background should be taken into account in the realisation of hospitals**. Medical care and scientific knowledge have always influenced the realisation of hospitals, mostly by moving the interest of designers towards determined ends. **The facts happening in our social and scientific context should still influence the realisation of hospitals**. There are however traditional aspects that have been more consistently pursued in hospital design because they consistently respond to the needs and preferences expressed by people. Due to this fact, specific components (mostly regarding Environment and Function) have been a constant object of interest for designers who have sustained their use and improvement. **The same components** (identified in 3.1.3 Conclusion of Hospital Building in History) **should continue to be integrated in hospital design**. Identical objectives should be fulfilled by improving the quality of hospital design on the base of the improved standards of life, taking into consideration what the corporate consultant of the Center for Health Design, Lafayette, CA (U.S.A.) says: *"the challenge of great innovators is not how to get new ideas in your mind, but how to get old ideas out. Innovation is how you keep things fresh"*. Natural cures and means have always had the approval of the people. Even when scientific knowledge prevailed, their use still remained valid, though subordinated to official medicine. Well-off people have always been willing to pay for this kind of treatments and cures throughout history up to now. The approval gained by **natural means of therapy and their positive contribution to healing suggest their introduction on a larger scale**. More and more sophisticated solutions have been introduced in hospital design as well as improved sanitary principles and consciousness in the matter of hygiene and health. Since progress has always found a general 'correspondence' within the building configuration, hospitals have lost their 'genuine conditions'. In modern hospitals, 'technology' and 'humanisation' today represent the 'hard' and 'soft' aspects of health care. People's complaints confirm the need to re-establish appropriate standards for the realisation and configuration of hospital buildings (Part I Current Hospital Conditions). Martin S.Valins writed: *"both medicine and architecture are tending to place less of an emphasis on high technology, and instead are becoming more sensitive to the needs of the human condition, the environment and earth's finite resources"* [15]. From this consideration the call emerges for re-establishing the appropriate proportions between human biological needs and specific unpleasant consequences of progress. The closer consideration of human needs and the use of natural ingredients should be re-integrated in hospitals against this situation.

PREVALENCE OF ALLOPATIC MEDICINE OVER HOMEOPATHIC
CONSTANT PRESENCE OF NATURAL MEANS OF THERAPY
CONSTANT INTEREST OF THE PEOPLE IN NATURAL MEANS OF THERAPY
CONSTANT INTEREST OF DESIGNERS IN THE FOLLOWING ITEMS
PATIENT'S PRIVACY
HOME-LIKE FAMILIAR ASSISTANCE AND ATMOSPHERE
GLOBAL CONFIGURATION OF DESIGN
PRESENCE OF NATURAL ENVIRONMENT AND INGREDIENTS
STRUCTURAL FLEXIBILITY
INDOOR CIRCULATION SYSTEMS
LAY-OUT OF HOSPITAL FUNCTIONS
CONSTANT INFLUENCE OF THE FOLLOWING ITEMS IN HOSPITAL DESIGN
MEDICAL KNOWLEDGE
TECHNOLOGICAL KNOWLEDGE
SOCIALLY RELEVANT FACTS

Present factors influencing Hospital Design
Chapter 4

Summary

Depending on the improved life standard and the rapid development of the progress, increased comforts are often given in the design and function of other large modern public buildings (such as hotels, commercial centres, office buildings, train stations, airports etc.).
The physical and psychological well-being of the occupant of the building is aim of design in the realisation of other public buildings and institutions (4.3.3.1 Physical and Psychological Well Being: case-studies, 2.3.2 Quality of Life and Well Being)).
From various circumstances it is possible to ascertain that living standards have improved, producing increased demand for increased comforts. The design of some newly built hospitals in U.S.A. includes for example extremely costly furnishing components and rich architectonic scenarios. At the same time, conventional hospitals look 'cold and institutional', unable to satisfy patients' expectations. On the one hand, extremely luxurious hospitals and on the other obsolete buildings are compared.
The increase of risks related to health and environment affects the buildings (2.1 Environmental Conditions of Hospitals). The building activity is influenced by this situation. Additional risks related to the environment have been recorded about hospitals, due to the particular function and design of the building (4.1.1 Risks affecting Environmental Conditions).
People ask for new solutions to environmental pollution and health risks. The return to the use of natural ingredients, materials and products, evident in every activity of life, includes the revival of alternative therapeutic treatments. This return to the 'natural' seems to be a reaction to the problems of pollution and to the other risk factors related to public health and environment (1 Health, Environment and Building Design). It seems to be an inverted mechanism against sophistication.
The health care structures have already been influenced by this situation and a series of initiatives have started to be taken, which promote the application of 'natural'. The demand for natural means of therapy is increasing and some initiatives have been already taken by the United States to combine natural therapeutic components to traditional medicine.
Hospitals are changing in contents and functional quality as is asserted by the following statement: *"in medicine today, the key terms are wellness, prevention, outpatient service, diagnostic services"* [2]. Due to the increase of means and therapies, several day-hospital treatments are addressed to out-patients also for prevention and well being. There is a renewed interest for physical activity not only in the prevention of disease but also in health care.
Hospital configuration has been transformed by the introduction of new activities, the large scale use of technological systems and equipment. But designers complain of the many difficulties faced in refurbishing old hospital buildings (4.2.1 Lack of Flexibility: case-studies). It seems that it is sometimes impossible to renew old buildings by realising structural or technological adaptations.
Modern components of design and information systems are needed. Due to the increase of activities and the frequency of out-patients, old hospital buildings also *'present obstacles to way-finding'* [2].
Remarks about design failings come from many directions (4.4 Hospital Design and Designers Responsibility). There is a series of 'misfits' that designers can probably ameliorate in planning a hospital. Many defeating situations have recently been attributed to poor maintenance and

design. A lack of co-ordination exists between designers and builders, administrators and personnel of hospitals that require suitable measures to be taken in planning and building a hospital.

4.1 Hospital Design and Environmental Condition

Summary

There are risks affecting the environmental conditions of hospitals that depend also on design, maintenance and the activity of hospitals. Researchers investigating the causes of specific health disturbances in hospitals attribute the responsibility for this situation to a number of factors. These include inappropriate use of chemicals in disinfecting, inadequacy of maintenance and design failings.
Regular maintenance of building systems, appropriate building techniques and materials, supply of specific information to the personnel about specific risks related to work performances can avoid, or at least reduce, some risks related to the complex building and function of hospitals.

4.1.1 Risks affecting Environmental Conditions

As in case of the Sick Building Syndrome (S.B.S.), patients and staff of hospitals have complained of disturbances and health dysfunctions studied by researchers as the Sick Hospital Syndrome (S.H.S.). In one of the studies with the aim of ascertaining the causes of health disturbances in hospitals, the researchers asserted that *"the design, construction and maintenance of the whole building"* needed to be carefully reviewed *"especially focusing on materials, ventilation, thermal conditions, physical and biological pollutants, and such hospital-specific issues as the disinfection procedures"* [29].
Many other factors were identified as responsible for producing health disturbances and complaints regarding inadequate environmental conditions. Design misfits and poor maintenance or biological hazards were identified as contributing causes to the problem. Poor lighting, high levels of noise and unhealthy microclimate were indicated as some of the components creating discomforts in hospitals. Pollution from roads, the use of chemicals in hospital activity, the presence of biological agents and inadequate air conditioning were considered other factors determining the poor quality of the air indoors.
Designers, builders and staff of hospitals should receive appropriate information in order to improve their knowledge and approach in the performance of their work. Awareness of various hazards and knowledge of specific risks should be increased to combat 'defeating situations' by means of appropriate information and hygiene propaganda.

4.1.1.1 Sick Hospital Syndrome: Case-studies

Specific health disturbances complained of by hospital staff have led to research with the aim of finding their causes. But the presence of simultaneous polluting components and their different impacts on every single individual doesn't make it easy to define the measure of their single responsibilities.

People are often exposed to the sum of various factors that disturb their well-being conditions. Researchers who studied this subject asserted that various factors contribute to producing poor environmental conditions in hospitals. One of the factors that influences this situation is the large scale use of air conditioning systems. Other responsible factors are the combination of anaesthetic gases, the presence of inappropriate microclimatic parameters and uncomfortable noise and light levels [40, 41]. It also resulted from these studies that the presence of chemicals or gases in the air produces general symptoms in people working in particular sections of the building [40]. Surgeons complained for example discomfort due to generic factors in relation to the environmental conditions in operating theatres, for this reason called the *"unhealthy operating room in hospital"* [26] by researchers investigating the causes of the problem.

Two large Hospitals were also the objects of study, an old hospital and a newly built hospital [27]. Personnel had moved from the first into the second and general symptoms were felt by the people working in the new hospital, who were analysed soon after their transfer from hospital to hospital.
The personnel of the two Hospitals were invited to answer specific questions to ascertain the origin of the symptoms. The investigation asked about the typology of disturbances and their work-relation (for example: *"their frequency, latency time after starting work.."… "duration and changes outside the workplace of each symptom"*). Significant variables were considered such as work-related factors influencing groups of symptoms (professional category, length of service, use of video display, etc.) or personal parameters (age, sex, smoking habits, etc.). The total number of people interviewed was 645, corresponding to 90% of the staff.
The symptoms were classified in the following groups: "*ocular* (burning and/or conjuctival hyperaemia, lacrimation); *upper airway* (rhinorrea, stuffy nose, nasal itch, repeated sneezing, epistaxis, dry throat, sore throat, thirst); *respiratory* (chest tightness, dyspnea, wheezing, dry cough); *cutaneous* (erythema, wheals, dry skin, itchiness -whether general or of exposed parts); *general* (headache, lethargy, lack of concentration, irritability, dizziness).
The most common causes of discomfort registered by the new hospital are reported below:

	Old Hospital			**New Hospital**		
	Total (n=406)	**Males** (n=207)	**Females** (n=199)	**Total** (n=229)	**Males** (n=69)	**Females** (n=160)
Strong Lighting	4,7	2,4	7,1	39,7	27,5	45,0
High Temperature	26,2	25,7	26,6	30,3	34,8	28,3
Dry Air	26,3	19,4	33,5	54,8	52,2	56,0
Stuffy Air	43,8	43,1	44,4	55,0	42,4	60,3
Passive Smoke	33,4	33,5	33,3	19,3	17,4	20,1
Discomfort	46,9	48,8	45,0	45,2	23,2	54,7

The differences between the two typologies of buildings were also taken into consideration. The old hospital had been built in the 1940's according to the standardised techniques of that

period. It was shaped in two blocks with natural ventilation. The new hospital was built in the late 1980s according to more modern criteria and was thermally insulated. The researchers reported the following consideration about the new hospital: *"in offices, corridors, halls, staff-rooms and on the stairs there was neither adequate mechanical ventilation nor enough natural ventilation by means of windows which could be opened"*.
The staff of the new hospital generally complained about the dry air. While 40% of the staff of the new hospital complained of strong lighting, only 4,7% complained of the same discomfort in the old hospital. The prevalence of symptoms was as follows: ocular (67,1% Vs 17%), cutaneous (56,4% Vs 15,5%), upper airway (67,1% Vs20,9%) and general (57,3% Vs17%).
Health disturbances were significantly more frequent in the new hospital ($p< 0,001$) and here the prevalence was registered of respiratory symptoms ($p< 0,01$). Symptoms were reported more frequently by the nurses ($p<0,05$). The people working in the neonatal unit complained more often than other workers ($p<0,01$) about ocular, upper airways, respiratory, cutaneous and general discomforts.
It was noticed that discomforts regarding various causes were prevalent in the new hospital and that general symptoms were mostly related to irritation.
On the basis of a number of facts the final report concluded that *"discomfort and symptoms typical of the SBS were present"*. It was also asserted that the responsibility for this situation was *"probably not linked with personal or psycho-social factors but rather with structural deficits in the building itself"*. The researchers stated that: *"structural factors in the new Hospital, which may have played a part include insulation and synthetic materials in building and furnishing, a ventilation system which did not ensure a comfortable micro-climate, and strong lighting in some units"*.
The staff of the new hospital often complained about the dry air. The relative humidity of the air resulted in fact lower than that necessary to consent optimal conditions of comfort. Complaints were also motivated by strong lighting, since critical levels of lighting were recorded in particular circumstances such as the neonatal division. Here for example, ocular and cutaneous problems in addition to general discomforts were more prevalent than elsewhere, faulting deficits in lighting and microclimate. The fact that symptoms were reported more often by the nurses than any other professional category was attributed to their working during the night and *"to their being in areas with insufficient changes of air and low relative humidity levels"*.
The air conditioning systems that didn't work properly were considered to be one of the causes of these discomforts. It was supposed that the emissions of chemical substances from walls and furnishings could have influenced the manifestation of discomforts *"particularly in sealed units with air conditioning"*. The researchers considered the *"airing period to elapse before transferring the staff"* to be inadequate. They finally asserted about the presence of air pollutants: *"furthermore, we are of the opinion that a too brief airing period before occupying the newly-built hospital undoubtedly made a significant contribution to the onset of symptoms"*.

4.1.1.2 Risk of Disease: Case-studies

Various diseases are connected to biotic agents, which produce similar health disturbances to the Sick Building Syndrome, for example breathing complaints, tiredness, headache, fever, skin complaints, etc [28]. The presence of biotic agents can be reduced or avoided by the application of appropriate techniques in building and by the regular maintenance of building and technological systems. Designers and builders should be aware of the existence of this specific risk in order to adopt appropriate solutions in the realisation of hospitals.
The biotic agents are the following:

1) Atopic diseases (asthma, rinitis, conjunctivitis, eczema, sinusitis), deriving from allergies, infections, erithems.
2) Chronic bronchitis and lung emphysema, deriving from erithems.
3) Extrinsic allergic alveolitis, deriving from organic dust.
4) Humidifier disease, deriving from antigens of thermophilic organisms.
5) Legionella, deriving from infection of legionella pneumophila.
6) Lung cancer, deriving from carcinogenic radiation and material.
7) Pneumoconiosis, deriving from mineral dust.
8) Pontiac fever, infections as Legionella pneumophila.
9) Prurigo parassitaria, deriving from infections and irritations of mites and insects.
10) Rheumatoid arthritis (low temperature increases complaints).
11) Food poisoning, deriving from toxins from Salmonella, Campylobacter.
12) Skin infections, deriving from micro-organisms.

The risk of disease derives from direct contact with specific materials or organisms, from inhalation of emissions from specific material, from altered food, from the quality of the air. This risk is hence related to the environmental conditions, components of design and configuration of the building.
Temperature and humidity create the favourable conditions for the micro-organisms to live in and increase the disturbances related to Reumathoid arthritis. There are also structural characteristics or technological components that create suitable conditions for some biotic agents to live in and proliferate.
Situations like these have recently been recorded in hospitals as the result of various studies. One of these was recently aimed at ascertaining the origin of general health disturbances complained of in a specific hospital [29]. In this case the presence of biological risks was taken into consideration. An investigation was carried out concerning the construction characteristics in order to ascertain their possible connection to the activity of microbiological factors. The eventual presence of Legionella Pneumophila was investigated in the ventilation systems. This was done by taking samples from the filters and from the water used for humidification. The presence of bacteria, microfungi and actinomycates was also examined by means of tests to detect dust mites in samples of ambient dusts. Specific results came from these studies. The researchers made also final specific and interesting considerations. They asserted that some microbiological factors represent an "*ambush"* risk (for example aspergillus and alternaria) and added that *"aspergillus sp., though reportedly more common in air-conditioned residences, and Alternaria sp. are ubiquitous in nature"*. For this reason, they sustained that their presence should be regularly tested for to exclude any possibility of proliferation.
On the basis of the previous considerations, it was concluded that this kind of risk must be kept under control by means of cleaning, regular maintenance and the use of appropriate furnishing and building components [28, 29].
In fig.1 the whole dust ecosystem is represented including fungi, bacteria, insects and mites that take part in allergen manufacture in the home. It can be noted (fig.6) that the decrease of these allergens indoors depends on the indoor climate in addition to the regular removal of dust. Dry and even air represents the proper environmental condition to avoid this risk, which can be avoided or reduced by the right air parameters and ventilation, natural light and sun.

4.1.1.3 Risk of Pest Infestation: Case-studies

At the '2nd International Conference on Insect Pests in the Urban Environment' (7-10 July 1996) pest management was supported in contributing to public health [32]. The risk of pest infestations in hospitals was also discussed. It was said that hospitals imply many activities that *"may be the creation of ideal environments for the support of many pest species, providing them with ample harbourage, shelter and/or food"* [32]. Also in this case, the causes of pest presence are strictly connected to the components of hospital design. Insects, rats and birds are generally *"attracted to buildings for shelter, food and harbourage"* [32] say the experts, and in hospitals there are building/furnishing components and equipment supplying suitable places for the pests to live.

Regarding the causes of pest infestation in hospitals, three important reasons are given by researchers:

1- the movement of meals, laundry etc.;
2- the harbourage furnished to pests by equipment (producing infestations that are *"extremely difficult to treat"* [32]*);*
3- the presence of building features facilitating harbourage and proliferation.

It is besides possible to focus on the following three factors mostly influencing this risk:

A- the activities of the hospital,
B- the equipment and furniture,
C- the building structure and features.

From specific investigations carried out to ascertain the nature of the pest species found in hospitals, it results that *"the techniques and materials used in the construction of many older and most modern hospitals may predispose the buildings to infestations that are difficult to treat and almost impossible to eradicate"* [32]. This happens in case of structural elements -like for example voids and suspending ceilings- that create difficulties in the treatment's strategy and in the performance of maintenance. The choice of building/furnishing material and the regularity/imperfection of the building techniques facilitate or hamper pest infestation. The numerous functional changes recently realised in hospitals resulted for example responsible to produce new structural opportunities facilitating the pest proliferation (5.2.1 Lack of Flexibility: case-studies).
Building technologies, design and furniture can contribute to pest infestation in buildings. Researchers assert that *"building design can often exacerbate the problems encountered in attempting to control pests within a hospital complex"* [32]. Designers and builders have the possibility of preventing this risk in the planning and realisation of hospitals. *"Although it may be difficult to keep hospitals completely free of pest"* the researchers assert *"every effort should be made to achieve a reasonable level of control or eradication, whichever is practicable"* [32].
The activities of hospitals were also identified as representing a potential source of risk. Specific places were capable of facilitating pest development and particularly *"the ductings, boiler and laundry were also identified as high risk areas"* [32]. The researchers state: *"as expected the kitchens were the primary focus of concern"*.
The risk exists both in refurbished and newly built structures. Ducts and voids were identified as the most likely features for the development of infestation, the researchers asserting: *"most hospital buildings are threaded with ducting which carries water, gas, electricity and drainage provides a means of access enabling pests to reach and colonise many suitable areas within the hospital (Burgess, 1984)"* [32].
Supporting the opinion that *"hospitals are likely to fall within the highest risk category"*, the researchers suggested executing regular inspections as a measure of prevention. They also adviced establishing *"closer links between the hospital staff and the environmental health departments"*

[32], in these circumstances *"rapid maintenance targets were established to contribute to the integrated programme"* [32]. Finally, a close relationship was created between *"authorised officers"* and the hospital. The establishment of an integrated approach of the hospital staff together with environmental health staff and contractors was finally seen as the proper strategy to achieve pest free environments. The researchers added that the same commission *"could advise architects and facilities managers on the features which may encourage the proliferation of pest species"* [32]. The contribution of this commission -owing to their personal experience and knowledge- would be able to prevent the risk of infestation both in the realisation of new hospitals and in the structural adaptation of older structures.

On the basis of the above considerations designers and builders should give their contribution against this risk. For this reason, the type of pests found in buildings are reported below as well as the circumstances consenting their presence in buildings.
Two categories of pests are distinguished according to the typologies found in buildings:
A- pests living within the structure and in the surroundings of the building (such as cockroaches, ants, crickets and bristletails);
B- pests living in stored food (like beetles, moths and certain mites).

There are three components strictly related to the environmental conditions of the building able to influence their presence and proliferation. They are:
1) hygienic conditions;
2) microclimate;
3) determined structural features.

There are also particular circumstances related to the physical conditions of the building (obsolete structure, renewal of the building, etc.) that should be taken into consideration to avoid this risk. The proliferation of pests finally depends on determined climatic conditions and scarce cleaning.
To maintain the proper hygienic conditions, it is necessary both to destroy insects by cleaning and to avoid rubbish that can provide food for them. As a consequence, designers and builders should realise spaces which are easy to clean (for example by means of the use of appropriate building materials and configuration) and well ventilated to avoid dampness. It should be taken into account that pests require damp conditions to flourish and that a warm well ventilated surrounding is inimical to them. For this reason designers should create adequate ventilation, temperature and/or air moist against this kind of problem.
There are structural components suitable for various organisms to live in or to move from place to place. For this reason the structural components of the building liable to this risk have been reported below, including the contribution that could be given in these cases by designers and builders against this risk.

PIPES, DUCTS AND CHASES
"The principal structures inhabited by cockroaches are pipe runs, ducts and chases" say the experts, asserting that *"intermediate lengths of ducts and chases should be capable of opening easily for inspection"* [30]. It is also added that *"cockroaches are large and active insects and there are records of their travelling quite long distances inside the building"* [30].
Designers and builders should take measures against the risk of pests' propagation by applying proper criteria in designing and building. Structural requisites and technologies applied in building in fact should respond to infestations.

CRACKS, FISSURES AND JOINTS

Harbourage for pests is given by particular building features. It was asserted about: *"apart from crevices in furniture, bugs will infest cracks in plaster or woodwork, e.g. badly fitting joints around door or window frames, skirting boards or picture rails"* [30]. Against this type of problem, experts suggest sealing small joints and pipe connections, and that such thin fissures as *"the spaces surrounding pipes passing through walls"* that *"should be properly flanged and solidly packed"* [30].

Insects can lodge in very narrow spaces and in the structural imperfections or voids within the building. Designers should avoid applying structural manipulations potentially responsible for structural imperfections (5.4.1Design Misfits and Risks). Builders should properly seal these spaces and provide the possibility of inspecting them. In every other circumstance of this kind, designers and builders should give the proper contribution against the liability of infestation.

WARM PLACES AND FURNITURE

Other possibilities exist for pests to find a comfortable place to live in warm places such as those supplied by the furniture. For this reason they like those spaces close to warm pipes and heating system like kitchens and bathrooms.

The experts sustain that "*blattella germanica, which appears to be the most frequent offender at present, is a lover of warmth and is usually to be found in crevices near hot-water pipes"* [30]. Cockroaches *"are also troublesome in hollow wall spaces adjacent to ovens or kitchens stoves"* [30].

The experts sustain that preventive measures should be taken more often in the realisation of buildings, sustaining for example that *"fibreboard partitions and similar constructions in kitchens should be carefully sealed with strips of gummed tape"* [30].

Metallic nets are used to stop rats and mice getting in through the windows of kitchens and canteen, or pigeons building their net in small windows on the top of buildings. But the risk of pest infestation is commonly underestimated in the planning and realisation of the building, since attributed to other kinds of faults (for example defective cleaning and dampness). Designers provide the quality of design from different points of view, but do not consider such 'details'. Builders execute the plan taking into consideration only more evident risks. Eventual structural enhancements preventing this risk are commonly realised only after an infestation, though this problem should be faced in the plan and realisation of a building.

"20 or 30 cockroaches in a hotel boiler room may be acceptable" it was asserted in Public Health Pests by Burgess *"whereas a single insect in a hospital operating theatre clearly is not"* [31]. Designers and builders should contribute to avoid this risk by making appropriate choices in the realisation of hospitals, on the basis of specific information concerning the factors contributing to the pest infestation in relation to their work.

4.1.1.4 Risks, Design and Hospital Activity: Case-studies

Researchers have found that the health disturbances complained of by people often depend on the poor air quality (4.1.1.1 Sick Hospital Syndrome: case-studies). This has happened often in the mechanically ventilated sections of hospitals. The scarce efficiency of these ventilation systems derives from various causes: excessive air velocity, insufficient moist air, inadequate air change or temperature [29].

In these sections it has often been considered difficult to produce comfortable conditions in relation to temperature, ventilation and mostly air moisture. The inconveniences commonly produced were directly verified by recording people's complaints in places adopting air conditioning.

The engineer Basile W. Filios, chief by the engineering office of the Klinikum Hospital in Aachen (D) was contacted and interviewed about this matter since a large scale use of ventilation systems is made in the Klinikum Hospital (8.1.2 Interview with the Chief Engineer of the Klinikum Hospital). It results from this interview that patients complain the lack of air moist and fresh air. This depends on the difficulty of regulating exactly the microclimate indoors in relation to different situations external to the building as air moisture and temperature. In practice, it is impossible to make continuous adjustments. The ventilation systems work on the basis of specific parameters that take into account air moisture and temperature, but the weather conditions are considered only up to a certain extent. The difficulty of adapting methodically the microclimate to the outside climatic conditions produces physical discomforts such as sore throat if people spend a long period in hospitals.

A recent research carried out in hospitals was focused to ascertain which factors could produce health discomforts related to their environmental conditions. In this circumstance, the researchers mostly lament the very strict relationship between hospital and traffic roads, asserting: *"the quality of inside air is strongly dictated by outside pollution, the latter mainly depending on hospital position with reference to automotive sources"* [42]. Perplexity is expressed about the possibilities to find a radical solution to the problems due to traffic roads like noise and pollution. They mostly complain the difficulty of supplying fresh air by means of ventilation systems while contemporaneously avoiding an input of pollutants. Notwithstanding the measures adopted in this case like *"air filtration or chemical purification"* [42], they sustain at last that "*the supply point of outer air to HVAC systems is a critical choice and needs to be judiciously chosen"* [42]. For this reason they finally propose the restriction or abolishment of automotive circulation in the hospitals neighbouring as the only "*immediate and inexpensive countermeasure"* [42] against the problem of indoor air pollution and noise.

These researchers underline besides the importance of assuming fresh air in hospital environments. They consider its presence indispensible as *"a factor of major concern with respect to its sanitary relevance affecting well-being of patients, working performance of hospital staff and safety of visitors"* [42].

Experts studying the origin of the Sick Hospital Syndrome (4.1.1.1 Sick Hospital Syndrome: case-studies) found that poor air quality sometimes depends on chemical products used in specific hospital activities. The responsibility of personnel in the correct execution of procedures and their awareness about risks play a part in ensuring 'healthier' conditions in hospitals. This is the case for example of cleaning and disinfecting procedures.

In a recent study carried out in a hospital, researchers report that *"a significant contribution from ethanol was detected in samplings carried out in coincidence with the disinfection procedures"* [29]. The use of ethanol and glutaraldehyde as disinfectants were for this reason restricted in the hospital that was object of study [29].

Chemical and radioactive products, numerous gases and biological agents are used in hospital activities. In practice, patients and personnel are potentially exposed to various hazards depending on the complex function of hospitals. Researchers sustain that *"exposure to chemical substances from biomedical activities in hospital should not be overlooked"* [33]. Not only the medical staff but also many individuals as patients, visitors and any other people working in a hospital can be involved in various risks like *"exposures to chemicals, radioactive materials, and biological agents as well as safety hazards such as fire, explosion, and electrical injuries"* [33].

Depending on the complex function of hospitals, aimed investigation should be conducted to identify the nature of the hazards nowadays present in hospitals also in order to establish the measure of their impact. One of the several studies carried out on hazards in hospitals [33] states in fact that it is difficult to establish the exact entity of the risks connected to the hospital activity. On the basis of these considerations the identification of the many risks

actually present in hospitals is considered by the experts to be a first unavoidable step towards a policy of effective health protection and management in hospitals [33].
The *"primary prevention strategies"* [33] to apply against this kind of risk are addressed to varied objectives. Failings in maintenance contribute to determine failings in the function of ventilation systems and inappropriate environmental conditions in hospitals. Researchers take into consideration the relevance of applying *"materials substitutions, engineering controls, safe work practices, and use of protective equipment"* [33]. In practice, they suggest that a correct execution of determined procedures is necessary *"to reduce or eliminate exposures"* [33].
On the basis of these and other general considerations made by researchers in relation to specific failings recorded in hospitals (2.1.3 Individual Responsibility), the application of regular maintenance and the individual awareness in the prevention of risks is needed to improve the environmental conditions of hospitals.

4.2 Hospital Design and Environmental Configuration

Increased day-hospital practices and diagnostic services and the request of fitness and wellness treatments has determined the emergent image of a hospital devoted to prevention before than health care. The increment of activities created besides the new imagine of a multifunctional building. Activities are now susceptible to develop by the time in quality and quantity while requesting functionality of spaces and flexibility in the plan of the building. Depending on the increased number of out-patients the lack of information is more often claimed at present in hospitals. Way-finding and modern means to supply information should be integrated in design. An increased presence of out-patients and the new activities put into evidence that the configuration of hospitals is resulting obsolete and inadequate from several points of view. As a consequence, these buildings have been recently object of plural consecutive refurbishment and structural changes.
A series of design 'misfits' was recently registered in the design and configuration of these buildings also deriving from plural changes. The expert in hospital design Mikho is adding that structural additions and refurbishment *"have served to mostly destroy the architect's original concept for the hospital building"* [23]. It was besides stated the '2nd International Conference on Insect Pests in the Urban Environment' held on 7-10 July 1996, that one of the causes of pest infestations in hospitals is the presence of the structural compromises resulting by these frequent renewals. Designers and builders from their own are responsible of some misfits of design interfering with this situation.
Defeating design, lack of information and environmental risk are testifying the need to find new criteria for hospital design. The quality of hospital buildings should be ameliorated by taking into considerations some new issues in hospital design.

4.2.1 Lack of Flexibility: Case-studies

A new approach to the medical practices and the trend towards the application of health prevention before than therapy, incremented the affluence of people to hospitals: people, prone towards new therapeutic methods, changed their attitude towards healthcare. This revolution of habits transformed the traditional standardised image of hospitals into a new type of structure. Differently proportioned in spaces and technological means, this was resulting difficult to be identified into a definitive new model of building. It is reported in

'Healthcare Design 2000', by Russell C Coile Jr. [21]: *"Built to rigorous safety codes and building standards, hospitals are long-lived, even if they become functionally obsolete after the first 15 years"*.
It looks however that the changing in hospital function and structure is nowadays only more evident though it has always been one of the hospital prerogatives. The progress and the continuous scientific and technological growth has been always influencing the building structure of a hospital. To confirm this point of view, when talking about hospital condition, E.Mikho sustains that *"typically, the physical growth is architecturally not compatible with the initial project"*. It seems that science and technology are progressing too quickly to consent the hospital buildings to grow in parallel of the increment of means and the development of new therapies. Frequent consecutive renewals of the building took recently place by hospitals. To obtain positive results by means of the refurbishment of hospitals results sometimes impossible.
Not only the medical equipment is more recently improved and increased, but also the large application of technological means and computerisation producing bigger requests beyond the expectations. Difficulties of different nature made sometimes impossible to renew the old buildings not sufficiently dimensioned or adequately designed to support increments and changes. It is for example asserted by the hospital designer Mikho that *"the principal difficulty of accommodating change is presented by the engineering services"* mostly if *"little or no attention and minimum space is given to the requirements of engineering services"* in the original plan of the building [23]. The consecutive structural technological changes recently realised in hospitals created a lack of coherence in their general configuration. Mikho asserts in fact to this purpose: *"evidence will not only show that hospitals have grown, but that different departments have grown at different rates..."* [23]. It is evident that the traditional criteria adopted in the planning of hospitals should be changed.
Needs are besides changing very quickly, in parallel with technology. The experts R. Miller and E. Swensson asserted to this purpose that *"hospital and healthcare facility design must be sensitive to and responsive to the marketplace"* [2] while referring to the continuous progress taking place in health care about function and means. Hospital buildings are object of different type of renewals, including the introduction of new technological means. Medical equipment is also evolving rapidly.
A recent item reports [21]: *"science offers a total package of workstations, panels, legs, walls technology, desking and seating that is completely flexible and adaptable to clinical environments, ranging from a group medical practice to a complete primary healthcare center"*. The existence of 'perennial' critical problems taking place in planning is underlined by the experts asserting that *"a perennial problem for planners, architects, and interior designers is how to build flexibility into healthcare facilities for a set of future functions and technologies that may be very different from today's"* [21]. This means that building structure and systems should be thought in the perspective of being open to future adaptations and changes.
The traditional hospitals were resulting inadequate from many points of view to support many modern situations. Their plan was often presenting plural obstacles to the application of future adaptations. After plural consecutive manipulations, the old hospitals lost their identity and the aim of their original project. To underline this consideration, Mikho is adding: *"later additions have served to mostly destroy the architect's original concept for the hospital building"* [23]. This means that message and starting brief of the project cannot be maintained alive through the time without the existence of appropriate premises.
The ideas of the first designer are often resulting later mislead by false interpretations given by the intervention of a second or more designers. Misunderstandings occur concerning the false interpretation of architecture. As a consequence, the harmony of design is missing after postponed structural additions. Against this kind of inconveniences, critical information should be given in the original project consenting the future development of the building.

Designers should have the global view of design taking also into account the possible alternatives about additional future changes.
Plural consecutive manipulations and later additions are often producing a scarce efficiency of technological installations and technological misfits in the network of the technological systems. For this reason, the complex configuration of a hospital should be thought globally, in advance not only about its present but also about its future. Structure and systems should be planned within the perspective of changing in dimensions and consistence, according to appropriate criteria of structural and technological flexibility.

4.2.2 Lack of Modern Components of Design: Case-studies

The lack of quick way-finding systems was recently complained in hospitals. It is reported in fact by R.L.Miller (AIA) and E.S.Swensson (FAIA) [2]: *"among the most intimidating aspects of large hospitals are the obstacles they present to way-finding"*. The lack of information supplying is besides complained by old and large hospitals, as it is clearly denounced in an item written by J.Spiers, Health Policy Adviser to the Social Market Foundation in London. By the Royal Sussex County Hospital at Brighton, he experiences in this item the role of visitor and describes the difficulty of patients and visitors to identify the way to their final destinations. The object of his initiative is to denounce *"what has been invisible to management"* [25]: that is plenty of information lacking about the hospital's services and activities. Here is part of this text: *"Our map don't say 'You are here'. They are colour coded, but we don't say how or why. They direct people to a customer care centre, but we don't have one. We have toilets which have no sign on the door. No one knows how many toilets we have. We have lifts, but with no mini-directory in them to say what is on each floor. We don't say which floor gives which access to other buildings. We don't tell people which floor they are on when they are outside the lifts. We don't give directions as to what is on that floor. Our Social Work Office (not sign posted) has a door, hidden behind a cupboard.....We don't say the public they can use our restaurant, though they can...."* [25]. The list is even longer than that, but what is clearly evident is that the observations correspond to quite common information that are generally missing by the conventional hospitals. A situation that is depending either on the increment of activities or of the several refurbishment recently occurred by hospitals. Hospitals are grown by the time as well as the possibilities of misunderstanding. Modern hospitals assumed a more complex configuration compared to the traditional model and, as a consequence, this put into evidence the need of way-finding. Our reality was changed in the last decades by the recent increment of activities and the growth of population. By the traditional model of hospital, any kind of information was supplied at the desk, by the entrance hall. Now, the increased activities of hospitals created more complex buildings. The increment of out-patients is besides producing frequent contacts of the patients with hospitals for different reasons. These facts are supporting the application of way-finding and information.
People now expect easier contacts and a quick life-style, since generally solicited by a large application of modern means for communication and information. To make hospital buildings assume the requisites of other modern public buildings, adequate means of information and way-finding should be supplied.
The emergent problem of way-finding makes now concentrate designers attention on this aspect of design, becoming object of interesting considerations the experts of design are making. For example David Fine, Co-ordinator of Health Research Institute and Hallam University Collegate Crescent Campus of Sheffield writes an essay [16] sustaining the combination of colours, images and information together. He is reporting the following case to support the combination of images and way-finding: *"A hospital in the north east had such inadequate signing that staff would take devious routes to avoid being asked by visitors for directions. A arts*

scheme involving signage on the Alice-in-Wonderland storyline to the children's wards has helped both staff and visitors find and take the quickest routes from A to B." The double purpose was practically fulfilled in this way, either to supply necessary information, either to impress colour and fancy to that section of the hospital.
Also in the past the application of a way-finding systems in hospitals was supported in combination with images and colour. *"Signs are tools and furnishing at the same time"* asserted for example the architect C. Casati promoting way-finding in hospitals already in the 1980's. He sustained the integration of way-finding in hospital design, based on codes, colours, numbers and images [24]. An immediate message would be given in this way, addressed to various categories of individuals, elderly and young speaking any language. *"The signs must be understood by everybody"* he said in creating a series of appropriate images to be applied in hospitals to this end and proposing the use of material and colour to communicate more quick perceptions.
This and other recent experiences suggest to apply convenient systems of way-finding in hospitals, having the double function to supply information and decoration at the same time.

4.3 Hospital Design and Function

Summary

Hospitals have lost their characteristic of being an institution to go to only in case of serious illness. Owing to improved means as diagnostics and therapy, hospitals are at present addressed to a larger number of out-patients instead of in-patients.
Increased day-hospital activities such as ambulatory surgical operations, diagnostic examinations, fitness and wellness treatments have led to hospitals actually supporting both prevention and cure.
The development of science and technology and improved living standards influence the function and configuration of hospitals. But typology and configuration, the standardised level of comfort of conventional hospitals disappoints patients' expectations.
On the contrary, the design and function of some newly built hospitals in the U.S.A. seem to receive patients' approval and the consent of doctors. These American hospitals look like residential buildings in terms of comfort and like hotels in their supporting services. Closer assistance is provided to the patient and the reality of every-day-life is brought within the building by the 'mall' and by the promotion of activity.
The introduction of relaxation systems in hospitals was proposed in the Program of the Ninth Symposium on Healthcare Design held in Boston (U.S.A.), supporting the opinion that people wish to have less stressful environments.
The attempt to change the traditional image of hospitals has been made also in other countries on the basis of analogous criteria.
Criteria for an 'occupant-focused' deign have been applied in the realisation of 'Healthy Buildings'. As happens in the realisation of other categories of public buildings, for example in the case of the 'Healthy Offices' and the 'Healthy Universities', similar items of design should be applied in the realisation of Hospitals promoting Health and Well Being.

4.3.1 New developing Categories of Hospitals: Case-studies

Three typologies are clearly emerging in the newly built hospitals in the U.S.A.: the Mall Model, the Hospitality Model and the Residential Model [2].

The *Mall Model* includes a commercial section that is generally located on the ground floor. Patients and visitors have a range of services and items at hand. Situations of routine are created, the hospital assuming the atmosphere of everyday life. The building gives the idea of a modern structure like other large public buildings (for example shopping centres that invite people to spend time inside the building). This creates a direct connection between the patient and the 'living' world. The patient assumes in this case a 'de-stressing' role of 'consumer'. Referring to this Model, experts of hospital design R. Miller and E. Swensson state: *"the analogy to shopping...can alleviate much of the apprehension and anxiety associated with medical procedures, which are often performed in settings that promote passivity, casting the user of the service in the role of 'patient' rather than 'client' or 'consumer'."* [2].
The Mall type of hospital offers a range of alternatives to patients, staff and visitors. People find a series of useful items in the 'Mall' where there are products like newspapers and magazines, therapeutic items for health and prevention (like optical and sanitary articles, retail items and so on). It is useful for patients, visitors and staff to have the chemist at hand, gift-shop, coffee-shop, bookstore, etc. In the big hospitals, it is also possible to find one or more restaurants. While waiting, visitors and occasional patients can spend a period of time within this area instead of sitting in a waiting room. The same facilities are useful for the large and varied public of a hospital. In the Mall of the large hospitals, there are activities dealing with research and conference organisation under one roof.
Thirteen retail shops, different restaurants and even a bank are provided in the Dartmouth-Hitchcock Medical Center in Lebanon (New Hampshire), built in 1991. There are other health-related services in the American model of Mall, as is asserted by R. Miller and E. Swensson: *"the medical mall also offers an opportunity to cater and develop another growing segment of the healthcare market, community-oriented health maintenance, wellness programs, prevention and health education. Sports medicine, gym and spa facilities are also highly appropriate to the medical mall setting"* [2]. Some European models of hospitals also include shopping areas, for example the Klinikum Hospital in Aachen (Germany). Though this area has more modest dimensions, it is possible to buy newspapers and grocery, gift items and flowers. A coffee shop and a self-service restaurant are available for the public.
The origin of the Mall model, as Ralph Hawkins writes [3], is identified in the typology of a hospital where the patient rooms are connected to a medical-office building through one or more corridors. The corridor becomes in this case the 'main street' of this area that is rather populated (but not critical to performing the hospital activity).
This kind of passage represents a traffic line considered in practice 'obliged' by the storefront display attracting the flood of people, giving the opportunity to identify the main directions of this traffic. It allows planning in advance the appropriate lay-out of the circulation of patients and people, also concentrating on way-finding and means for information at appropriate crucial points. To plan the circulation of the people according to the lay-out of the utilities finally creates a fluid circulation of the people coming in and going out the hospital.
In conclusion, structures like these offer many advantages: they make the patient assume the role of 'consumer' and offer utilities at hand for the large number of people visiting, living and working in hospitals.
This Model also offers flexible areas, suitable to answer alternative functional solutions and structural adaptations of the building, making use of the flexibility of the Mall.

The *Hospitality Model* includes a residential structure which look like a hotel, individually annexed to the hospital or included within a 'Mall'. This structure is used by the family of patients or by patients that do not have the possibility of being assisted at home, but need constant assistance. Here the client is considered a 'guest' rather than a patient. Atmosphere and configuration of the building are 'hospital' and comfortable. Plants and paintings are provided, dining rooms are attractively decorated and warmly illuminated. Not only the building configuration, but also its utilities give the impression of being in a hotel.
Houston's Methodist Hospital is an example of Hospitality model [2]. Here special services (for example laundry and restaurant) are provided for the patient and family that correspond to a first class hotel. The staff take care of the patient, but is also available to respond to family needs.
Analogous requisites should, to a certain extent, be included in the design of all hospitals, as is asserted that *"even conventionally designed hospitals can, to a degree, incorporate operational policies based on the hospitality model"*. In conclusion, patient rooms and the utilities available for visitors and clients should assume a familiar and 'hospital' character following the driving purpose of the Hospitality Model.

The *Residential Model* in practice reproduces the same familiar atmosphere that people find at home. Furniture and building materials, curtains and colours, lights and paintings create the proper environmental configuration of a patient's room. Here he is allowed to receive visits at any time, can get any kind of information and closer assistance by the nurses. A lounge is available with videocassette, a book case, a kitchenette where the patient can prepare his own meals and coffee.
This has already been taken into consideration in certain older and other recent but special hospitals. For example in the 'Rudolph Stainer' Hospitals or in the case of hospitals promoted by the Planetree organisation, which was founded in 1978 by Angelica Thieriot.
This woman realised a non-profit organisation, the Planetree, whose name comes from the 'plane tree', which is the tree under which Hippocrates used to sit with his students to discuss medicine. A. Thieriot, asserting in fact to be *"horrified by her experience with conventional hospitalisation"*, wanted to *"humanise the quality of patient care"* according to Hippocrates' principles [2].
This model gives privacy to the patients and support to their families. Owing to its home-like comfortable configuration, the experts say that the Residential Model results *"from a conviction that familiar environments are less stressful"* and help a patient's healing [2]. The intention behind this Model should be more generally adopted in order to humanise the anonymous atmosphere typical of conventional hospitals.
There are other types of hospitals recently realised all over the world that have the aim of supporting the family of the patient, such as hospitals for terminal care. In Paris (F) for example, Jeanne Garnier gives special facilities to the family of the patients including a suite - comprising bedroom, bath and kitchen- called *'espace famille'* [38]. This is for the family that wants to assist a patient. The same hospital includes also an apposite room, *'espace de deuil'* [38], where the family suffering the loss of a patient can be consoled by volunteers.

4.3.1.1 'Mall' Type of Hospital and Activity within Health Care

The interesting thing about this model of hospital is the objective 'reality' it takes into the hospital, that also means 'something to see' and 'fun'. It gives the patients the impression of living in the every-day-world and establishes the role of the patient as '*consumer*' and '*client*' (4.3.1 New developing Categories of Hospitals).

The model also offers a wide range of opportunities and activities for large public of hospitals. In the Mall of certain American hospitals it is possible to practise 'physical' activities (for example exercises in a fitness centre) or 'intellectual' activities (satisfying psychological needs, buying books or newspapers). The kind of 'activities' at hand gives the patients the opportunity of feeling interested in something. At the same time it promotes taking initiatives, it is in practice 'repaying' the reduced activity of the patient and activity is promoted as a positive mental attitude supporting healing. This model offers comfortable services and utilities at hand that were totally excluded from hospital buildings (such as hairdresser, chemist, restaurant and so on). Ambulant in-patients are habitual 'clients' of the Mall if they do not have relatives who bring them what they need. People who need to remain in the building for a day or for hours (when for example undergoing examinations, waiting for a diagnosis, visiting, assisting a patient, etc.) find a range of opportunities to spend time in some way. People working or having business to do within the building can 'save' time finding a series of utilities at hand before leaving the hospital. Everyone can profit from coffee shops and self-service, shops for buying newspapers and snacks, sanitary products and medicines. These kinds of components should improve the level of comfort of conventional hospitals. Various advantages to this model should be taken into consideration in hospital design, such as its flexibility towards future changes.

4.3.2 Renewed Request for Traditional Therapeutic Means: Case-studies

The renewed use of natural products has been seen in many areas of life, implying the renewed demand for traditional means in therapy and prevention (3.1.1 The Influence of Natural Means of Therapy). Numerous proposals are given at present in this matter (like 'beauty farms' and specialised 'beauty shops' emerged all over the world). Natural products in commerce are generally increased (for example clothing, medicines and food, etc.) and large consent of the people for the 'natural' is evident. This is also confirmed by the recent realisation of special types of hospitals.

4.3.2.1 Natural Therapeutic Ingredients and Cures: Case-studies of Seattle and Springfield

In the United States, Mr. Manthey who is a management consultant at Harborview (the main public hospital near Seattle) was *"well aware of a growing interest in natural medicine"* [14].
The Seattle area was going to establish the first natural medicine-based clinic in the United States and the will to be involved in this business was confirmed by the support given by the local governments across the country (from Alaska to California to New York to Illinois).
Several local hospitals *"expressed interest in being involved in operating the clinic"* [8]. Approvals coming from many directions made it finally possible *"to make the project reality"* [8].
Natural means of therapy receive the consent of the people. At the same time the recent natural-medicine-based clinics are approved of by the doctors and experts. The project in Seattle [14] was favoured in fact by the following motivations: *"the intense interest among all sectors in natural medicine, as well as the presence of renowned natural medicine practitioners and learning sites in the area, the lack of any organised opposition from the traditional medical establishment, and the political will and wherewithal"* [8]. People's consciousness about the advantages of prevention rather than cure is increasing. The improved quality of life and the new policy of prevention support the introduction of modern principles in health care.
Health care seems to go in two directions: towards the use of natural products and therapies, and towards the emergent consciousness in the matter of prevention. The Citrus Valley Health

Partners (U.S.A.) sustain the opinion that it is better to support the health of people than to cure diseases, asserting that *"cultivating community health goes deeper than providing necessities such as immunisations and regular check-ups"*[9]. The benefits given by prevention are well motivated also by the expert in health care Tibbett L. Speer's, firmly asserting that *"unless we focus on health, there won't be enough money left in the system to take care of sickness"* [9].
A trend towards prevention is consequently reflected in the newly built American hospitals as well as in modern medical buildings with ambulatory surgery capabilities, the so called out-patients clinics.
A large number of beauty farms and wellness centres have recently been realised to respond to people's requests for natural treatments. Special hospital are even being realised, like the Crozer-Keystone Healthplex site in Springfield (PA, U.S.A.), which is the prototype of a Health Club. This hospital provides primary, preventive and rehabilitative care under one roof. A detailed list of its various activities includes for example *"tennis and basketball courts, a swimming pool, an indoor track, and aerobic and weight training areas"* [10].
People ask in practice for alternative solutions in order to escape from environmental hazards and contamination. This return to the 'natural' is interpreted today as an inverted mechanism of sophistication. People's preferences and the increased demand for the 'natural' support the need to re-establish appropriate proportions in hospitals between sophisticated high-technology and renewed requests for humanisation.
Plural initiatives are being taken to re-establish more human proportions in health care and to find a new balance between modern means and traditional principles of medicine. This situation should be considered in hospital design in order to find appropriate correspondence into a new configuration of hospital.

4.3.2.2 Physical Activity: Case-studies

In ancient times the Greeks and the Romans used the famous aphorism 'mens sana in corpore sano', which underlined the importance of physical activity as a mean of therapy and prevention. Following Hippocrates principles, this theory was supported until recently. As the experts of today still sustain, physical activity should be performed for good health and for the prevention of diseases, in combination with good dietary habits and no smoking [7].
The positive results of a moderated life style and physical activity have in fact recently been accepted once more. Recent scientific publications support the benefit of physical activity not only as means of disease prevention but also of health care. In the NIH Consensus Development Conferences it was asserted: *"All americans should engage in regular physical activity at a level appropriate to their capacity, needs and interests....moderate levels of physical activity confer significant health benefits. Even those who currently meet these daily standards may derive additional health and fitness benefits by becoming more physically active or including more vigorous activity. For those with known cardiovascular disease, cardiac rehabilitation programs that combine physical activity with reduction in other risk factors should be more widely used"* [6].
The new prevention policy sustains that *"contemporary medicine seeks to be preventive, to promote health, rather than to be remedial, to 'cure' ills already present"* [2]. Several scientific items and national campaigns have recently promoted initiatives and programs for health care and prevention. Their aim is to supply information to people about the importance of performing regular physical activity. Their purpose is to increase people's participation. On the basis of these considerations, hospitals should increase their activities for diagnostics and prevention. Some recent American hospitals include physical activities for prevention and wellness, like gymnastics and sports medicine (8.1 Planned and Built Examples and 4.3.1 New developing Categories of Hospital).

The attitude of experts and medical personnel, supporting the policy of the W.H.O., confirms that health care structures and systems are changing, incorporating the new prevention policy. Prof.J.Cantwell -Chief Medical Officer of Olympic Games '96 and clinical professor of medicine at Morehouse School of Medicine (Atlanta)- and Dr.P.Fontanarosa Senior Editor of JAMA stated that [7]: *"in addition to its effect in reducing mortality, lifelong physical activity may promote wellness and thereby help decrease healthcare costs by reducing the need for hospitalisation"*.
Hospitals are expected to face the aims at present sustained in health care, to 'prevent' illness and 'support' therapy. On the basis of the previous considerations, appropriate initiatives should be taken in the realisation of hospitals.

4.3.3 Prevention Policy and Sustainability in Building

The W.H.O. aimed to improve the *'health of populations'* by means of '*health promotion'* [11]. This policy started in 1961 when the World Health Organisation defined 'Health' as *"not merely the absence of disease or infirmity, but a state of complete Physical, Mental and Social Well-being"* [12].

"The purpose of development" -is actually stated by the W.H.O.- *"is to improve all people's quality of life, including their health"* [11]. The W.H.O. also asserted regarding the buildings and the environments where we live: *"environments are not just the visible structures and services surrounding us but have spiritual, social, cultural, economic, political and ideological dimensions as well. Furthermore, all the different facets of life are interwoven and inseparable"* [39].
The issue consequently emerged as providing physical-psychological well being to the 'occupants of the building' in the different circumstances -at home and in offices, schools, universities, etc. In order to plan for example 'Health Promoting Universities' this aim is fulfilled by *"protecting the health and promoting the well-being of students, staff and the wider community"* [11]. The realisation of *'Sustainable Buildings'* is being promoted in the design of private and public buildings.
In the case of the 'Healthy Office', its definition is the following: *"a healthy office building is one that with its material and immaterial qualities promotes the complete well-being of the users"* [12].
To support the health and well-being of patients and people -including staff and visitors of hospitals- is the final purpose of a Sustainable Design for Hospital. For this reason the function of the Hospital promoting Health and Well Being should be optimised and supported by a patient-focused design.
According to the frame of design adopted for the realisation of Healthy Universities and Healthy Offices, analogous design criteria should be used for the realisation of Hospitals promoting Health and Well Being.

4.3.3.1 Physical and Psychological Well-being: Case-studies

Here the two examples are taken of the 'Healthy Universities' and 'Healthy Offices'. In 'Health Promoting Universities' it is stated that the aim of a 'Healthy University' is *"protecting the health and promoting the well-being of students, staff and the wider community"*[11]. In 'Healthy Office Buildings' [12] a definition of the 'healthy office' is given in the following way: *"a healthy office building is one that with its material and immaterial qualities promotes the complete well-being of the users"*.
But two types of well-being are necessary to produce the 'complete' well-being of the occupants, physical and psychological well-being. On the one hand the *"technical parameters of architecture (thermal comfort, ventilation, lighting, etc.)...directly influence the human body and physical condition"* [12]. On the other hand the *"perception of architectural spaces"* influences *"the mind and primarily mental condition"* [12].

Two categories of components are necessary to the fulfilment of the 'Healthy Office'. The first category concerns objective environmental factors (temperature, air moisture, noises, intensity of light, air quality, etc. creating the conditions for 'physical' well-being). The second concerns emotional factors influencing 'psychological' well being. For example, a 'Healthy Office' is realised at *'human scale'* and it includes the contact with *'natural environments'* (like light, plants, water, variety of views) [12]. Its components support the well-being of the occupants in relation to the natural and the built environment.
The aim of the healthy office is a *'user-orientated'* design, that is also *'integrated with other function'* supporting the psychological well being of the user. Its design is concentrated both on the 'individual' and the 'environment (natural and built)'. Finally, he healthy office is *'dynamic'* in space and character [12].
The statement of the researcher asserting that *"perception of architectural space influences the mind and primarily mental condition"* [12] underlines the relevance of 'perception' in building design as conjunction between environment and individual.

4.3.4 Living Standards and Arts in Hospitals: Case-studies

Owing to the opportunities given by today's advanced technology and by higher living standards, improved comforts and modern technological means are offered in every area of life. People also demand improved comforts and the increased use of modern technological means in hospitals. This happens for example in the case of the application of arts in hospitals, which has recently been taken into consideration in different countries (e.g. in United States and in England).
A painter of Rosedale (N.Y.), Robert Selkowitz, created a series of prints for hospitals titled 'Therapeutic Images' [14]. *"They inspire and soothe the spirits of all who view them in the hospital environment, without impact on the budget of the hospital"* says the painter. Some of these images have been used by the Kingston Hospital in the Hudson Valley (N.Y.).
The same painter also acted between the local arts community and the hospital to acquire 74 original works [13]. *"My personal experience"* Selkowitz says *"is that (art) is often overlooked and that after the carpets and window treatments are installed, the walls remain barren or are decorated with an afterthought of color-coordinated prints of no significant appeal. It doesn't have to be this way"* [14].
Various experts approve of this type of initiative. The presence of arts in Lehigh Valley Hospital was emphasized in a recent essay [15], where it is reported that 28 sculptures from a donation were placed in the hospital's gardens. Elliot Sussman, president of Lehigh Valley Hospital, was also interviewed about arts in hospitals. *"Art humanises the hospital environment"* he says, *"it takes the place of enormously complex technology, where a lot is happening at breakneck speed, and provides respite. Patients so often have little to focus on but themselves, inside a very sterile environment"*.
Initiatives to support the introduction of arts in hospitals have been taken in London where the 'Helping to Heal Exhibition' was organised by Arts For Health. In this situation it was stated that *"arts were a vital part of the initial brief"* of St.Mary's Hospital of the Isle of Wight and of the Chelsea and Westminster Hospital. Photos and other material concerning the use of arts in hospitals were exhibited, giving a modern idea of hospital configuration.
D.Fine co-ordinator of the Health Research Institute and Hallam University of Sheffield was also interested in arts in hospitals. Sustaining the opinion that ease and comfort support patient healing, he asserted: *"how people feel and behave is affected by where they are, and a positive environment helps patients to recover more quickly and easily"* [16]. He also asks this question: *"Would you feel comfortable in a bed room or a sitting room without any paintings, photograph, posters or decoration?"* [16]. Referring to arts in hospitals and promoting the realisation of 'healing environments' he finally states: *"why should hospitalisation deny patients theatre, dance, live music and literature?"* [16].

Accustomed to the improved comforts at home and in public places, people can better appreciate the quality of our environments and of their components. The configuration of hospitals is also going to change probably for this reason, taking on more modern patterns. It is stated that a modern hospital *"no longer appears as a monolithic edifice to both patients and staff, instead it becomes a warmer and friendlier place"* [16].
The presence of decorations, paintings and sculptures creates less stressful environments of human dimension. This kind of component should be integrated in hospital design to produce a familiar relaxing atmosphere and home-like environments against the traditional stereotyped environments of hospitals, faulted for being *'cold'* and *'dismally inhospitable'* [18] (3.2 Quality of life and well being).

4.3.4.1 Quality of Life and Hospital: Case-studies and Planetree Model

It is reported in U.S.News & World Report (July 1991): *"Most hospitals are dismally inhospitable. A weakened patient and traumatized family are greeted by harsh lights and cold stainless steel, labyrinths of white corridors, thumping equipment, and acrid mysterious smells. The sick rarely have access to information, privacy, or a place for quiet talk and grieving. The resulting sense of anxiety and helplessness is the worst imaginable to promote healing"* [18]. Bare walls and white corridors, typical smells and a typical atmosphere remind the patient of the typical environment of hospitals connected with pain and disease. Alternatives have been created in hospital history to produce more familiar environments (3.1.3 Conclusion of 'Hospital building in History'). This still happens today in the realisation of the more hospitable environments of private clinics and special hospitals.
Built on the basis of Steiner's theories the Community Hospital of Herdecke (D) includes special activities for the patients and comfortable home-like environments.
Since 1978 the 'Planetree Program' was promoted the comfortable home-like environments of the Planetree model of hospital based on the realisation of familiar environments and a patient-focused design (4.3.1.1 'Mall' type of Hospital and Activity within healthcare).
An interesting study was recently carried out by researchers to ascertain the validity of this model. Two different sections of the same hospital were compared: an older section realised in the traditional configuration of hospitals; and a 'new' unit refurbished according to the Planetree Model. The enhancements realised in the new unit were mostly focused on fulfilling patients needs and to support their comfort as is explained: *"operating on the premise that the hospital environment is an important factor affecting health, the unit is designed to create a pleasant and soothing atmosphere for patients. Rooms are decorated in bedspreads, paintings, and plants to create a home-like atmosphere in contrast with the stark and antiseptic look of typical hospital rooms"* [17].
At the end of this study the renewed section of the hospital received the approval of the patients. The researchers asserting: *"data indicate strong, if not unequivocal support for the role of the physical environment in creating a more supportive hospital environment for patients, staff and visitors"* [17]. This unit finally resulted as being *"significantly more positively than the unrenovated unit"* [17].
The success of this Model was motivated as follows: *"the Planetree model is a small but growing approach to hospital care which views the physical environment as central to patient-focused care"* [17]. The realisation of a patient-focused design now is reminiscent of the purposes of the 'Healthy Office' that is also based on a user-orientated design (4.3.3 Prevention Policy and Sustainability in Buildings). As in this case, the 'healthy' Office and University were directed exactly at the realisation of a home-like atmosphere, promoting the 'complete' well-being of the users. It is possible to deduce that environments and well-being are supposed to be indispensable ingredients for the fulfilment of design in different circumstances. These types of enhancements that people actually approve and now expect in various areas of life seem the

obvious consequence of improved living standards. The consent of the people represents the driving impulse existing behind identical proposals from many directions.
The increased demand from the people for comforts is confirmed by the recent realisation of some extremely luxurious hospitals in the United States. There are cases in which extraordinarily rich environments and a high level of comfort has been supplied in health care structures (8.2.1 Present Experience: Planned and Built Examples). These cases testify to the increasing demand for every kind of comfort, that is in this case the realisation of luxurious environments and prestigious decorations. However, an excess of luxury seems like a paradox in a context of health care, where practical concrete problems of assistance and management are uppermost.
Positive evaluation has also been given in the case of the luxurious decoration provided only on one of the floors of the American hospital John Hopkins. This mostly focused on the influence produced on the patients by the refurbishment of this hospital. Toby Gordon as John Hopkins' vice-president of planning and marketing asserts: *"the floor fills the need and produces benefits that ultimately help all patients"* [19], while it represents a *"voiceless paging system that eventually can be applied throughout the hospital"* [19].
To modify the negative impression patients have of hospitals, alternatives should be created for the conventional environments of hospitals. The expectation for higher living standards is manifested through the various initiatives taken to create alternative models of hospitals.
If on the one hand there are conventional and 'institutional' hospitals, on the other there are now a number of alternatives for hospitals and 'excessive' examples like these.
Designers should take into considerations the purpose that is behind these new trends in order to support patient well-being by means of a patient-focused design (4.1.3 Prevention Policy and Sustainability in Building).

4.3.4.2 Perception of Hospital Environment

The advantage of positively impressing patients by means of design has often been considered a component of patient healing (3.1.3 Conclusion of 'Hospital Building in History'). Not only in the past, but also in the present. R.Miller and E.Swensson from FAIA assert that *"scientific studies argue that emotional stress tends to exacerbate physical illness, whereas environmental factors that contribute to a sense of emotional well-being tend to ameliorate physical conditions"* [2].
Recent research reports that small enhancements in hospital environments produce better results than bigger changes in structural components. Lighting and decoration, new furniture, materials and colours of floor and wall coverings, even the presence of green plants were demonstrated to produce benefits for patient healing and well-being [17]. A. Sloan Devlin, professor of Connecticut College, asserts*: "studies have demonstrated that modest changes in decor, furnishings, and even the arrangement of furniture can have therapeutic effect"* [17]. In his opinion it also seems that there is *"mounting evidence that the environment has a therapeutic role for hospital patients"* [17]. There are however opposite opinions concerning the influence produced by the components of our environment on the individual.
Contrary to what other researchers sustain, Herzberg, Mausner and Snyderman expressed the opinion that the environment is *"capable of producing dissatisfaction but not of creating satisfaction"* (1959). According to his statement, the components of the environment are only able to exercise a negative influence on the individual. This means that the requisites of the environment are considered able to affect individuals anyway, even if only negatively. Referring to the two contrasting opinions, A.Sloan Devlin states at the end: *"thus continues to be important to demonstrate that the environment does, indeed, make a difference"*. If the components of the environment do however influence the individual, the two possibilities exist also in the case of

hospital design. The conventional configuration of hospitals has been faulted by people. Alternative models of hospital are at present emerging that seem to receive people's approval. As a consequence, it is possible that design can incorporate some positive components from these new models in order to improve the traditional configuration of hospitals.

4.3.5 Conclusion of 'Hospital Design and Function'

Hospital buildings are changing in their role and function. New models of hospital recently realised in the United States show the most important changes currently influencing hospital design. The *Mall Model* of hospital takes the reality of every-day-life into hospitals, supporting 'continuity' with what exists in life outside of the hospital. In the Mall, the patient is a 'client' and a 'consumer'. The shopping area answer the needs of various categories of people in different circumstances responding to speed of modern life.
The particular configuration of this Model allows a number of advantages in planning. It suggests establishing the main traffic lines within the building according to the shop displays. It allows establishing crucial points for way-finding and information. It supplies flexibility of spaces within the Mall that can eventually be destined to other needs emerging over time.
In the *Hospitality Model*, the patient is considered 'guest' and the building looks like a hotel. It is comfortable in configuration and atmosphere. Patients and their families can benefit from services usually found in a hotel (for example laundry, restaurant, accommodation for the family, etc.).
The *Residential Model* humanises the quality of hospital care. It supplies the patients with closer assistance and information. Its configuration has the characteristics of a home-like environment (for example decoration and painting, soft illumination, comfortable home-like atmosphere). Patients' rooms are more hospitable and offer privacy to the patient. Kitchenettes and bookcases are available according to the user's necessities.
The three models have the common intent of focusing different initiatives on the patient. Supporting 'activity' and the fulfilment of patient-focused design, they promote the psychological and physical well being. They introduce some 'fun' and the reality of every-day-life into hospitals, familiar and comfortable atmosphere. These hospitals are 'dynamic' structures open to various categories of people and mostly to a large number of out-patients. They can be considered competitive with other categories of public buildings. Compared to the 'Healthy Offices' and 'Healthy Universities', many affinities exist between the requisites of these buildings and the new categories of hospitals. The fulfilment of a 'Healthy Office' or of a 'Healthy University' depends on specific components of design focused on optimising the relationship between the individual and environment. In a 'Healthy Office' the 'complete' well-being of the user includes psychological and physical benefits. Promoting contact with a natural environment, its configuration is realised on a 'human' scale, its atmosphere is familiar but varied to the occupants. Its design is 'user-orientated' and integrated with other activities. The building configuration becomes 'dynamic' in space and function.
Similar characteristics are also fulfilled by the three models of American hospitals.
The well-being of the users is the aim of a 'Healthy Building' and the perception of the natural and built environment assume a relevant role in the accomplishment of various categories of buildings. The determinant role of perception often assumed in the past in the architecture of buildings and hospitals, has been re-established (3.1.1.1 Temples and Healing places, 3.1.3 Conclusion of 'Hospital Building in History', 4.3.3.1 Physical and Psychological Well Being: case-studies).
Many attempts have been made to improve the standardised environment of hospitals also by supporting the positive perception of the built environment (for example by means of arts in

hospitals, the introduction of modern components of design, the application of natural relaxation systems, shopping areas and activity).
The Planetree organisation as well as other 'special' hospitals sustain the benefits and the positive impression given by the appropriate configuration of hospitals. The Planetree Model receives the approval of patients, experts and researchers.
On the one hand there are experts debating the therapeutic role of the environments in hospital buildings. On the other hand other experts sustain that it is possible to influence positively patients' approach to hospitals by creating the appropriate environments in hospitals. There are finally other researchers who sustain that it is possible only to avoid the negative impression given by specific environments. These points of view however support the need to avoid the negative impact given by the environment on the patients.
As estimated by Anthony Lehman -professor of psychiatry and director of the Center for Mental Health Services Research at the University of Maryland School of Medicine in Baltimore- there is an emergent interest in the quality of life which concerns also health care. In quality of life *"is the fundamental question about what difference medical treatments really make in people's lives, reflected by the well-known medical aphorism 'the surgery was a success, but the patient died"* [20] he states. The support of quality of life, he sustains, *"serves as an example within the broader context of any chronic and debilitating illness"* [20].
In conclusion, if the traditional model of hospital is actually obsolete and if it is possible to introduce improvements in hospital design, an alternative model of hospital should be planned which is also based on the previous considerations.

4.4 Hospital Design and Designers Responsibility

Several types of medical equipment and technological systems, chemicals and radioactive products and gases are used in hospitals. The buildings include activities not only related to medical care, but also to its support such as registration and administration offices, kitchen, laundry and disinfecting, patients' rooms and other ancillary services supporting the needs of in-patients and out-patients (waiting rooms, toilets, coffee shops, etc.). Various professions should therefore give their contribution in the design and function of hospitals. Expert designers and technicians contribute to hospital design and function, integrating different aspects of design into the same project.
Designers have an increasing number of tasks related to the prevention of different hazards (4.1.1 Risks affecting Environmental Conditions) requiring special prescriptions. There are for example risks deriving from sophisticated systems such as air conditioning and electricity (in operating theatres, neonatal units, etc.), management and design for fire prevention or explosion due to the presence of gases, biological laboratories making use of radioactive and toxic products and so on. Specific structural requisites and furniture are required in the various medical cabinets for diagnostics and therapy. For a series of reasons hospital designers have to face single complicated aspects of the same project and plural risks. Structural design and the various technological systems are studied by different experts usually working in parallel towards different aims of one project.
The acknowledgement of a series of facts is now indispensable to producing efficient hospital buildings. Awareness of risks is needed against the background of increasing specific regulations. Designer should better combine the large range of factors today that influence hospital design. It was stated in Hospital Function that designers have the opportunity of

including 'positive' components of design as well as materials and resources (1.1 Causes of Health Risks in Buildings) in order to produce more 'positive' models of hospitals. This means that designers can improve the Function, Environmental Condition and Configuration of Hospitals.

4.4.1 Design Misfits and Risks

Poor maintenance and/or inadequate ventilation systems are sometimes responsible for producing poor air quality and/or diseases in hospitals (4.1.1.1 Sick Hospital Syndrome, 4.1.1.2 Risk of Disease: case-studies). Pest infestation is *"favoured by certain constructional features and commonly occurring faults"* depending on building design as in case of successive renewals of the building (4.1.1.3 Risk of Pest Infestation: case-studies). A number of misfits are attributed to design and maintenance of hospitals producing physical discomforts and health disturbances or disease in people. Uncomfortable thermal conditions, light level and noise, the presence of physical pollutants and biological agents (4.1.1.1 Sick Hospital Syndrome: case-studies, 4.1.1.2 Risk of Disease, 4.1.1.3 Risk of Pest Infestation: case-studies), emissions from building materials (4.1.1.1 Sick Hospital Syndrome: case-studies, 4.2.1.4 Risks, Design and Hospital Activity: case-studies) are some of the factors which produce discomfort in hospitals.
Too many situations affecting hospital environments are determined by failings of design and maintenance. The architect and hospital planner Seymour Remen states: *"we see many projects that are wrongly and wastefully conceived: engineering systems that fine engineering talent would never recommend; nursing units so separated either horizontally or vertically as to leave no hope for efficiently utilising nursing and support personnel over three shifts. As planners, we invariably inherit some of those problems which are recent, and which cannot be reversed. But perhaps they can be ameliorated"* [37].
On the basis of the above facts designers and builders should contribute to the prevention of many risks related to building and environment by taking appropriate measures in design, realisation and function of hospitals.

Conclusion of Present Factors influencing Hospital Design
Chapter 4

Failings have been recorded which affect the environmental conditions of hospitals in connection to building design. They make it possible to identify what kind of enhancements could be introduced to the design of hospitals in order to improve their environmental conditions.
Failings have also been recorded which affect the environmental configuration of hospitals in order to identify what kind of enhancements could improve the configuration of conventional hospitals.
At the same time the changes have been studied at present influencing health care and hospital design in relation to the function of some newly built hospitals. They make it possible to identify the kind of positive enhancements to be introduced to the function of conventional hospitals.

1) FAILINGS AFFECTING THE ENVIRONMENTAL CONDITIONS OF HOSPITALS

The studies carried out on the S.H.S. show lacks in the requisites of the indoor environments (for ex.: deficits in lighting, presence of noise, poor microclimate and quality of the air, etc.). A series of health risks affects the indoor environments of hospital buildings. They are mostly due to the presence of pollutants from roads, building materials and hospital activities. But biological risks also derive from poor cleaning and maintenance or other misfits in building design concerning ventilation systems and microclimate, inadequate building techniques and materials. Misfits occur sometimes in the design of hospitals contributing to specific situations of risk. Consecutive refurbishment and structural changes in hospitals can produce misfits in the building design, thus promoting pest infestation. Poor maintenance and cleaning, defects of ventilation systems were mostly responsible for various situations at risk. These are added to further hazards related to hospital activities.
Well-being is strictly related to physical environmental conditions. The quality of hospital environments should be ameliorated from different points of view, for example, by the optimisation of microclimate, quality of air, light and illumination. Risks connected to the environment, such as biological risks and any potential hazard should be taken into consideration in hospital design. Awareness of these risks is needed to fulfil this aim.

2) FAILINGS AFFECTING THE ENVIRONMENTAL CONFIGURATION OF HOSPITALS

Misfits of design mostly derive from the several adaptations of these buildings to quickly evolving social, scientific and technological progress. Usually the *"physical growth is architecturally not compatible with the initial project"* [23], says Mikho, supporting the opinion that hospitals are traditionally susceptible to change. These changes have been more frequent in the last decades. The quick development of technology produced in fact an increase in the industrial production of items to be used in every activity of life (this happened for example in the case of computers and software). In health care, medical equipment and specialised furnishing material were also introduced into hospitals. *"Hospital and health care facility design should be sensitive to and responsive to the marketplace"* [2], the experts assert, supporting the opinion that these buildings should be competitive also by applying modern means and technologies to avoid becoming obsolete quickly. But to be competitive hospitals should be flexible in every sense that means in function and configuration.
The impossibility of applying refurbishment and changes has been recorded (functional, structural and technological) against the background of the difficulties related to the limited design of the conventional hospitals.
The hospital designer Mikho asserts that the plan of a hospital should consent later additions and changes. In the planning of hospitals *"a final size or form is not essential"* he says and *"at the beginning only the direction and the level of growth are decided"* [23]. The future changes and/or eventual extension of the building structure and of technological systems should be according to some starting ideas contained within the original project. In this way the final results would be coherent to identical leading-criteria connecting postponed phases of the same project.
Not only building flexibility but also way-finding recently appeared as one of the most relevant faults of conventional hospitals. Lack of way-finding was often complained of in the large conventional hospitals. This also depends on the recently increased number of activities. Prompt information should be given to visitors and patients. The multifunctional structure of modern hospitals should correspond to the fast life-style and the modern components of design proper of other modern public buildings. Signs, images, colours should be combined in

the application of way-finding, at the same time supporting the modernisation of the criticised 'white' environments of hospitals (4.3.4.1 Quality of Life and Hospitals).

3) CHANGES IN THE FUNCTION OF HOSPITALS AND IN HEALTH CARE

New typologies of hospitals (Mall Model, the Hospitality Model and the Residential Model) offer familiar atmosphere, 'less stressful environments' and patient-focused design. Particularly, these hospitals intend to 'humanise' the quality of patient care, introducing a kind of home-like assistance and home-like components as in the environmental characteristics (for ex.: furniture, illumination, decoration, objects to use, etc.). To de-stress the patient is one of the aims of hospitals that finally support the participation of the patient in a number of activities. Special initiatives are taken in this sense and spaces are supplied providing a variety of opportunities. The patient can socialise or practice individual activities (such as reading, listening to music, etc.). Suitable spaces grant privacy to the patient and to his family (for example 'espace famille' and 'espace de deuil') (5.3.1 New developing Categories of Hospitals).
According to a patient-focused design, the patient's needs are closely taken into consideration. He is considered sometimes as a 'guest' of the hospital (Hospitality Model), sometimes as a 'member of the family' (Residential Model), sometimes as a 'consumer' and 'client' (Mall Model).
The 'reality' of the every-day-life is brought within the building of the Mall Model. Here it is possible to buy different and useful items. The patient can find 'interest' and 'amusement' in the commercial area, provided by the display of items and shops, the chance given just by watching people. 'Activity', intended as physical or psychological creates less stressful conditions of life in hospitals. This Model in practice introduces the new role of patient-consumer, the de-stressful function proper of this space, the possibility of transfering some 'reality' of every-day life into hospitals, the promotion of 'activity and amusement'. Other advantages are provided by this model such as the competitive aspect of a modern structure, the increase of flexibility, the supply of utilities for a large public (in- and out-patients, staff and visitors). This Model is compared to the modern pattern of other public multifunctional buildings, recently built all over the world, where shopping areas, coffee-shops or restaurants are usually annexed to a modern building. It finally gives a modern impression of the health care structures.
Some 'psychological' and 'physical' activities are promoted in these newly built hospitals. The patients can profit of a range of opportunities, depending on their personal preference and compatibility with his physic condition. A range of possibilities is provided, for example verbal activities, music-listening, watching movies, playing computer-games or reading. For the patients allowed to move, appropriate spaces are provided for physical exercise supporting rehabilitation, health and prevention of diseases. The new issues in healthcare are in fact prevention, activity and patients well-being. To do at least a minimum of physical activity has been suggested to everybody in the prevention and in the cure of different diseases.
The increased request for natural therapeutic means and products not only in health care but also in every activity of life is evident. There is also a renewed application of natural means of therapy documented by the realisation of special newly built hospitals, or better special clinics, based on the use of natural cures. In these places homeopathic therapies and physical activities support health care and prevention, well being and fitness.
A mounting belief regarding the positive contribution of prevention is evident. From this standpoint, patients should directly support their own health by *"taking responsibility for their own health-care"* [10]. They are becoming 'protagonists' in the matter of health care. Some newly built hospitals have already introduced activities dealing with health and prevention.

A higher level of quality is also required from the different points of view, since hospitals now correspond to a model of a structure quite obsolete in style and environment. The individual and particular condition of the patients (but also of staff and visitors) should be taken into account in designing towards the fulfilment of physical or psychological well-being. The environmental components of a hospital are often supposed to influence positively patients attitude towards healing, though this is still debated. If some experts sustain that 'our environments are able to impress a negative influence', other experts assert that 'a positive influence can be impressed by determined characteristics of our environments'. On this basis, it is easy to think that something should be done any way: the criticised conditions of hospitals should be changed. If the environment can have a positive or a negative impact on our psychological condition, more positive environments should be produced in hospitals.

Summary of Chapter 4

CHANGES influencing **HOSPITAL FUNCTION**
FUNCTION OF HOSPITAL
(hospital like a hotel, hospital like a mall, etc.)
FUNCTION OF THE PATIENT
(patients assume a more active role and take responsibility for their health)
FUNCTION OF HEALTH CARE
(prevention policy, physical and psychological well-being of the patient)
FUNCTION OF MEDICINE
(use of natural therapeutic means, promotion of physical activity)

FAILINGS affecting **ENVIRONMENTAL CONDITIONS OF HOSPITALS**
PRESENCE OF PLURAL RISKS
(owing to improved technology and increased activities)
PRESENCE OF MISFITS IN DESIGN AND MAINTENANCE
(owing to lack of information and specific education)

FAILINGS affecting **ENVIRONMENTAL CONFIGURATION OF HOSPITALS**
LACK OF FLEXIBILITY
(structural, technological, functional)
LACK OF MODERN COMPONENTS OF DESIGN
(means for information and way-finding, comfortable configuration and transportation means, etc.)

Conclusion Part II

Hospital Design: Past and Present Considerations

CHANGES AT PRESENT INFLUENCING HOSPITAL DESIGN REGARDING FUNCTION

PREVENTION POLICY IN HEALTH CARE
(supported by means of information and traditional therapeutic principles)
SUSTAINABLE DESIGN PROMOTED BY THE W.H.O.
(promoting physical and psychological well being)
DIFFERENT ROLES OF THE PATIENT
(consumer, client, guest, 'member of the family')
DIFFERENT ROLES OF HOSPITALS
(various proposals are recorded of hospitals like hotels, residences, mall)
SOCIAL INITIATIVES AND ACTIVITY PROMOTION
(patient as active protagonist taking responsibility about his health)
PROMOTION OF PHYSICAL ACTIVITY
(either in health care or prevention)
PROMOTION OF NATURAL THERAPEUTIC MEANS
(supporting prevention, therapy and healing)

COMPONENTS CONSTANTLY INFLUENCING DESIGN REGARDING ENVIRONMENTAL CONFIGURATION

PRIVACY
FAMILIAR ASSISTANCE
HOME-LIKE FAMILIAR ENVIRONMENTS
POSITIVE PERCEPTION OF THE ENVIRONMENT
NATURAL INGREDIENTS SUPPORTING PATIENT'S HEALING
(fresh air, sun, green spaces)
STRUCTURAL FLEXIBILITY
LAY-OUT OF HOSPITAL FUNCTION AND CIRCULATION
ISSUES PROVIDED BY PROGRESS
(social, scientific and technological)

ASPECTS AT PRESENT INFLUENCING DESIGN REGARDING ENVIRONMENTAL CONDITION

PRESENCE OF RISKS INVOLVED IN HOSPITAL ACTIVITY
NEED OF CO-ORDINATION OF PLURAL ASPECTS OF DESIGN
(depending on the presence of plural activities and technological systems)
PARTICULAR RESPONSIBILITY OF DESIGNERS, BUILDERS AND TECHNICIANS
(general and specific information should be supplied)

Constant Influence of Progress on **Hospital Design**
Inadequacy of Hospital Design **to Progress**
Specific Responsibility of Hospital Design

Final considerations

Recent rapid Progress has determined substantial changes in the function of hospitals. Sporadic proposals emerge from the newly built hospitals in the U.S.A. New concepts of 'hospital', 'patient' and 'health care' have been recorded, mostly deriving from the new policy of prevention and well being.

The aim of this chapter was to identify which factors at present influence hospital design (in Function, Environmental Condition and Configuration) on the basis of the changes taking place in hospitals. On the one hand complaints of different nature were recently recorded concerning traditional hospitals, which look *'dismally inhospitable'* and *'cold'* (4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree Model). On the other hand, some newly built hospitals in the U.S.A. have won approval from various categories of people. There are newly built hospitals (4.3.1 New developing Categories of Hospital: case-studies) which look like hotels or residential buildings. Home-like atmosphere and confidence are emphasised by their home-like environments where people can find habitual characteristics (furniture, decoration, type of illumination, etc.). Here, the institutional aspect proper of a conventional hospital is eliminated. These buildings look like other public buildings which are part of everyday life. They are mostly visited by out-patients requesting only ambulatory cares. The presence of a large entrance hall and services proper to a hotel make the patient feel like a 'client' instead of 'sick'. The new typologies of hospitals realised in the U.S.A. sometimes look like hotels, sometimes like residential buildings. They offer a series of facilities (like shopping areas, restaurants, accommodation for the family etc.). Practically built 'at human dimension', they 'humanise' the quality of the assistance and create a less stressful approach of the patient to the hospital. Every-day reality is brought within their buildings by the introduction of activity. Here the patient takes on different roles, being considered a 'guest' or a 'client' or a 'consumer' and sometimes 'a member of the family'. A higher level of privacy is achieved in these modern hospitals if compared to conventional hospitals. Patients can socialise or practice activities according to their preference. They also result motivated by the presence of 'initiatives' like cooking or reading or visiting the mall. It doesn't matter if they can or cannot move, there are physical and 'psychological activities'. Physical activity is more often included as a component either for health care or prevention of diseases. The famous Roman aphorism 'mens sana in corpore sano' seems to be still valid. A minimum of physical activity is in practice considered a support for the cure and prevention of diseases. On the basis of the new prevention policy and the increased awareness of people about disease and health, patients are finally supposed to 'take responsibility' for their health conditions.

Patients' well-being becomes a relevant item of hospital design for the realisation of Sustainable Hospitals. Individual well-being is fulfilled in design according to the new issues dictated by the W.H.O. about the realisation of Sustainable Buildings (2.3.2 Quality of Life and Well being). Various examples have been reported concerning other categories of public buildings conceived as Sustainable. In these buildings, not only the physical but also psychological well-being is included in design. The requisites of building configuration and function are becoming the focal objective of Sustainable Design in accordance with the following statement asserted by the W.H.O.: *"environments are not just the visible structures and services surrounding us but have spiritual, social, cultural, economic, political and ideological dimensions as well. Furthermore, all the different facets of life are interwoven and inseparable"* [1].

The Center for Health Design in U.S.A. states: *"our aim is creating a future where the built environment supports the highest level of human health, well being and achievement in all aspects of life and work"*. Some researchers sustain that the presence of appropriate environmental components in hospital design positively influences patients' healing. Other researchers sustain that the environment can only influence our psychological condition, though its impact can be either

positive or negative. At this point designers have to choose between the two opposite opinions… What is certain is that hospital design should integrate alternative components to improve the conditions complained of in 'Current Hospital Conditions' (Part I).
Patients' well-being is strictly related to the physical condition of hospital environments. A series of physical conditions should be improved in design not only regarding building and furnishing components. The environmental conditions should be improved mostly in regard to microclimate, quality of air, light and illumination. Misfits have been recorded in the design and maintenance of hospitals. Uncomfortable situations should be prevented in design as well as any potential hazard likely to be found in hospitals in relation to various activities. Healthier conditions of life should be created in hospitals by increasing the use of natural ingredients and by adopting appropriate technologies in building.
The complaints of designers regarding hospitals suggest including criteria supporting the structural and technological flexibility of the building. Typologies applied in history which included potential for flexibility are still needed in hospital design. On the basis of the constant adaptation of hospitals to issues deriving from social development (according to the evolution of technology and therapeutic means, the growth of the building itself), hospitals should be considered dynamic structures. Relative criteria should be integrated in design consenting refurbishment and changes coherent to the original project and the original idea of the whole. Hospitals are becoming 'high performance workplaces', expected to be competitive and 'responsive to the marketplace'. The introduction of modern items of design and means should be integrated in design according to the model of other modern public structures. The large public of hospitals and their plural activities suggest the introduction of way-finding and information systems as in every modern multifunctional public building. This makes these buildings competitive with other public buildings and reflects the fast style of life proper to the modern social context. Against the traditional 'white' and 'flat' atmosphere, colours and the 'reality' of the every-day-life should be introduced in hospitals, modern components of design (for example large glass-sheets and skylights, escalators and information systems, etc.). Images, decoration and relaxing pictures 'making sense' in the context of a hospital should be provided against 'white walls'. Alternatives like arts, sculptures or any other components should be introduced in design producing less stressful environments, establishing at last the 'human dimension' of hospital environments.
Systematic design and methodology is needed to co-ordinate different aspects of the same project by combining the single individual competence into one final product in order to avoid misfits of design and maintenance. Prevention should be supported by the authorities, by supplying hygiene propaganda and information to the people. The holistic collaboration of all target groups is necessary to the accomplishment of the hospital plan, to fulfil the quality of design at present and in future perspectives. This collaboration would also include the perspective of making economically convenient choices taking into account the pay-back out-come in relation to choices made about longer perspectives in terms of time. Not only the technological quality of the project should be provided, but also the quality of design should be improved in relation to Function, Environment Conditions and Configuration of hospitals. To approach hospital design systematically would produce the two advantages: to save time and money in the future, and to reach more positive results.
It results from History that Social, Technological and Scientific Progress have always influenced Hospital Design**. The** rapid development of Science and Technology, in addition to new Social changes, are often responsible of the failings **recorded in hospitals that are resulting inadequate to times.** For these reasons the changed registered in society should find appropriate correspondence in Hospitals.

Part III

Perspectives for the Enhancement of Hospital Design

"Health and hospital care have to be seen as a dynamic process" say some German experts in hospital design, *"dealing with emerging approaches to hospital care and hospital architecture means anticipating future development..."* [1].

Enhancements in Environmental Conditions

Chapter 5

Summary

On the basis of the facts reported in Parts I and II (1 Health, Environment and Building Design, 2 Hospital Design and Building Environment, 3.1.1 Environmental Conditions and Configuration, 5.1 Hospital Design and Environmental Conditions, 4.4 Hospital Design and Designers Responsibility) designers, builders and hospital staff should contribute to promoting 'healthier' Environmental Conditions in hospitals.

Construction and design of the building involve various risks related to health and environment. Designers, builders and producers of building materials should collaborate for the prevention and elimination of these risks (1- Health, Environment and Building Design). The use of building and furnishing materials deriving from natural renewable resources is supported and promoted in the realisation of sustainable buildings. Designers and builders should in particular use appropriate technologies and materials in buildings.

The growing responsibility and sensibility for environmental and health problems has created a deeper awareness of the benefits of using renewable natural ingredients. People are interested in 'natural' and look for natural environments, products and means (4.3.2 Renewed Request for Traditional Therapeutic Means: Case-studies). The global situation has started at last to be classified within a frame of ecological concern and a policy of disease prevention (2.3.1.3 The W.H.O. and the new Prevention Policy). On the basis of these facts, criteria were established by the W.H.O. towards sustainable development (4.3.3 Prevention Policy and Sustainability in Building).

The well-being of the occupants of the building started to be the aim of design for different categories of public buildings (4.3.3.1 Physical and Psychological Well Being: Case-studies). A higher level of comfort and quality of life has been achieved by designers in accordance with the increased public demand of the use of natural products and means in different areas of life. Quality of life started to be measured from a different point of view. If previously people expected comforts in every activity of life (at home, in offices and in the social services), their expectations shouldn't be disappointed in terms of life standards. Rather the quality of life should be changed in an ecologically positive sense.

According to the assumption of 'natural' and of a 'healthier' life-style, people already appreciate natural products and means. This attitude introduced the more positive evaluation of life-quality based on the 'healthier' life-style.

The attribute of 'healthy' given first to the products and then to the building introduced new parameters in the building realisation as well as the new concept of 'sustainability'. Designers considered the possible disadvantages produced by short-sighted perspectives and by the choice of products, building technologies and systems which are not classified as 'healthy'. New criteria were adopted in planning and building towards sustainability and prevention of the risks related to the environment.

On the basis of the previous considerations, hospitals should be introduced into an appropriate framework of design consenting the production of hospitals in line with the production of other buildings. This would be possible by integrating into hospital design the criteria already applied in buildings to prevent risks and diseases, and to improve the impact of the building activity on environment and ecology.

The Choice of the Site, the Use of Clean Technologies, the Appropriate Building and Furnishing Material and the Improved Quality of Design are considered the factors capable of improving the Environmental Condition of hospitals.

5.1 Choice of the Site

The growth of cities has transformed the conditions of life that people were used to until thirty years ago. The existence of mega-cities all over the world has given rise to a series of anomalies in the natural environment such as the increase of air pollution recorded in the last decade, which is mostly due to heavy traffic. The effects produced on health by electromagnetic fields are being investigated by researchers all over the world in relation to wide-spread use of electrical equipment seriously suspected of affecting our health (1-Health, Environment and Building Design).
The existence of hazards influences our environmental conditions and health. The Sick Building Syndrome (S.B.S.), traffic and industrial production, a number of factors related to building and environment contribute to the increase in health disturbances and diseases (1-Health, Environment and Building Design). A close correlation exists between building design, environment and health risks. Appropriate measures are being taken in planning against these risks (1- Health, Environment and Building Design) and the supply of fresh air is one of the measures recommended by the experts to counter plural factors producing indoor pollution (1.2 Conclusion of Chapter 1).
Patients and hospital staff, apart from being influenced by the identical problems of the S.B.S., are also affected by other risks more strictly related to hospital activity and the Sick Hospital Syndrome (S.H.S.). In relation to these facts, the designers of hospitals should take into consideration the choice of an appropriate site for a hospital (2- Health, Environment and Hospital Design).

5.1.1 Increase of Natural Components

From the Middle Ages on, hospitals started to be realised in city centres. This was mostly to create a direct connection between patients and hospitals. However a series of complications now affect the modern proportions of cities: heavy traffic and overpopulation changed standards and the quality of life. On the one hand, distances and traffic have increased, as well as the affluence of people to the hospitals. The demand for large parking areas and the intensity of traffic jam are in direct contradiction to the idea of having hospitals in city centres. On the other hand, the development of modern means of communication and transportation gives people the chance to be in contact with one another and to move according to their own individual means and preferences. The result is that contacts have become easier.
In the early hospitals, the fact of being built in a wonderful place represented an indispensible component of hospitals as well as providing sun and fresh air. Now the importance of contact with nature and a peaceful scenario has been lost. The healthy environmental condition of hospitals in ancient times, which was then included as part of the therapy has been lost over time. 'Traffic noise' is offered instead of 'natural sounds' and patients breathe 'smoky air' instead of 'fresh air'.
In one of the numerous studies carried out in hospitals on the Sick Hospital Syndrome, the researchers complained of the proximity of the hospital from the traffic (4.2.1.4 Risks, Design

and Hospital Activity), asserting: *"the quality of inside air is strongly dictated by outside pollution, the latter mainly depending on hospital position with reference to automotive sources"* [2]. They propose the restriction or abolishment of automotive circulation in the hospitals neighbourhood as the only "*immediate and inexpensive countermeasure"* [2] against the problem of indoor air pollution and noise. They underlined also the importance of fresh air in hospitals as *"a factor of major concern with respect to its sanitary relevance affecting well-being of patients, working performance of hospital staff and safety of visitors"* [2].

The supply of natural ventilation is still stressed in design as it has often been during hospital history (3.1.1.4 The Issue of increasing Indoor Ventilation, 3.1.1.8 Constant Issues: Familiar Configuration, Structural Flexibility, ventilation). The obvious deduction from these considerations is that hospitals should be built at best outside the cities to re-establish the 'healthy' conditions of life that had always existed in hospital history (3.4 Conclusion of Chapter 4).

A natural environment creates healthier conditions of life, the introduction of fresh air and the presence of natural components such as green spaces and sun. Not only physical but also psychological benefits are provided by the choice of a natural resort for a hospital. A site that is connected to the natural landscape rather than to cement walls would, in fact, re-establish the contact between the individual and nature (4.3.3 Prevention Policy and Sustainability in Building). Not only for this reason, but also for the preference expressed by the patients to this purpose also and in order to increase the contacts with nature, the patients' rooms should have a window with view on the natural landscape (7.1.3 Patients Rooms, 7.1.3.3 Multipurpose Window).

In history, hospitals were often built in a green landscape. The Askleipeion, the monasteries, the open spaces of the hospitals built in the Renaissance surrounded by beautiful gardens testify to this fact. The Pavilion model of hospital was also built on a large site, consenting the realisation of new pavilions far from the road. This allowed the patients to have a 'view' from their windows on the natural surroundings. Contrary to the historical situation of hospitals integrated into a green landscape, it is quite usual today for a patient to have a view of cement and brick walls from the hospital window. Some research has proved that this doesn't support the relaxation and healing of the patients (7.1.3.3 Multipurpose Window).

To realise a hospital in a built up context implies inconveniences both for the area itself and for the patients, in fact: the patients suffer from the pollution, noise and traffic deriving from the built context; the social context bears the presence of a building of large dimensions, the movement deriving from many activities and pollution due to the many technological installations (1- Health, Environment and Building Design).

Hospitals are large public structures. They are dynamic in space and function (Conclusion of Part II). The preference of the designer for an open space as the site for a hospital, against the restrictions of city areas, includes also the possibility to realise further extensions and refurbishments of the building (4.2.1 Lack of flexibility). To develop the design of a hospital horizontally offers a number of advantages, including the reduction of stairs, elevators and lifts (3.2.1.10 The First Skyscrapers in the Twentieth Century, 3.2.2 Building typology).

In conclusion, on the basis of the above situations and the facts reported in Part I and II (1- Health, Environment and Building Design, 2- Hospital design and Building Environment, 3.4 Conclusion of Chapter 3, 4.1 Hospital Design and Environmental Conditions) it is possible to assert that hospitals should be built in green open spaces and low traffic areas near the urban context, but out of the city centre.

5.1.2 Principles of Feng-Shui

The ancient principles of Feng-Shui have influenced the activity of building in the east, mostly in China. It is nowadays the object of interest and study also for western countries and our community. Its principles suggest the way to live in harmony with the earth, the site of the building and its landscape, which can offer the best conditions for living [6].
Feng-Shui, which means wind and water, is the most common name to refer to the theory and practice of localisation of the sites which are in harmony with the natural elements [6]. The term more commonly used in the Chinese literature is however Ti-li which means lines and earth models, studied in the Chinese culture in relation to man and nature [6]. They are part of the study concerning the Earth, its natural models and the models created by man.
Feng-Shui promotes the benefits of creating a positive relationship between man and the natural environment in building and furnishing. Parameters and terms of reference are given to fulfil this aim, which include elements and animals proper to the Chinese tradition and culture [6]. But the factors which finally support the positive relationship between the man and the building are the site and the natural environment, the presence of water and its relationship with the building, the orientation of the building to the sun, the geography of the land, the disposition of the furniture within the building etc.
The advantages produced by supporting the positive relationship between building and site (5.1.3 Requisites and Prerogatives of the Site: Case-study) and the appropriate disposition of the furniture indoors (1.1.4 Electrical Pollution) are today often supported by researchers and designers in building. These facts should be taken into consideration also in hospital design as explained below.

5.1.3 Requisites and Prerogatives of the Site: Case-study

The building area for a hospital is sometimes chosen on the basis of the availability of the land, the presence of pre-existent infrastructures, electrical ducts, sewer systems etc. Economic and political interests often profit from this kind of decision, in a context of various difficulties and circumstances which unavoidably influence the final choice.
There are often 'advantages' against possible or sometimes evident 'disadvantages', related to the choice of the site, which are often disregarded before the realisation of a hospital. Often designers only think of modifying and changing the site configuration, without considering what already 'does exist' in the matter of prerogatives and eventual failings. On the contrary, they should take specific profit from the site (depending on its morphology, land exposition and orientation, meteorological and geological characteristics, presence of a stream or a source of water, natural resources and beauty etc.). The local situations should be taken into consideration that are likely to produce advantages for people's health and environment. An adequate site for a hospital should mainly correspond to a 'healthy' place, a natural 'open' resort next to the city, allowing the design to profit from natural resources, such as local energy and materials, sun and green spaces, a special morphological configuration and natural beauty etc.
'La cité industrielle' for example, created by Tony Garnier at the beginning of this century, was planned to take advantage of the profitable configuration of the site. The model of terrace-hospital of the project was built in a quiet open area situated out of the centre of the city. It was extended in a natural landscape and oriented toward the sun, considered an essential ingredient for therapy. A steep configuration of the land was taken as a shelter for the building against the wind. The terraces of the hospital faced the sun, so that the patients could benefit from heating and light in addition to the fresh air.

Appropriate methodologies should be adopted in design to support the health and well being of the individual. Designers of hospitals should take advantage of the use of local materials (saving on transportation and maintaining cultural standards and habits), the use of natural energy (reducing the pollutants in the air), the presence of natural beauty (profiting from the natural resources, the physical psychological benefit of their presence and view), the requisites of the land (e.g.: profitable exposition to the sun, configuration, etc.).
In accordance to the configuration of the land and exposition to the sun, other conveniences can be obtained in terms of heat by sheltering the building from the wind, by avoiding openings on north exposed walls etc. The possibility of increasing natural illumination by means of design should be considered (e.g. by the use of glass-sheets and skylights, orientation and reflection of material, orientation and inclination of surfaces in relation to the sun light, photocells and solar technologies in the realisation of roof/prospects etc.) and to derive practical gains from specific meteorological conditions (on the basis of the economic return given by the storing of rain water, its re-use for toilets and gardens). Similar considerations should be made also to improve indoor ventilation, which could be done by taking advantage of the wind.
In conclusion, the empirical principles of the vernacular architecture (in the building realisation) and Feng-Shui (in the choice of the site) should be taken into consideration by designers, builders and researchers in the production of hospitals. The examples from ancient times and from the experience of more primitive cultures still suggest that various possibilities are available to improve the indoor environmental conditions in buildings (by means of natural ingredients and empirical expedients). Means like these have always been present in the history of architecture, regarding the building and realisation of hospitals (3.1.1.4 The Issue of increasing Indoor Ventilation, 3.1.1.8 Constant Issues: Familiar Configuration, Structural Flexibility, ventilation).

5.2 Application of Bio-Compatible Technologies

The continuity of hospital life makes these building function twenty-four hours per day. The advantage from the use of technologies for energy saving is, for this reason, proportional to two parameters: quantity and continuity of hospital activities. The continuity of the activities and the presence of a lot of electrical equipment and technological systems (fig.7) demand high energy consumes in hospitals while affecting health and environment. For this reason, the use of 'clean' technologies would produce economic and environmental benefits.
The example given by the production of sustainable buildings should be taken into consideration. Appropriate building technologies, renewable materials and passive systems already used in other categories of buildings, as for example in the complex of dwellings called Ecolonia in Alphen ad Rijn (NL), should be integrated into the plan of hospitals.

5.2.1 Realisation of Walls

Walls can be used to support energy saving. Exterior walls can have, for example, glass surfaces of various sizes and different level of insulation, consequently influencing indoor temperature and illumination. Technologies, materials and colours applied to their structure determine the proper requisites for passive solar systems.

There are possibilities of improving the indoor physical conditions of buildings by means of building walls specifically designed. Owing to their structural characteristics, requisites like thickness, building materials and layers of paint, they have the capacity to improve not only on the indoor microclimatic conditions, but also other parameters of comfort (such as for example acoustic insulation, reflection of illumination and effect produced by material and colour, etc.). A wall made of water tanks acts for example as heat storage. A wall painted black act as heat storage or transfer. Walls are 'means' to be used in passive systems (fig.8) as in the case of Trombe walls. The placing of creeping plants on wall surfaces can improve their insulation to a certain extent in winter and in summer.
Each part of the building should be seen in the perspective of being useful from various points of view, in order to gain any possible benefit, from its own capacities in addition to appropriate technologies.

5.2.2 Realisation of Windows

Windows are essential parts of the 'wall'. They make different contributions to the indoor temperature, ventilation and air moisture, according to their surface and number, material and manufacture. They are real 'tools of design' whose exposition and orientation can lead to great success or failure with regard to temperature and comfort. In addition to air change, they allow the elimination of particles and dust, radon radioactivity, emissions of chemical products and other pollutants.
According to their manufacture, they impact on energy consumption and can support energy saving. To this end, they can be sometimes reduced or even abolished on North facing walls. They introduce daylight and can be used to increase average indoor illumination. By the use of appropriate materials and according to their orientation, skylights and glass-sheets promote the energy saving and produce comfortable conditions in terms of temperature and light. They also make possible to create the right circumstances of light and warmth to consent plants to live and to improve the quality of the indoor environment (for the array) and microclimate (for the production of air moisture) Plants, illumination and warmth, by improving the quality of the building's environment, support patient well being (4.1.3.1 Physical and Psychological Well Being, 4.3.4.2 Perception of Hospital Environment). The appropriate use of windows, sky-lights and large glass-sheets should be taken into consideration in hospital design.
Different types of windows are in production today, which testify to the multipurpose functions they can have. There are special windows, such as the German 'Fachglass', allowing the production of electricity through the action of solar cells situated in semitransparent glazing. This further possibility, increasing the requisites of a window, saves electricity for illumination. This suggests their possible use in patients' rooms where the windows are usually oriented towards one direction. These rooms also have analogous conditions of light and space, with almost identical needs of illumination.

5.2.3 Realisation of Roofs

Roofs protect the lower levels of a building from the weather conditions, and are responsible for the interchange of the physical conditions between the outside and the indoor spaces. Their large surface is directly in contact with solar radiation, air and rain. Being a 'means of transfer' of large dimension, they offer at the same time more possibilities than other components of the building to profit from the weather conditions. By taking advantage of specific situations, roofs consent the storage of rain water and the growth of green plants. For

these reasons, roofs can have multipurpose functions beyond just acting as physical protection for the building.
They are made of different materials, built with different techniques and configurations, which have different aims. Often used in passive solar systems, they supply alternative solutions for energy saving as in the application of photovoltaic panels. They also supply thick insulation against heat and cold, and can be used for heat storage. With the realisation of sod green roofs, it is possible to give a further contribution to building insulation and the opportunity is given to recycle rainwater.
Skylights and roof-windows bring the radiation and light of the sun indoor, ameliorating the quality of spaces, mostly in the case of the gloomy areas directly underneath them. These spaces become 'special' places when a conservatory, a winter-garden or a roof-garden can be created on the top of the building.
By means of suitable materials and colours, insulation and building technology, roofs give a different contribution to the indoor environments in terms of temperature, microclimate, atmosphere and architecture. In practice they can improve the quality of the building design, by supporting the energy saving and recycling of rainwater, the realisation of comfortable places and the presence of 'natural' ingredients like sunlight, air and green plants. These facts should be taken into consideration in hospital design (4.3.2 Renewed Request for Traditional Therapeutic Means).

5.3 Building and Furnishing Material

Frequent maintenance and refurbishment support hospital activities and function, since hospitals are large public buildings, capable of functional changes (2.2.1 Limits of Design, 4.2.1 Lack of Flexibility). The choice of products should be carefully evaluated also in relation to this fact. When building materials and components are in fact repaired or replaced, the activities of a hospital are greatly influenced by the movement of people, dust and materials. These are sometimes long lasting works that make impossible to perform hospital function regularly. Maintenance should be as rapid and easy as possible.
Considering the unavoidable changes to building, furnishing and finishing materials, choices should be focused on materials and products which require modest maintenance (easy to dismantle and to substitute) and facilitate building refurbishment (modular components).
The prerogatives of a hospital suggest the preference of resistance and integrity of products, the use of safe materials (not releasing chemical emissions and dust) and ease of cleaning. Products that release chemical or radioactive emissions contribute (even if sometimes in small amounts) to producing scarce quality of air indoors (2.1.1 Sick Hospital Syndrome) should be avoided or reduced in furnishing and building (1.1.2 Polluting Materials). Builders and designers should use finishing materials and building products which are durable counter to heavy public use and to frequent cleansing, disinfecting and working procedures.
The use of natural and renewable, recycled building and furnishing materials should also be supported in the realisation of hospitals (1 Health, Environment and Building Design). The choices made by designers about building and furnishing products should be focused on ameliorating our environmental conditions (1 Health, Environment and Building Design) and particularly the environmental conditions of hospitals on the basis of the situations complained of in hospitals (2.1.1 Sick Hospital Syndrome).

5.4 Improving the Quality of Design

Excessive illumination, noise, uncomfortable microclimates, air pollution from traffic are some of the problems affecting the environmental condition of hospitals. The presence of many functional activities and technological systems, electrical equipment, chemicals and radioactive products increase the various situations of risk in relation to health and environment (4.2.1 Risks affecting the Environmental Condition). Plural 'dysfunction' affecting the environmental conditions of hospitals are due to poor design and maintenance. It seems that close detailed co-ordination of various aspects is lacking in hospital design despite plural components of design. An expert in hospital design says: *"the hospital is a unique kind of puzzle having a great many parameters and possible permutations for decision-making"* [5].

Design misfits, scarce maintenance and poor performance of hospital activities were identified as the main causes producing discomfort in hospitals (4.1.1 Risks affecting the Environmental Condition). The quality of design could generally be ameliorated by the contribution of the single individuals working on the realisation and function of hospitals, who could avoid the failings occurring 'in between' single different competences or deriving from a lack of co-ordination.

The presence of many technological systems and the plural different activities of hospitals create the existence of various components of design. Plural aims and different components of design make the 'whole' of the project. Different aspects of design unavoidably impact on identical environments of a hospital. Groups of specialised technicians usually work separately on the realisation of the same project. Instead their closer collaboration would create 'healthier' conditions in hospitals in relation to health and well being, which depend on environment and building design.

The researchers investigating S.H.S. maintain that a closer co-ordination of various components should be established in hospital planning (4.1.1.1 Sick Hospital Syndrome: case-studies). At the end of a study on the Sick Hospital Syndrome, these researchers state: *"a major problem is that an evident lack of integrated decision making between different professions (architects, engineers, and health personnel) may occur when hospital buildings are being planned"* [4].

The activities proper to hospitals and their large public structures create at the same time numerous situations of risk (4.1.1 Risks affecting Environmental Conditions). To prevent a series of risks due to the responsibility of single individuals (designers, builders, maintenance technicians, patients and staff of hospitals), appropriate information should be supplied. As some biologists state, *"hygiene propaganda should seek to combat prejudice and ignorance by dissemination of the simple facts of insects biology and of the best control measures"* [3].

"Special technical information" [3] should be supplied to all the people involved in the design, realisation and maintenance of hospital buildings. Designers, builders, technicians and hospital staff should know all the risks to the health of the people, which are due to hygienic conditions, microclimate, structural features and technologies or other component of design.

All the people working on the hospital realisation and function should be informed of the existence of the risks related to their activity and of the possibilities they have of positively influencing the conditions of hospital environments, health and the well being of the patients and staff.

Awareness and knowledge should be increased, since the use of appropriate building technologies, materials and components of design, typology and manufacture of the building contributes to avoiding the risks related to building and environment. Also design and

maintenance of hospitals should be supported by a systematic methodology including criteria for the prevention of risks related to health, environment, design and maintenance of the building. Risks (e.g.: development of biotic agents, release of polluting emissions, etc.) can be avoided by the technologies and choices systematically made in design.
Regular maintenance should be performed by hospitals and the approach of designers, builders and technicians to the maintenance of the building should be incorporated in design and supported with systematic methodology.

Conclusion 'Enhancements in Environmental Conditions'
Chapter 5

Hospitals should be built out of town mainly to be free of the pollution from traffic. In this case, healthier conditions of life would be available for staff and patients. Traffic, pollution and noise produced by the presence of multifunctional public structure such as hospitals would be avoided for the people living nearby.
Hospitals would be built in this case on open land. This would offer better possibilities of benefiting from natural ingredients (sun, fresh air, etc,) and to taking advantage of opportunities offered by the site (profitable position regarding sun and wind, resources and materials, etc.) and natural items (trees, bushes and green plants, etc.) to be included in the plan of the building. The natural beauty or components (stream of water, sloping land, hills etc.) of the landscape could be incorporated in design.
Open land would give the possibility of further extension of the building and its horizontal development could be promoted with the relative advantages (increase of flexibility, reduction of lifts and stairs etc.). The natural landscape would finally re-establish the ancient and healthy relationship between patients and nature.
On the basis of similar experiences in other categories of buildings, designers should take into account the application of 'clean' building technologies in order to support energy saving and to avoid environmental pollution (1 Health, Environment and Building Design). The application of 'clean' technologies in building and passive systems, in addition to the use of natural renewable materials, would contribute to improving the indoor environmental conditions of hospitals (2.1.1 Sick Hospital Syndrome).
Specific choices made in design are capable of answering plural aims at the same time. If it is possible to improve the quality and performance of the architectonic components by the application of alternative technologies and materials, why not try to increase their functionality in plural directions? To this end hospital design should include structural components and specific materials towards multipurpose aims in order to improve the quality of design from different points of view (5.2 Application of 'Clean' Technologies, 5.3 Building and Furnishing Material, 5.4 Improving the Quality of Design). The use of non-polluting, renewable products requiring little maintenance and the use of recycled materials should be taken into consideration in design. Building materials that are easy to dismantle and replace should be used in hospitals to counter a number of disadvantages (long-lasting maintenance works and refurbishment creating dust and dysfunction in the activity of hospitals).
The following ingredients should finally be included in design to counter many 'defeating situations' recorded in hospitals, that relate to design (4.4 Hospital Design and Designers Responsibility):
- systematic methodology of design

- collaboration of different people (designers, builders, technicians, hospital staff and patients)
- preventive co-ordination of plural components of design (technical components of design, maintenance and management of the hospital)
- regular maintenance and proper performance of hospital activity

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Summary of chapter 5

ENHANCEMENTS IN ENVIRONMENTAL CONDITIONS

CHOICE OF THE SITE
REALISATION OF HOSPITALS IN NATURAL AREAS
INTEGRATION OF NATURAL INGREDIENTS
USE OF NATURAL RESOURCES
PROFIT FROM THE PRINCIPLES OF FENG SHUI

CHOICE OF TECHNOLOGIES FOR ENERGY SAVING
INCREASE IN INSULATION
(insulation made of natural materials)
USE OF PASSIVE SYSTEMS
(passive solar system and photovoltaic cells, wind energy etc.)
USE OF APPROPRIATE BUILDING TECHNOLOGIES
(filter areas, conservatories, windows and skylights, etc.)

CHOICE OF THE BUILDING/FURNISHING MATERIALS
RENEWABLE
HYGIENIC NON-POLLUTING
REQUIRING LITTLE MAINTENANCE
EASY TO DISMANTLE AND REPLACE
USE OF RECYCLED PRODUCTS

IMPROVEMENT IN THE QUALITY OF DESIGN
CO-ORDINATION OF (THE COMPONENTS OF) DESIGN
HOLISTIC COLLABORATION
SYTEMATIC METHODOLOGY OF DESIGN
REGULAR MAINTENANCE
PERIODIC REVISION OF THE COMPONENTS OF DESIGN
EDUCATION AND INFORMATION

Enhancements in Environmental Configuration

Chapter 6

In hospital history, certain specific components have always influenced the realisation of hospitals, since they respond to the needs of patients and staff (3.1.3 Conclusion of 'Hospital Building in History). These components should be fully adopted in hospital design as indispensible to support the comfort and well being of patients and staff.

Urgent problems, emerging in the social context, in medicine and health care during history were dealt with the application of appropriate solutions in the realisation of hospitals. Starting from the end of last century -that is when the circumstances were right- there are other components which result always more often applied in hospitals. They are structural flexibility (which had already been previously introduced in hospital design) and the realisation of a system of circulation for people and means within the building (a need deriving from the physical, scientific and technological growth of the hospital). Due to the persistence of the same needs, the introduction of these two items now becomes an important issue in design. With the growth of out-patients and day-hospital activities, new models of building should be developed.
The frequent functional changes recently taking place in hospitals create serious design perplexities in finding possibilities of structural adaptation. It is evident that the design of hospitals should be more flexible to counter the present difficulties of re-adaptation of the old hospitals and that appropriate criteria should be included in design. Not only owing to the rapid social progress, but also to the demand of hospitals to be dynamic in function and structure (3.1.1.5 Emergent Needs: Familiar Configuration and Structural Flexibility, 3.1.1.8 Constant Issues: Familiar Configuration, Flexibility, Ventilation, 3.1.3 Conclusion of 'Hospital Building in History), the design of hospitals should be based on criteria of structural and technological flexibility.
Conventional hospitals quickly became obsolete against the background of recent rapid progress. The increased number of activities show the need of way finding, becoming an indispensable component of design. As in other large public structures, modern systems of information and modern technological means (e.g.: computerisation, elevators and lifts etc.) should be introduced in hospital design. Hospitals should be adequate to the modern social context to be competitive with other modern public structures. Owing to the misfits recorded in hospitals (2 Hospital Design and Building Environment, 3 Hospital Design and Function), the collaboration of various people is necessary to improve the quality of hospital design and function (5.4 Improving the Quality of Design) from many points of view.

Recently built hospitals correspond to the improved social welfare. They are result substantially transformed in function and configuration, focused on 'humanising' the health care structures and on improving the relationship of the patient with disease and hospitals. Their buildings create relaxing and familiar environments, providing a series of comforts for the patients' well-being. Arts have been for example introduced into hospitals to produce a home-like atmosphere and more comfortable environments. Some newly built hospitals look like other modern public buildings (e.g.: residential buildings, shopping centres, hotels, etc.), creating the reality that makes part of every-day-life (4.3.1 New developing categories of Hospitals: case-studies). They include comforts and activities for the patients such as shopping areas, hairdresser, restaurants, etc.

The modern concepts of patient and health care emerge against the social background of hospitals (4.3 Hospital Design and Function). The new trends look like a return to the basic principles of medical care (3.2 Health Care, 3.2.1.1 Temples and Healing Places). A correspondence has been noted between these trends (in society, health care and newly built hospitals) and the traditional theories (of Hippocrates and the Asklepieia). The modern role taken on by these new buildings and the approval found in society support the opinion (sustained by various experts) that the quality of the environment does make a difference to the healing of the patient (4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree model).
To produce a positive attitude of the patients towards healing is actually one of the aims of hospital design (2.3.2.1 Patient Well Being and Policy of the W.H.O.). To include as an aim of design, the fulfilment of physical and psychological well being of the patients, is supported by the recent policy of the W.H.O. (4.3.3 Prevention Policy and Sustainability in Building) and by the principles from the past realisation of certain hospitals (3.1.1.1 Temples and Healing Places). The criteria used in design for the realisation of Sustainable Buildings (e.g.: Healthy Offices, Universities, etc.) have been studied for the analogous fulfilment of a patient-focused design to be integrated in the realisation of the Hospital promoting Health and Well Being.

6.1 Typology and Design

As a consequence of the recent quick development of science and technology, hospitals are the object of plural consecutive refurbishment. *"...A lot of unbusy architects and builders right now...are doing a lot of retrofitting..."* [1] was recently asserted in the report of a round table discussion about hospital design [4]. But the adaptations (structural or technological) necessary to respond to modern issues imply practical difficulties of different natures: *"it is extremely difficult to take an old building and make it profitable in a managed care system on a reuse basis..."* [1]. In relation to this, they say: *"we're no longer building our facilities with interior load-bearing walls. We're building our facilities with greater distances between columns and larger bays providing for flexibility..."* [2]. They even propose the realisation of completely free and open spaces, as an alternative to interior design, consenting greater possibilities of refurbishment.
It is at present sustained by experts in hospital design living all over the world that, owing to the quick development of science and technology, hospital buildings are today becoming obsolete soon after their realisation. However the difficulty of corresponding 'variable and changing' needs within one structure, doesn't emerge only in the present circumstances. The same problem was sometimes evident through history from the Renaissance (this means since the time when social changes and the increasing population highlighted the need of structural flexibility). But flexibility was very often a component of hospital design even before (3.1.1.2 Hospital: hotel belonging to the Church). Being constantly influenced by the development of technology and scientific progress in fact, hospitals are constantly required to change. *"Typically, the physical growth is architecturally not compatible with the initial project, and later additions have served to mostly destroy the architect's original concept for the hospital building"* [1] is written by Emanuel Mikho Ph.D., executive Vice-President by Consultants Healthcare Architects and Planners Michigan, U.S.A.
Designers recently complain of objective difficulties regarding the refurbishment of old hospitals. They are obsolete structures set against increasing needs and technological means, the number of patients and activities. These buildings have structural and functional limits. To

realise a new extension of the building is not always feasible and the objective impossibility of producing functional changes is sometimes evident. This is particularly so, if the building configuration was strictly defined by specific purposes of design that excluded change and extension of the activities.
Disappointing results often derive from the refurbishment of old hospitals, particularly if structure and technological systems were previously designed for other purposes and needs. The original network of systems is for example sometimes scarcely dimensioned to support new sources or increases of energy. In the case of the integration of a new technological installation, an increase of energy is necessary which was not foreseen before as well as the new lay-out of the system including new technological components. For these and other reasons, a new change often excludes the possibility of profiting from the situation formulated in the original project. When the typology of design is not open to alternatives, every further structural/technological change becomes even more difficult, especially if repeated manipulations have occurred to the same building. There are structural failings that sometimes result from these changes that were considered responsible for promoting inconveniences and risks such as for example pest infestations (4.1.1.3 Risk of Pest Infestation: case-studies).
The introduction of criteria of design for structural and technological flexibility is also indispensable for the application of structural extensions and changes coherent with the original plan. Consecutive changes, occurring through the time, are in fact usually realised by different designers who give their own individual interpretations of the design of the building. Repeated manipulations deny the original coherence and 'cleanliness' of the architecture of the building. The interference of several designers on the same project practically destroys the intention of the first designer about the whole.

6.1.1 Flexibility and Modularity

Positive results have been recorded regarding the application of criteria supporting structural flexibility and modularity in hospitals. This happens for example in the case of the Klinikum Hospital in Aachen (D), mentioned as a winning model of flexibility by G. Martinazzoli in 'Gli Impianti Ospedalieri' published by La Nuova Italia Scientifica 1995.
In the case of Klinikum, the functional spaces have modular dimensions owing to the modular distance of the columns. In contrast to what happens with spaces varying in size, these rooms can be more easily adapted to a new configuration. *"This flexibility was the key to reach new needs in reasonable times"* says the engineer Mr. Filios Basile chief of technical administration of the hospital who was directly contacted and interviewed (8.3 Interviewing the Chief Engineer of the Klinikum Hospital). He asserted in fact that various structural changes had occurred over time to meet the needs of different doctors and to respond to various requests of the staff.
But modularity not only promotes the flexibility of the building, it also gives the possibility of using modular building/furnishing systems and the quick assemblage/removal of building parts. These characteristics should be taken into consideration in hospital planning since they offer an advantage in terms of time (not only in building realisation, but also in the case of refurbishment and maintenance) and in terms of functionality, if furniture and spaces are produced according to serial models (ex.: laboratories, cabinets, patient rooms, etc.). The use of rapid solutions in building and/or furnishing makes it possible:
- to realise the refurbishment faster
- to respond more quickly to needs emerging day by day in the performance of hospital activity
The increase of living space and furniture in proportion to the application of multiple elements is advantageous for a hospital (this is particularly so in the furnishing of laboratories, medical

cabinets, patient rooms and any other room where it is possible to use modular furniture). The application of prefabricated modular elements, as in the case of partition panels, consents quick renewals and easier maintenance. This happens also in the case of the assembly of furniture to be adapted to specific spaces. These kinds of systems support the coherence of design, the realisation of structurally 'clean' refurbishment, the fulfilment of the same results even after plural consecutive adaptations. They finally reduce the period of time usually necessary to carry out refurbishment and specific manufacture otherwise produced by means of traditional systems.
The technological systems should also be structurally and technically flexible with the view of being developed according to the hospital growth. Some basic criteria for structural/technological flexibility should be defined in the starting project. Common terms of reference should be formulated in order to support the development of design coherently with the original idea of the whole. This would make it possible to maintain the first intention of the designer also in the future and to integrate changes into a harmonious whole.

6.2 Standards of Living and Modernisation

John Michiel Currie -Principal for Health Care NBBJ Architects in Washington D.C.- supports the realisation of more modern hospital buildings. He states that *"patients and families are far more involved in the 'commerce' of the facility. They have needs for getting around unaided and they have expectations that the building will operate almost as a hotel or retail establishment"* [5].
Hospitals should be familiar and hospitable places so as to counteract the negative impression that patients have of hospital environments ("most hospitals are dismally inhospitable….harsh lights and cold stainless steel, labyrinths of white corridors, thumping equipment…" -reported in 2.3.2 Quality of Life and Well Being). Their institutional configuration and advanced technology make hospitals look rather like 'laboratories of high-technology'.
At the same time an improved standard of comfort has been seen in newly built hospitals (4.3.1 New developing Categories of Hospitals: case-studies) as in other recently built public and residential buildings. Also, different levels of comfort have been achieved in newly built hospitals. On the one hand, extremely luxurious buildings have been built (4.3.4 Living Standards and Arts in Hospitals: case-studies, 4.3.4.1 Quality of Life and Hospital: case-studies and Planetree Model). On the other hand, general complaints are recorded in conventional hospitals (2.3.2 Quality of Life and Well Being). Improved quality and comfort is expected in hospital design by patients, experts and hospital staff (2.2.1 Limits of Design, 4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree Model).
The lack in adequacy of hospitals in the face of the social advance is evident. Hospitals have become 'obsolete buildings' from many points of view instead of being adequate to the new standards of living and being competitive with other public structures.
The necessity emerges to introduce more modern items in hospital design. However some newly built hospitals have received the approval of the public, revealing various alternative trends for the realisation of hospitals (4.3.1 New developing Categories of Hospitals: case-studies, 4.3.2 Renewed Request for Traditional Therapeutic Means: case-studies). From the architecture of these and other modern public buildings and in conformity to the new living standards, it is possible to formulate the type of enhancements that should be adopted in design for the modernisation of hospital configuration.

6.2.1 Introduction of Modern Means and Items of Design

Particularly now, that our rhythm of life is frenetic, computerised means of information and way-finding should be integrated in hospital design as well as modern systems of transportation. To be coherent with modern architecture, the same criteria of 'modernisation' should be introduced in hospital design which have recently influenced the realisation of other public institutions. Modern components of design should also be introduced in hospital design, such as those already introduced in the modern design of other public buildings of large dimension.
Hospitals should provide more comfortable environments and living standards also concerning the assistance given to the patients. Not only they should support the application of medical treatments, but they should also promote the physical/psychological well being of the patient in different circumstances (4.3.3.1 Physical and Psychological Well Being: case-studies).

6.2.1.1 Way-finding and Circulation System

Hospitals are mentioned by psychologists in the list of those places particularly discouraging for the public in orientating. There are experts asserting to this purpose: "*there are some places - residential areas, museums, hospitals...- in which way-finding is notoriously difficult, even for long-time residents"* [3]. Notwithstanding this opinion, way-finding has often been neglected in the environments of hospitals and spaces where we live and spend the day.
Hospitals have plural functions that can confuse people's ability to find the right destination (e.g.: medical examinations, visits to the patients, therapies etc.). This can also be confirmed by individual personal experiences and talks with people, but the experts in psychology state: *"a person's stress level rises when he or she gets confused about directions"* and "*the way the built environment is structured very much affects the ease with which people find their way through buildings, neighbourhoods, and cities"* [3]. Regarding the impact of way-finding on human behaviour, hospitals should produce a feeling of familiarity, solidarity and security in the patients (4.3.3 Prevention Policy and Sustainability in Building). If way-finding is a motive of stress and anxiety, a more positive feeling of confidence should be impressed also in this case by the environmental configuration of hospitals. Designers should make the patients feel in a comfortable and familiar place, on the basis of what the experts state, *"the ability to orient oneself, both socially and physically is a major contributor to an individual's feeling of security"* [3].
The lack of way-finding is complained of in conventional hospitals and this problem was also raised in the literature by a significant item about this matter. This was written by John Spiers, Health Policy Adviser, presenting this paper at the Royal Society of Medicine in London on April 1994. The report he made was about the Royal Sussex County Hospital in Brighton, which he visited with the intention of focusing on the present conditions of hospitals, as if he were a wheelchair patient.
Here he complains the absolute lack of way-finding: *"our maps don't say 'You are here'. They are colour coded, but we don't say how or why. They direct people to a customer care centre, but we don't have one. We have toilets which have no sign on the door. No one knows how many toilets we have. We have lifts, but with no mini-directory in them to say what is on each floor. We don't say which floor gives which access to other buildings. We don't tell people which floor they are on when they are outside the lifts. We don't give directions as to what is on that floor. Our Social Work office (not sign-posted) has a door, hidden behind a cupboard. We don't tell people if they have an option to use their lift or stairs. We call the ENT department two different things within three feet of each other outside the department. We don't tell the public they can use our*

restaurant, though they can. We have no directory in A&E. We upgraded a building housing physiotherapy (and the management team) and put a handle on it which physiotherapy patients couldn't open" [4].
Poor way-finding and lack of information are rather common today in the large, old hospitals. This happens especially if they have increased or transformed their activities over the time. Their unexpected degrees of growth have occurred in a more or less chaotic way and have in fact determined gradual approximate consecutive adaptations at different levels without any common criteria. For the same reason they didn't fulfil a definitive and common final end. What was invisible in the planning of the building, or unattended, was realised through various gradual changes completely outside any program. This made it impossible to take hospital configuration and efficiency under control.
Hospitals became multifunctional buildings with plural departments (2.3.1 Social Background), but a system of way-finding is usually lacking as well as any modern means for information and transportation. Patients and personnel spend day and night within the building and a variety of individuals visit hospitals every day. These people have varying physical conditions and psychological attitudes (e.g.: the emotional condition of the patient implies the limit produced by anxiety, by their approach to medical treatment and results, their individual expectations and talks with doctors). Modern means of information, way-finding and transportation should be provided for their well being.

6.2.2 Modernisation implies identity of design

'Personality' and fancy should be attributed to the 'white and inhospitable' environments of hospitals (*"most hospitals are dismally inhospitable….harsh lights and cold stainless steel, labyrinths of white corridors, thumping equipment…"* -reported in 2.3.2 Quality of Life and Well Being). Against 'insignificant' and 'impersonal' environments, comfortable and modern array, decorations and colours should be incorporated in design as in other modern buildings. The presence of familiar items (such as paintings and decoration) and components of design (such as colour, type of illumination and building/furnishing material) should create a more familiar atmosphere to communicate a comfortable positive message that patients need and expect (4.3.4 Living Standards and Arts in hospitals: case-studies, 4.3.4.1 Quality of Life and Hospitals: case-syudies and Planetree Model, 4.3.4.2 Perception of Hospital Environment). A less-stressful image of hospitals should be produced to counter their traditional stereotyped image and the anonymous cold atmosphere produced by their institutional model (empty walls of corridors and wards).
As in the realisation of other large modern public structures, the reality of every-day-life should be created also by hospitals. According to the recent technique of 'neighbouring', the large modern public strictures (such as shopping centres, hotels etc.) include for example walkways, coffee-shops, restaurants and so on. This kind of image should be given to hospitals in order to obtain the following advantages: the production of modern hospital buildings, the impression of modern health care facilities, support of the well being of patients and of hospital activity, adequacy to improved social welfare.

6.2.2.1 Way-finding, Images and Colour: Case-studies

Way-finding in hospitals can also include colours and images. An example of this combination is reported in the essay 'The Importance of Arts in Hospital Development' by David Fine, who explains how the characteristics proper to the way-finding system have completely changed the reality of a hospital. He says*: "a hospital in the north east had such inadequate signing that staff would take devious routes to avoid being asked by visitors for directions"* [6] and asserts that more

positive results were soon obtained by helping the patients to identify destinations by means of colour and images.
The example of the children's ward is mentioned. Here an arts scheme was created *"involving signage on the Alice-in-Wonderland storyline"*. This invention helped patients and visitors to *"find and take the quickest routes from A to B"* [6].
Already in 1980, the architect Carlo Casati sustained that way-finding should be used as a tool of design, asserting: *"signs are tools and furnishing at the same time. They are not part of the treatment, but part of a whole they must harmonise with. Today they give life by colours and lights"....."the psychological importance and function of these signs is obvious as they are part of the whole hospital complex, of its design and internal decoration"* [7]. He also sustained that *"information has to be turned into codes consisting of colours and numbers"...*
The following description gives an idea of the system he applied in hospitals: *"...different materials have been successfully used to meet these needs, like white and coloured plexiglass, luminous paints, aluminium and others- and more sophisticated techniques have been adopted"* [7]. This short list suggests some opportunities in combining way-finding/information systems with furnishing/building components. But many other alternatives put forwards by inventive designers can be considered capable of fulfilling the same aim.
Casati's book 'Architectural design of hospitals. A problem of social psychology' illustrates a series of signs to be adopted in hospitals (fig.9). Thinking of a book that was written about twenty years ago (when hospital structures were smaller and with fewer functions), the large variety of signs he published here may even be excessive. But, written in Italian and in English, this book promotes new principles. In fact, the positive contribution of this book should be identified in the alternative approach given to design, the purpose of positively influencing the patients and in the practical efficiency attributed to way-finding. The book not only maintains the integration of way-finding systems in hospitals, but also promotes the use of way-finding in combination with other components of design.
The idea of the author focuses on creating a secure atmosphere by means of decoration combined to the supply of information. He is therefore a promoter of the use of images, materials and colours to support the quick intuitive perception of information and a positive impression of the environment. In practice, he cared for the psychological contribution achieved by design. In this sense the author should be considered a forerunner, since he supports the same modern idea of familiarity and humanisation that are currently the object of hospital design. By supporting the feeling of familiarity that the environments of hospitals should communicate, he maintained the important role of information towards various purposes: *"to simplify the traditional sign systems, to make it similar to that of the hotels people are familiar with, so that hospitals are thought of as temporary accommodation, not too different from any other place..."* [7].
C. Casati sustained three relevant components still the object of interest in hospitals realisation today. They are the presence of way-finding, the realisation of quick systems of information given by the immediate perception of signs and colours, the combination of these systems with array and design.

6.2.2.2 Presence of Colour and Natural Light: Interview with the Patients

The presence of colour and light in hospitals has been the object of recent studies carried out by experts claiming that they have positive psychological effects on patients [10].
The researcher Farber Birren complains for example about the presence of *"drab, monotonous environments"* [10] in hospitals. He also claims that there is a negative effect produced on the sight deriving from the combination of 'white walls' and strong illumination. *"Illumination is seen*

as the cause of the problem (sight disturbances)*"* he states *"in most instances it is the off-white walls rather than the lighting that are at fault"* [10].
In one of his studies focused on identifying the preferable colours for a hospital; he notes that colours have different influences on individuals, asserting: *"hospitals deal with a broad cross-section of humanity, and common denominators for colours should be sought rather than individual predilections"* [10]. He concludes then that there is *"need for variety in patient accommodations, as well as in areas of general use in the hospital"*. By taking into consideration the preferences of any individual, he sustains that a variety of colour should be adopted in design to realise the same familiar environments to which people are used to in their every day life.
Finally, he states that the presence of colours is in general important in hospitals and says that the *"choice of colour is all too often based on personal feeling and personal whim. There are certain definite principles -backed up by sound research- that should guide hospital design. It is not that rules should be followed, but that hospital purposes such as medical care and convalescence, should be considered first"*.
What patients expect from hospitals is not only physical assistance, but also psychological comfort. Designers should create a pleasant environment for example by comfortable temperature and illumination, home-like spaces and familiar components, comfortable seats and so on. These factors express the assistance given constantly by the hospital to the patients in order to promote their healing and well-being.

6.2.2.3 Hospital Identity: Case-studies

The introduction of colour, art or decoration in hospitals has interested experts and researchers. Operating for example on the premise that the hospital environment is an important factor affecting health, the Planetree Organisation ascertained that the physical components of the hospital play a positive role in creating more supporting environments for hospital patients (4.3.4.1 Quality of Life and Hospitals: Case-studies and the Planetree Model). Older and more recent studies (carried out to ascertain the possible benefit of colour and decoration in hospitals) maintain the advantage given by creating home-like environments by including familiar components in hospital design (4.3.4 Life Standard and Arts in Hospitals: Case-studies, (4.3.4.1 Quality of Life and Hospitals: Case-studies and Planetree Model). A very representative study was conducted by some experts few years ago (6.2.2.1 Colour and Natural Light: Interview with the Patients) to ascertain the possible psychological benefits provided by colours on hospital patients. In these circumstances it resulted that it is not the application of single colours, but the variety of the environment and colours that assumes an important role within the configuration of a hospital. This important point of view should be taken into consideration in hospital design.
According to the book 'Design that Cares', a few issues are indispensable to establishing *"good relationships between the health care facility and its consumers"*. One of these issues is the attribution of 'symbolic meaning' to the hospital [11]. The image of a hospital providing assistance and solidarity should be expressed by the designer in order to communicate confidence and trust to the patient instead of discomfort.
A feeling of 'solidarity' for example could be impressed in different ways. This could be done by means of concrete facts (supplying for example adjustments and conveniences for the patients, providing accommodation for their families, etc.) [11] and also by means of design and architecture. It could be the message given by means of specific components of design to confer 'symbolic meaning' to the hospital.
David Fine, the co-ordinator of the Health Research Institute at Sheffield Hallam University is the author of an article published in Health Estate Journal of July '95 that deals with this kind of subject [6]. Here he is determined to express the role of 'solidarity' of the hospital by means

of design and in special cases by means of arts. To this end, some planning and design processes are mentioned by the author, where arts have been 'incorporated' into the building plan. Finding, for example, a relationship with the speciality of the hospital, at the Spinal Injuries Unit of Northern General Hospital (Sheffield), the sculpture of the 'wheelchair basketball player' symbolises the powerful message of his strong and encouraging personality. But David Fine mentions other examples, such as the 'history panel' of the Chapel Allerton Hospital. He says this communicates 'positive certainty' to visitors and patients, who would be positively impressed by the subtle message given by a hospital 'having its history'. The images of the hospital history and the renewals of its structure would confer the impression of this hospital as *"a place with heritage, character and future"* [6].
Fine sustains that arts *"are part of their buildings, they 'do not get in the way', they remain uncluttered..."* [6]. By attributing a positive impression to the hospital, the author practically gives a personal 'identity' to the building which lasts over time. Designers have also the possibility of conferring to a hospital credit and references, up to a certain extent, by producing a positive perception and by giving a 'confidential image' by means of design.
Producing determined 'impressions' by means of design is generally implied in architecture. 'Suggestion' is also taken sometimes as real 'tool' of design, over time used in the realisation of 'suggestive scenarios' (4.3.3.1 Physical and Psychological Well-being: case-studies). The use of 'suggestion' was even adopted (and still is sometimes..) as real component of therapy (3.1.1.1 Temples and Healing places).
Designers should still create a comfortable relationship between hospitals and patients by means of design and by the perception of a positive message. The configuration of the three American Models of hospital reminds one of a hotel or a residential building, while some American hospitals look even excessive in terms of luxury and decorations (4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree Model). A similar intention of the designers has often been expressed in different ways, not only in the present but also in the past. Arts and decorations were already integral components in the Askleipeia (3.1.1.1 Temples and Healing Places). Private clinics and special 'alternative' hospitals (4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree Model) also use decorations and pictures for producing comfortable and home-like environments. Hospitals have been changed over time in array and configuration for the creation of ever more comfortable environments. At present, the approval of patients, staff and visitors of the presence of arts in hospitals (4.3.4 Living Standards and Arts in Hospitals: case-studies, 4.3.4.1 Quality of Life and Hospital: case-studies and Planetree Model), suggests that it is possible to improve the standardised level of comfort proper to conventional hospitals also by the use of arts or images, decorations and pictures, creating comfortable home-like environments in hospitals.
The realisation of specific items such as an artistic composition, a special fountain able to characterise the building design, would contribute to give a hospital its own identity. By means of design, it is also possible to give references about the hospital speciality. On the one hand, designers would be able to impress trust about the medical profile and requisites of a hospital. On the other hand the same items could be intended as 'special places' to be visited by the patients and to be intended useful as referral points for way-finding (7.2.2.1 Special Places and Activity, 9.2.2.3 Combination of Information and Image).
Considering the beneficial positive approach produced by the arts in hospitals, some 'decoration' should be part of the plan of the building (this doesn't mean including 'expensive art' in the plan of a hospital). According to the circumstances and financial possibilities, images and colour should be integrated in design, such as pictures or 'murals' (fig.), to provide the 'bare walls' and surroundings of traditional hospitals with colour (9.2.2.3 Combination of information and images, 8.2.1 Present Experience: Planned and Built Examples). Special

building/furnishing components, other decorations would be able to fulfil this purpose as well. Special subjects, realised by skilled artists experienced in health care design, could otherwise illustrate specific subjects proposed and discussed by the experts and designers working on the general configuration of the hospital.

6.3 Improving the Quality of Design

Hospitals have recently been the object of frequent refurbishment. The same thing has happened in different countries. But these changes were often considered responsible for misfits of design, which even produce situations at risk (4.1.1.3 Risk of Pest Infestation: case-studies). Refurbishment were considered capable of producing misfits and lack of coherence in building design (4.2.1 Lack of Flexibility: case-studies, 4.2.1.3 Risk of Pest Infestation: case-studies). Some Swedish researchers assert: *"changes in use continuously taking place were regarded as a significant source of 'indoor' problems"* [8]. Certain Italian researchers state *"changes in destination and/or use often take place without a proper evaluation of the possible consequences"* [8].
The architect and hospital planner Seymour Remen states: *"we see many projects that are wrongly and wastefully conceived: engineering systems that fine engineering talent would never recommend; nursing units so separated either horizontally or vertically as to leave no hope for efficiently utilising nursing and support personnel over three shifts. As planners, we invariably inherit some of those problems which are recent, and which cannot be reversed. But perhaps they can be ameliorated"* [9]. The responsibility of designers in the production of misfits and the presence of consecutive faults affecting hospital function and design is evident. Though function, design and realisation of a hospital involve various categories of people, the components and aims of design are usually treated separately. A closer collaboration of different people, and not only designers and builders, should support hospital design since plural components act on the same environments and structural configuration of the building.
"Hospitals are usually the sum of many building programmes" [9] is reported in the literature. Their design corresponds to the total of plural projects (given for example by: the presence of medical activities, operating theatres, administration offices, sterilisation and laundry, kitchens, patient rooms and the relative services, plural technological systems and equipment requiring specific regulations, etc.). The experience of different people and their closer collaboration and their awareness about the presence of various risks is needed in design. The closer correspondence between design and function of hospitals should be taken into consideration in design.

Conclusion of 'Enhancements in Environmental Configuration'
Chapter 6

Frequent consecutive refurbishment was recently necessary in hospitals to deal with issues deriving from social progress. However, disappointing or scarce results have been recorded in the fulfilment of design. The lack of coherence to one project was one of the consequences of plural refurbishments applied to the same building. It was sometimes even impossible to re-adapt the old hospitals to modern issues. These changes often produced structural imperfections or 'defects' deriving from repeated manipulations. A series of disadvantages (in structure and functional systems) were recorded such as the pest infestations. It was concluded

that hospitals should be planned on the basis of structural and technological flexibility supporting the coherent accomplishment of these changes. The structural modularity produces advantages such as the possible execution of coherent and quick refurbishment by adopting modular components in building and furnishing. To reduce or to extend a space according to a number of modules is easier and quicker than to act in spaces varying in size and facilitates changes otherwise conditioned by structural limits. Modular systems in building and furnishing further simplify both the study of these structural changes and their practical realisation which require less time. They also facilitate the performance of maintenance which means avoiding the delay of the activities. Hospital buildings are 'dynamic' structures and the continuous development of hospital function would benefit from the possibility of realising quick adaptations. Flexibility and modularity allow work more easily both on a large and on a smaller scale. The integrity of the structure and its coherence to the same project would become possible simultaneously. Complaints have been recorded about hospitals regarding the poor quality of their environmental conditions (4.3.4.1 Quality of Life and Hospital: care-studies and Planetree Model). Lack of modern items of design has sometimes been complained of on the basis of the objective failings recorded in conventional hospitals (6.2.1.1 Way-finding and Circulation Systems). The presence of a large number of activities and people implies the presence of quick systems of information and modern patterns of design. Alternative models of hospitals are emerging in the United States (4.3.1 New developing Categories of Hospital: case-studies). New trends are recorded in their design, more modern perspectives about health care and a new 'concept' of the patient (4.3.2 Renewed Request for Traditional Therapeutic Means: case-studies, 5.3.4.1 Quality of Life and Hospital: case-studies and Planetree Model). Hospitals should improve their standardised level of comforts to be competitive with other categories of public structures and to support the health and well being of patients and people. The quality of design and the environmental configuration of hospitals should be improved according to what patients and people expect (2.3.2 Quality of Life and Well Being). Improved comforts and conditions of life are seen in society, finding correspondence in the recent realisation of more comfortable hospitals (Conclusion of Part II). More functional and comfortable environments should be generally created in hospitals: 'human' relaxing schemes of design should be adopted according to the new trends (4.3.1 New developing Categories of Hospital: case-studies). To this end, hospitals should also include analogous criteria adopted in the design of other categories of Sustainable Buildings (4.3.3 Prevention Policy and Sustainability in Building, 4.3.3.1 Physical and Psychological Well Being: case-studies). As was asserted by the experts, a hospital should be *"almost as a hotel or retail establishment"* [5]. The environment contributes to producing more 'positive' models of hospitals (4.3.4.2 Perception of Hospital Environment) and its *"features"* contribute to the *"richness of the environment"* [3] promoting the psychological well being of the patients (6.2.2.2 Presence of Colour and Natural Light: Interview with the Patients). This 'richness' should be added to the environment of hospitals and this could be done for example by implementing building/furnishing components and features (4.3.3.1 Physical and Psychological Well Being: case-studies, 4.3.4 Living Standards and Arts in Hospitals: case-studies). *"Sustainable Development is a vital condition for the continued habitation of this planet by human beings, but it is important that decision makers, engineers and technicians, final users of the building are prepared for the rapidly emerging environmentally sound technology"* [10] is stated by a group of researchers. The lack of *"integrated decision between different professions"* [8] has been complained of by researchers leading to lacks and misfits related to design and maintenance of the building. Hospitals are the *"sum of many building programmes"* [9] and the Hospital promoting Health and Well Being is produced by the realisation of *"the better puzzle which offers the most useful benefits to the institution and the community"* [9]. The wider collaboration of experts, patients and hospital staff is needed in design for the fulfilment of

more positive results and to answer the needs and expectations of different categories of people. General and specific information should be supplied to designers, builders and hospital personnel. A systematic methodology of design should be included in the realisation and function of hospitals taking into account management and maintenance of the building, which are both indispensable to keeping the aims of design valid over time. The perspective of keeping the conditions of design under control makes it possible to avoid inconveniences and out of programme misfits.

Summary of chapter 6

ENHANCEMENTS IN ENVIRONMENTAL CONFIGURATION

BUILDING TYPOLOGY AND FUNCTIONAL FLEXIBILITY
STRUCTURAL/TECHNOLOGICAL FLEXIBILITY
MODULARITY
LAY-OUT OF DESIGN
(in relation to activity, flexibility, circulation)

ADEQUACY OF DESIGN TO MODERN STANDARDS
MODERN MEANS
(in relation to information, transportation, etc.)
MODERN COMPONENTS OF DESIGN
(like large glass-sheets, entrance halls etc.)
ASSUMPTION OF IDENTITY
(like 'special' items, colour, etc.)

PROMOTION OF COMFORT AND WELL-BEING
USER-ORIENTATED DESIGN
HOME-LIKE COMPONENTS
IMAGES AND COLOUR
NATURAL INGREDIENTS

IMPROVEMENT OF THE QUALITY OF DESIGN
CO-ORDINATION OF THE COMPONENTS OF DESIGN
HOLISTIC COLLABORATION
SYSTEMATIC METHODOLOGY OF DESIGN
REGULAR MAINTENANCE
PERIODICAL REVISION OF THE COMPONENTS OF DESIGN

Enhancements in Hospital Function
Chapter 7

In the Third International Conference on Health Promotion (1996), the W.H.O. promoted the intention *"to improve public health by creating 'supportive environments'"* [1] and, as asserted, people and institutions were interested in this policy: *"the goal of creating supporting environments for health has far -reaching implications for both individuals and institutions"* [1].
The same Conference highlighted the existence of a strict correlation between health and physical environment (*"the link between health and the physical environment has long been recognised, yet it has been inadequately addressed"* [1]). On the basis of this assumption, various studies were carried out by researchers and designers to identify criteria of design supporting people's health and well being.
The Hospital promoting Health and Well Being aims to achieve patients well-being through hospital design. In this chapter the components are identified for the design of this Hospital on the basis of:

- analogous studies carried out by designers to fulfil the policy of the W.H.O. (4.3.3 Prevention Policy and Sustainability in Building).
- recent social changes influencing hospital design and function
- new trends currently affecting the development of hospital buildings
- the introduction of specific components that have always influenced hospital design through the history (4- Hospital Building and Health Care in History)

The aspects of design capable of promoting patients's health and well being are discussed in relation of these factors, in order to identify the appropriate components for the Hospital promoting Health and Well Being.

7.1 Patient-focused Design

The psychological well being of the patient is supported by improving the assistance by means of design and by taking into consideration patients' needs and preferences, which were identified on the basis of the following considerations:

1) patients' complaints
2) the study of hospital history and health care, their correlation
3) the gap between conventional hospitals and the new standard of life
4) the interview carried out with the patients of hospitals
5) the experience coming from the realisation of some newly built hospitals and other public buildings
6) the criteria already assumed in building in case of other categories of public structures and sustainable buildings

The factors that promote the physical and psychological well-being of the patients are discussed and illustrated below in relation to the main functional areas of hospitals.

7.1.1 Waiting Rooms and Reception Areas

The approach of patients to hospitals is first influenced by the impression they get coming into the building. The building configuration and organisation can communicate an individual

feeling of trust or apprehension. If the impact is positive, it produces a positive attitude in the individual.
Entrance halls and receptions therefore have the prerogative to de-stress the instinctive individual attitude of diffidence and uncertainty, which patients usually have in relation to diseases and hospitals. Their anxiety may concern diagnostic results and examinations, worry about registration, recover etc. Unavoidable interrogatives about diseases make patients feel delicate emotionally.
Assistance and hospital environment have a delicate role to play in making the patient trust and feel at ease. The well-known difference between institutional hospitals and private clinics, may perhaps depend on the quality and comfort given concerning assistance and environment.
In public hospitals built in the 1950s for the health care services, as the patients came into the building (through an institutional main entrance), they were formally directed to a stereotyped waiting room with bare walls and serial seats.
In the private structures for paying patients, on the contrary, the entrance hall was made of expensive materials, furniture and illumination to positively impress the patient. Costly crystal lamps and the presence of green plants or fresh flowers gave the impression of hotels built in the same period. The patient immediately received the attention of the personnel and was then directed to a comfortable waiting room (never in corridors as often happens in hospitals) with comfortable seats and illumination, something to read.
The same thing happens still today in private health care structures or private medical offices, where great luxury is sometimes seen. 'Hospitality' and comfort are given by the closer assistance.
But there are very newly built hospitals in the United States that, in contrast to the institutional buildings realised until few decays ago, offer familiar and comfortable environment and atmosphere. These buildings look like hotels in their configuration, comforts and in the assistance supplied. The increase of natural light and colours produces a feeling of comfort and well being, as well as the increased dimension of spaces at the entrance of these buildings. It is commented in the literature: *"with these porches the hall is like a street.....This allows residents to feel more like they're a part of the life going on in their facility"* [2].
The multifunctional structure of these hospitals includes facilities such as restaurants, banks and more opportunities for shopping. These hospitals are like other modern public buildings, where the so called technique of 'neighborhooding' brings the reality of everyday life. This makes these building competitive to other public buildings and produces a less-stressful approach of the patients to hospitals.
Hospitals have become multifunctional buildings open to a large public. They include a large number of day-hospital activities and they should be competitive in look and function to other modern public buildings.
At the entrance of the building, the reception area is the identification card of a hospital, corresponding to those places where people unavoidably come into contact. Being the starting point to reach any other destination, this area also represents a central meeting place. Here, the way to the activities and wards, places such as toilets and cafeterias should be clearly identifiable to visitors and occasional clients. On the contrary, in conventional hospitals, the constant presence of personnel in this area serves to provide also this general information.
According to modern living standards, hospitals should provide quick answers to any questions also by means of computerised information and way-finding systems. These should be mostly concentrated in this area to answer the questions usually asked by patients, such as activity timetable and presence of doctors, modality of application, formalities about treatments etc.

Waiting areas are not only found in the area of the entrance hall. They are present also in other parts of the building, sometimes created in corridors and wide passageways. People may spend long periods of time waiting and this makes the patient feel just like the number on his ticket. On the contrary, these spaces should be designed as appropriate hospitable places, providing hospitality and comfort to patients by means of activities (such as reading, checking computer information, videos explaining medical examinations etc.) and indispensable services at hand (such as toilets, drinking water, children's area, baby changing etc.). Clear way-finding should be given to reach the cafeteria and the toilets, the way to the medical cubicles and so on. Components of design such as decoration and paintings, a nice view from the windows, plants and colour should be integrated into the design to make patients feel comfortable and at ease. A comfortable microclimate and illumination should be provided and access to some green areas outside.
The approach to therapies and examinations should be comforting. The patients should feel at ease and entertained whilst waiting. The modern technologies such as computers for information and communication are more often associated to our everyday life. Nowadays people are used to being active individuals interested in increasing their knowledge. In these circumstances, patients and people could get information in hospitals by means of computerised systems. These systems could give more detailed explanations about therapies application or examinations. This could also supported by the projection of images and recordings of relevant information. The same means could also be used to give information about the sections and services existing in the hospital, about its history and references etc. At the same time sanitary education could be supplied in the matter of disease prevention.
A few opportunities such as the above should be included in the design of hospitals for the use of the patients.

7.1.2 Diagnostic and Treatment Areas

For the creation of these areas, the designer studies a functional distribution of space and equipment according to determined parameters. He focus attention on the dimension of spaces and distances, and on regulations concerning conventional requisites for the regular installation of the equipment. Walls and floors are made of appropriate building/furnishing materials, by means of proper building techniques. But white walls are usually the background to spaces containing nothing else but medical equipment. Traditionally representing the 'less pleasant places' of the hospital, these areas commonly betray the cool atmosphere of the circumstances.
To the patient undergoing an examination, the presence of medical equipment (often unknown) can only produce instinctive apprehension. On the contrary, here the patient should be comforted by a relaxing atmosphere, to feel at ease and de-stressed by a 'positive' approach to this experience. 'Solidarity' and comfort should be communicated by the atmosphere and the design of these spaces shouldn't be 'unpleasant'. For example, greatest assistance should be provided by means of design, familiar components (e.g.: warm illumination, coloured building materials, pictures on the wall, etc.) should be given to improve these usually 'anonymous' spaces. Comfortable items (e.g.: comfortable seats, a place to leave personal items like glasses or watches etc.) should be available to create a more relaxing atmosphere and configuration. The appropriate circumstances to produce comfort and relief to patients should be studied by the designer. The purpose of design in fact is also to make this experience more 'human', mostly by allowing to the patient to feel at ease and comforted by closer assistance.
The patients should not be treated exclusively for their disease, but also helped to dissipate fear and discomfort. The patient can take on a more positive psychological attitude based on the confidence and the sense of comfort created by the place and the assistance. To give the

patients understanding and support is not a matter of luxury and doesn't mean costly materials and furniture. It just means expressing closer attention and care for the patient in every circumstance.
The convenience of way-finding in the various phases of the examination should be fulfilled in design and the designer should think about patients' physical/psychological needs. Positive answers to these needs could be given by patient-focused design and functional spaces of human dimension (e.g. in the dressing room: right dimensions to move and sit, hang clothes, etc.). Comfortable items should be supplied also before and after treatments such as ergonomic seats, a mirror to comb one's hair, a small table and so on. Finally places should be planned so that they do not look cool and institutional but comfortable in space and content. The needs should be taken into consideration of the doctors, the patients and the personnel to design spaces that are comfortable and efficient in various situations. Every space should be properly planned by mean of useful proportions, functional services and other kinds of facilities that produce more comfortable environments. This aim shouldn't be necessarily achieved by means of expensive materials and components of design, but also by means of almost cost-less expedients (e.g.: by providing the green plants or flowers, pleasant smells, relaxing images and colours, etc.). At the same time, in order to improve the approach of the patient to the therapy, designers should avoid unpleasant circumstances; for example chemical smells, the sight of blood, etc. To eliminate this type of inconvenience, the circulation of the patients, personnel and equipment should be properly studied by designers in order to create separate circuits.
The fear of the 'unknown' usually produces anxiety to the patient. The first positive approach in this sense is given by way-finding, mostly in the context of a large structure. Designers should establish easy connections from the reception area to the final destination, from the waiting room to the cubicles or examination rooms. This kind of help would reduce the instinctive worry of the patient. For this reason, clear signs should be evident on the doors of cubicles, examination rooms and departments. Clear information should indicate the passage from space to space (e.g.: from the dressing room to any other consecutive passage of a medical procedure). The same information should be given to the patients when an examination or treatment is concluded. Patients might be confused about the way back, mostly due to the preoccupation they had at their arrival. Way-finding should be clear enough to show how to reach the dressing room again, the toilets, the next exit. Maps should be provided in the corridors saying 'you are here' and every other aspect should be taken into consideration to support assistance also by means of design.
Information about medical examinations and treatments are sometimes more interesting for a patient than any other form of distraction. It makes the patient conscious of what was unexpected and 'unknown'. General and visual information (for example by means of recordings and images projected on the wall) about what will happen during the examination should be given to the patients as well as the recordings of the relative explanations. The nurses would thus avoid having to answer the same questions to explain identical things to every single patient.
In conclusion, it is not only the task of the doctors and nurses, but also of designer to take care of the patient. This kind of strategy is focused on producing patient well being and should be introduced into hospital design. Design is not only is an accurate study of details; it is mostly the result of a series of considerations made by the designer in order to answer patients' physical and psychological needs, to support their well being.

7.1.3 Patients' Rooms

Two main aspects have always been conditioned the design of patients' rooms. They are the physical configuration of the room and the human consideration of the patient.
From the development of the ward, two assumptions can be derived. The first is that an ever decreasing number of beds was over time introduced into the ward (a common space included about 20-30 beds in the first large hospitals of the Middle Ages; the current room for patients includes six beds as the maximum). The second is that the quality of the assistance has improved: the control of the nurses on the patients was increased as well as the comfort given to the patients. In conclusion, a higher level of privacy and closer assistance has been provided in ever smaller departments.
Patients were often considered only as a number of people. They are now considered responsible individuals concerning their health condition, with greater consciousness about diseases. The relationship between patient and hospital has consequently changed: the patients become active protagonists of the hospital and protagonists of design.

7.1.3.1 What is emerging from history

The components of design that have particularly influenced the design of patients' rooms are (3.1.3 Conclusion of 'Hospital Building in History'):
1) PRIVACY
2) HOME-LIKE FAMILIAR ATMOSPHERE
3) POSITIVE GLOBAL CONFIGURATION
4) PRESENCE OF CONTACT WITH A NATURAL ENVIRONMENT

Privacy has always been the privileged objective of patients. Private rooms were already to be found in the Roman 'valetudinarium' (3.1 Hospital Building in History) but privacy over time became an advantage to be paid for. Already in the Middle Ages, people with financial possibilities could give their property to the church to get private accommodation in hospitals for the rest of their lives. In the Renaissance, the last floor of a hospital was reserved for the private rooms, which would be destined to well-off patients. Numerous clinics for paying patients have been built through the ages up to now.
The provision of 'familiar assistance' was the second purpose which has been constantly found throughout history. In the early hospitals, there was already an apposite space annexed to the private room of the patient. This was an ante-room for the servant who would supply constant assistance to the patient. In the Middle Ages, the cross-ward was created to supply assistance and surveillance from the middle of the crossing between two wards. In the nineteenth century, a square shape was given to the ward so that direct control could be carried out by the surveillance from the middle of the room. The patients lay around the central space, in an attempt to create a more confidential home-like atmosphere.
The creation of a globally positive comfortable environment for hospitals was ever more often taken into consideration by designers: in the luxury and comfort of the Askleipeia, in the mystical atmosphere of the Hospital of the Middle Ages, in the square format with a central fireplace of the ward of the nineteenth century, in the many private clinics and so on.
The furniture of a hospital of course depended on convictions, beliefs and means of the time. In the early hospitals, the precious decorations and the beautiful view from the portico and above all the natural surroundings were integral components of hospitals. In the Middle Ages, the effects of light and shade, the use of coloured glass-sheets and proper building materials were adopted to give a mystical meaning to the atmosphere of the ward. Later on, hygienic

issues were introduced in health care, influencing the choice of the furniture. They dictated a sort of regulation concerning the shape and material of beds and furniture. Essential furniture was used, which was easy to clean and was made of 'compact' material against the infestation of pests.
In the nineteenth century, Dr. B. Golding wrote for the first time his positive opinion about the familiar aspect of the ward which was pursued in design. He appreciated particularly hospital's *"similitude to an agreeable private mansion"* (3.1.1.5 Emergent Needs: Familiar Configuration and Structural Flexibility).
Experts in hospital design often focused their attention on the green surroundings of the hospitals. The relevance given to contact of the patient with green open spaces was already evident in the Hippocratic school. Later on, this contact was supported by the need, in the case of epidemics (such as the plague) and diseases (such as tuberculosis) to realise confined hospitals were the patients could be in contact with sun and fresh air. In this type of hospital, the rooms of the patients were located around an open space or a terrace, so the patients could most benefit from the fresh air and sun.
The need to establish contact between patients' room and the natural surroundings was really supported again in the nineteenth century. Florence Nightingale, also was considered an expert in hospital and sanitary matter, promoted this contact by supporting the realisation of the patients' rooms with a view of the natural landscape. Later on, the loss of this contact was complained of by experts and politicians when for the first time, due to the growth of the population, they were constrained to produce more intensive typologies of buildings.
Requisites such as privacy and familiar assistance, general comforts and natural surroundings, would be from then on mostly the prerogative of the numerous private clinics built for paying patients.

7.1.3.2 Patients' Well Being

Some of the recently built American hospitals testify that patients still have the same preferences, confirming the importance of components such as privacy, comfort and familiarity (4.3.1 New developing Categories of Hospital: case-studies). These hospitals are comfortable and familiar in their home-like environments. The Hospitality model looks like a hotel in its indoor environments and in the comforts supplied. Here a patient is considered a 'client' more than a formal patient. The Residential model is more than a residential building: familiar assistance and home-like environments are its typical characteristics (including decoration and pictures, home-like components such as warm illumination, comforts such as a small kitchen, etc.).
A still higher level of comfort is given by special newly built hospitals that provide expensive furniture and decoration, assiduous assistance and any kind of comforts such as restaurant and laundry. The luxury of their environmental components is addressed to the well-off category of people (4.3.4.1 Quality of life and Hospitals: case-studies and Planetree Model).
The influence on the patient of the environment and configuration of hospitals has always attracted the interest of psychologists and researchers. Many studies have been conducted on this matter. Some recent studies have been carried out to ascertain the influence the environmental configuration can have on hospital patients. Supporting the positive effect produced by the building array and configuration, these researchers have asserted in these cases *"that modest changes in decor, furnishings, and even the arrangement of furniture can have a therapeutic effect"* [4].
This theory has been often discussed by experts, while consents have been recorded among hospital patients (4.3.4 Living Standards and Arts in hospitals: case-studies, 4.3.4.1 Quality of

Life and Hospitals: case-studies and Planetree Model).). There are public and private organisations that sustain the positive influence that a comfortable familiar environment can have on the patients. This happens: in the case of some recently built hospitals realised for this purpose; in the case of older hospitals which follow specific traditional schools of thought based for example on Steiner' s theories; in some health care organisations, such as for example the Planetree Organisation.
The Planetree Organisation has recently been mentioned in the literature as strongly promoting the use of familiar and comfortable components in hospital environments. The Planetree Model of hospital was the object of recent research demonstrating the positive role the physical environment of hospitals has on patients (4.3.4.1 Quality of life and Hospitals).
On the basis of the above considerations, home-like familiar building/furnishing components should be introduced more generally into hospital design in order to create a more supportive environment for patients.

7.1.3.3 Multipurpose window: Interview with the Patients

Some experts maintain that the psychological effect produced in man by a natural landscape is relaxing. Research has also been addressed to ascertaining if this effect can also promote and support a patient's healing and well being. A recent study, carried out in hospitals, was focused on the effects produced on patients by a window-with-view overlooking a natural landscape. In this case, the researchers reported in their conclusions that the patients exposed to 'under-windowed' conditions experience a lower level of overall well-being and satisfaction compared to the patients living in units 'adequately windowed' [6].
Another study was conducted in hospitals to ascertain the 'therapeutic effect' produced in patients by the view of green plants and a natural landscape. This research also asserted that such a view is capable of reducing pre- or post-surgical tensions and anxiety [5].
A recent study investigated the post-surgical recovery rates for hospitalised patients in relation to the relaxing effect produced by contact with nature. The researchers referred to two groups of patients: one made up of patients living in rooms with a window overlooking a natural landscape; the second made up of patients with their window overlooking a brick wall. At the end of this investigation, the patients occupying the rooms with a 'view' of the natural landscape proved to have recovered faster than the patients facing the brick wall. The researchers asserted that *"those (patients) with more natural view had fewer postsurgical complications, faster recovery times, and required fewer painkillers"* [5].
There are other studies which testify that a window overlooking a 'natural surrounding' is a very important component for hospital patients [7] (8.1.1 Patients' Opinions). This matter was the object of an interview carried out to ascertain the preferences of hospital patients [7]. A window with a 'view' resulted the typical item mentioned by the patients. Their preferences concerned its determined position in relation to their bed, mostly to have a view outside. The researchers also considered that requisites and characteristics of the window of patients' rooms assume great relevance in the matter of preferences for many other reasons, including ventilation. The researchers stated at the end that: *"...the largest number of complaints spontaneously arising were about draughty windows and insufficient ventilation .which brings us to a discussion of hospital windows generally..."* [7]. But since the preference for a window with a 'view' was very clear, the researchers justified this fact by sustaining that the patients *"spent a great deal of time looking out the windows and enjoyed the opportunity to do so"*. They commented besides: *"one must bear in mind that the layout of most hospital rooms leaves the patient no alternative. He lies facing a blank side-wall"* [7].

The window with a 'view' was often considered a relevant requisite for hospital patients also in history, since it allowed relaxing contact with natural surroundings (3.1.1.6 The Pavilion Hospital in Nineteenth Century).
A window mainly gives the possibility of having fresh air indoors and this is a second point that finds confirmation in history, owing to the constant interest in improving the natural ventilation in hospitals (3.1 Hospital Building in History).
Several disturbances and diseases have been recorded in recent years particularly due to the increase of the environmental pollution and the constant exposure of people to various hazards related to environment and health. This happens in public and private buildings, where the supply of fresh air is promoted by researchers who have studied the causes and the influence of a series of factors related to health, building and environment (1.1 Causes of Health Risk in Buildings). The present environmental conditions of hospitals were investigated by researchers who support and promote natural ventilation (2.1.1 Sick Hospital Syndrome, 2.1.2 Presence of Plural Risks) also because mechanical ventilation systems sometimes produce poor air conditions and the risk of disease (2.1.1 Sick Hospital Syndrome, 2.1.3 Individual Responsibility). These facts promote natural ventilation in hospitals and the positive function of the windows which were also supported in history (3.1.1.4 The Issue of increasing Indoor Ventilation, 3.1.1.8 Constant Issues: Familiar Configuration, Structural Flexibility, Ventilation).
A window is also a precious source of natural light. Everybody knows the physical and psychological benefits produced by natural illumination. Hospital patients spend night and day in their room. Size and manufacture of this window allows to introduce abundant fresh air and natural light. It also increases their contact with the natural environment. The positive presence of natural ingredients and environments should be favoured in hospital realisation as it has very often been supported and promoted in history.

7.1.3.4 Conclusion of Patients' Rooms

Designers have over time slowly denied the familiarity proper to hospital environments and atmosphere, which is their aspect of 'humanity'. These aspects were lost with the evolution of science and technology, which produced ever more sophisticated environments. The lack of reality to man's measure seems to be complained of in hospitals (2.3.2 Quality of Life and Well being, 8.1.1 Patients' Opinion). On the contrary, the physical and psychological well-being of the patients should be fulfilled in design according to the recent policy sustained by the W.H.O. (4.3.3 Prevention Policy and Sustainability in Building). To fulfil this end, design and configuration of a hospital should respond to the wishes of the patients.
If the recent policy in health care promotes the prevention of disease before care, a hospital should substantially support prevention also by creating 'healthier' conditions of life. In this perspective, contact with green spaces and green plants as well as the presence of daylight should be supported in the design of hospitals. The possibility of enjoying sun light should be promoted in design. This could be done for example by increasing the use of large glass-sheets, skylights and windows, balconies and winter gardens, the array of the landscape surrounding the building.
To reduce the number of beds in patients' rooms has been the object of design in history in order to increase privacy. Designers should take this fact into consideration in order to increase privacy by means of design.
Patients' rooms should be comfortable enough for any individual. For example, a comfortable microclimate and the possibility of regulating air parameters and the position of beds/chairs should be provided. Light and air should be allowed to come in, but suitable curtains or screens should be provided against sunlight in order to create shade according to individual preferences.

The sight of a natural landscape and contact with life outside the building should be allowed by having a window with 'view'. Comfortable and hospitable environments should be provided for example by means of relaxing images and home-like pleasant surroundings, a variety of colours and comfortable furniture, the presence of some decoration. The introduction of paintings and familiar useful objects (such as a clock, radio, videotapes, etc.) would create a home-like environment in contrast to the obsolete and 'institutional' atmosphere of conventional hospitals.
The use of natural materials should be increased in buildings and furnishings, contrasting the use of products with chemical components, capable of releasing pollutants (1.1.2 Polluting Material). Home-like facilities and furniture should be given and everything necessary for the patients to feel at ease, as for example the adjustments of their bed, side-tables and chairs. The realisation of appropriate artificial illumination should be studied, in order to make different adaptations according to the circumstances and individual needs. 'Striking' contrasts and high concentration of artificial light -producing unpleasant effects on individual sight- should be avoided especially in combination with white environments (7.1.1 Waiting Rooms and Reception Areas). These and other acknowledgements should produce the feeling of the patient that the hospital is looking after him (2.3.2 Quality of life and Well-being, 4.3.4 Life Standard). A hospital should practically communicate solidarity.
A number of components should establish a *"good relationships between the health care facility and its consumers"*. According to the book 'Design that Cares', this is possible for example by *"showing concern for visitors by providing nearby, inexpensive overnight accommodations"* [8]. Not only accommodation for a family member, but also such comforts as modern means of contacting the personnel as quickly and easily as possible should be given to the patients. The possibility of having a quicker assistance would produce a more positive feeling as happened when the use of a bell close to patients bed was introduced in hospitals (3.1.1.10 The First Skyscrapers in the Twentieth Century). The same purpose could be now fulfilled for example by means of an interphone with a video located near the patient's bed. To implement assistance, quick direct contacts should be established between patient and personnel not only by means of an interphone, but also by a glass-sheet between the waiting room and nurse station. This kind of acknowledgement should be adopted in hospitals by patient-focused design to communicate the feeling to the patient that a hospital is constantly looking after him.
From this point of view, the following elements should be supported and promoted in design:
1) PRIVACY
2) HOME-LIKE COMFORTS (e.g.: the presence of familiar, comfortable items such as the possibility of making tea, listening to music, etc.)
3) FAMILIAR ASSISTANCE (e.g.: the quick contact with the nurse station)
4) NATURAL COMPONENTS (e.g.: light and air, contact with nature)
5) HOME-LIKE DESIGN COMPONENTS (e.g.: furniture and decoration, illumination and colour)

7.2 New Concepts of Patient and Hospital

The following factors which at present influence hospital design were illustrated in chapter 5 (Present factors influencing Hospital Design): the realisation of some models of recently built American hospitals, new living standards and the recent politics supported by the W.H.O. On the basis of these factors, in this chapter it is possible to identify the components capable of improving the quality of design regarding function and configuration of hospitals.

7.2.1 New Role of Patients

Some large hospitals built in Europe include a small shopping area, giving the patients the possibility of buying a number of items (e.g.: newspapers, flowers, gifts, grocery etc.). There are recently built American hospitals that include in these areas more facilities such as for example a chemist and an optician's, restaurants and a hairdresser. The presence of a 'mall' is intended to answer the needs of various individuals: occasional clients and visitors, patients and staff. The mall also gives more than an opportunity for the utility and 'relaxation' of the patients. This formula is closer to the formula adopted in the multifunctional centres created in some large private and public structures all over the world (e.g.: Ariadne Hotel in Stockholm (S), City 2-shopping centre in Brussels (B), many American public centres and residential buildings, etc.).
The 'patient' is considered as *"taking responsibility"* [15] for his health in-line with to the recent policy of prevention in health care. In some recently built American hospitals, the patient becomes a 'protagonist' of hospital activity and is an 'actor' of initiatives, 'client' or 'customer' of the health care facility (4.3.1 New developing Categories of Hospital).
This is the modern image of hospitals addressed to a larger public that has started to emerge in hospital design, resulting from the new social welfare. A building open to alternatives and activities for the patients, as testified for example by a new hospital complex, the Crozer-Keystone Health System (9.2.1 Present Experience: Planned and Built Examples). Health care, rehabilitation and prevention activities are provided in his multifunctional structure.
Recent social growth has produced a higher awareness in patients of health care and prevention. The more 'conscious' patients and the policy of prevention in health care presume the existence of modern hospital buildings which support the new social changes (2.4 Conclusion of Chapter 2, 5.3.5 Conclusion of 'Hospital Design and Function').
On the basis of these considerations, modern criteria should be introduced into the design and function of hospitals, taking into consideration: the new trends recorded in some newly built American hospitals (4.5 Conclusion of chapter 4); the traditional issues constantly influencing design and recorded in 3.4 Conclusion of chapter 3.

7.2.2 New Role of Hospitals

It is evident that hospitals are changing their traditional function of institutional buildings. The recently built hospitals in the United States are similar (in configuration and function) to modern residential buildings and large hotels (4.3.1 New Developing Categories of Hospitals: case-studies). They include facilities and activities (4.3.1.1 'Mall' Type of Hospital and Activity within Health Care). Here the patient takes on the role of 'client' and 'guest' reflecting the concept of the patient that 'takes responsibility' for his health (Conclusion of Chapter 4).
Some recently built hospitals are based on the use of natural therapies and physical activity (4.3.2.1 Natural Therapeutic Ingredients and Cures: case-study of Seattle, Springfields). Realised in the attempt to support health care, rehabilitation and prevention in one formula, they support the patient's health and well-being. Here the renewed use of traditional therapeutic principles is evident.
The configuration and atmosphere of conventional hospitals has been completely transformed in some recently built American hospitals that are based on a patient-focused design (4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree Model). The purpose of creating a relaxing atmosphere, home-like environments and comforts, and closer assistance supports their realisation. These requisites, constantly sought also in hospital history (3.1.3 Conclusion

of 'Hospital Building in History'), are newly improved in these hospitals which seem to answer the demands of patients (4.3.2.1 Natural Therapeutic Ingredients and Cures: case-study of Seattle, Springfields, 4.3.4 Living Standards and Arts in Hospitals: case-studies, 5.3.4.1 Quality of Life and Hospitals: cas-studies and Planetree Model).
On the basis of these facts and of objectives promoted by the W.H.O. (4.3.3 Prevention Policy and Sustainability in Building), modern hospitals should incorporate analogous and suitable requisites to support the health and well being of patients and the new prevention policy. To this end, the new trends in hospital design and function should be taken into consideration (4.3.1 New Developing Categories of Hospitals, 4.3.2.1 Natural Therapeutic Ingredients and Cures: case-study of Seattle, Springfields, 4.3.4 Living Standards and Arts in Hospitals: case-studies, 4.3.4.1 Quality of Life and Hospitals: case-studies and Planetree Model) as well as the typology of the components included in design for the realisation of Sustainable Buildings (4.3.3.1 Physical and Psychological Well Being: case-studies).

7.2.2.1 Special Places and Activity

A majority of hospital patients can move and walk. Often it is possible to see these patients outside the main entrance of the building or by the entrance hall, where a variety of people usually walk around stand or sit to watch other people passing by. Usually patients and people must wait for specialised medical examinations, therapeutic treatments, diagnostic tests and results, etc.
Cafeteria, toilets, waiting rooms and other places, where to sit and wait, show that a variety of people have daily contacts with hospitals. Notwithstanding this situation, the design of conventional hospitals does not provide special places where to go and stay (except waiting rooms and cafeteria) for their various broad public.
Many people, and not only patients, spend part of the day within the hospital building for different reasons. Many people go to hospitals every day for various reasons (such as to visit someone, to have a consultation, to undergo therapy or have a diagnostic examination, et.). There are many people who need to remain a great part of the day in hospital, as for example in- and out-patients waiting between consecutive phases of the treatment or consecutive examinations… relatives waiting for the surgical operation of the patient and regularly assisting the patient (particularly in such units as emergency, surgery and intensive care)…
For these people, usually there isn't a comfortable and quite place, except the waiting room or cafeteria where to sit and stay. Patients ask also for social contacts, information and physical comfort.
There are experts that assert: *"moving after surgery is often considered good therapy for the patient"* [8]. These experts also support the creation of spaces for activities (for example patients' lounges and library) and facilities (for example a hairdresser inside hospitals). To include hospital initiatives like these is considered positive for patient healing. These experts state that *"patients are more likely to walk if there are attractive and interesting places to go....many patients are encouraged to get up from their beds as part of the recovery process...they are more likely to become ambulatory if they have attractive places to go"* [8].
For these reasons, some 'special' place should be introduced in the design of hospitals and also special 'activities' should be included addressed to the various categories of visitors and patients, hospitalised for long or short period of time. These could be activities such as computers (for games and for the supply of medical information), reading and listening (books, magazines and tapes should be supplied in an apposite room), visual and verbal initiatives (such as the supply of videotapes, performances of shows) etc. Something 'special', intended as a place and activity together, this could also be the creation of a permanent

exhibition of items such as historical images of the hospital, or traditional medical tools and equipment used in history, or pictures and information about alternative medicine or pharmaceutical herbs, etc.).
The presence of a 'special' place where to go and the presence of 'activities' like these would: fulfil the need of different people, support the psychological well being of the patients, give a more modern image of hospitals (by improving the level of comfort and by supporting the assistance and supply of information).
The array of green areas should be also supply special places outside the building by including restful walks and benches, interesting points to be visited in nice weather. In this way the patients could for example contemplate a nice view or read a book outside or meet other patients outside.
Special places and special components of design should be created outside, to give the patients the opportunity to 'experience' the green surroundings of a hospital (these could be a green spot, a green garden and fruit trees or a flower conservatory, a small zoo or pond with fish, or a particular fountain or a stream with plays of water, a special clock with the different times of the countries in the world, an artistic composition or sculptures, exhibitions etc.). Open spaces should be provided also to practice modest physical activities, compatible with the physical condition of the patients, supporting health care, rehabilitation and prevention.
The initiatives above are considered to support the physical and psychological well being of the patients by: de-stressing the patients against the traditionally stressful relationship between patient and disease; encouraging the patients (*"...many patients are encouraged to get up from their beds as part of the recovery process.."* [8]); keeping them 'alive' physically and mentally.

7.2.2.2 High-Stress Reducing Formula: Case-studies

The 'Relaxation Room' was presented at the Ninth Symposium on Healthcare Design held in Boston, 14-17th November '96. This included psycho-acoustic therapy, meditation and relaxation systems to be used in hospitals. Here a relaxing and comfortable atmosphere provided by comfortable seats, images of nature in combination with music would promote stress-reduction in patients [11].
Some systems of relaxation also in the form of de-stressing expedients should be integrated into hospitals to support patients' well being. This could be fulfilled in different ways as for example: by introducing special components in design (7.2.2.1 Special Places and Activity); by means of natural ingredients and traditional principles (e.g.: by creating a winter garden supported by the presence of flowers and plants; by supplying the right atmosphere by means of images, colour, soft music, appropriate light; by supplying appropriate fragrances in apposite spaces and the atmosphere for relaxation, etc).
Recent studies, carried out by the Olfactory Research Fund, testify to the relaxing properties of some fragrances. The results of these studies *"reveal that fragrance can positively affect sleep, stress, alertness, social interaction and general feelings of well-being"* [12]. This is one of the several opportunities provided by the many natural means of therapy applied in history and still receiving people's consent (3.2.1 The Influence of Natural Means of Therapy).

7.3 Well Being and Prevention

Many possibilities are available to produce a patient-focused design to support patients' well-being. and the new politics of prevention (4.3.3 Prevention Policy and Sustainability in Building, 4.3.3.1 Physical and Psychological Well Being: case-studies). This could be also done on the basis of traditional therapeutic principles as those promoted first by Hippocrates, sustained then by the following Hippocratic schools and by homeopathic medicine until the present day. Some of these principles are based on the use of natural means of therapy, contact with nature and natural ingredients, and physical activity. The prevention of disease now promoted in health care is still based on analogous principles (4.3.2 Renewed Request for Natural Therapeutic Means: case-studies, 4.3.2.1 Natural Therapeutic Ingredients and Cures: case-study of Seattle, Springfields, 4.3.2.2 Physical Activity: case-studies).
Having supported and produced the healing of the patients through history (3.2 Health Care in History, 3.2.1 The Influence of Natural Means of Therapy), they are considered suitable to support patients' well-being (4.3.3 Prevention Policy and Sustainability in Building, 4.3.3.1 Physical and Psychological Well Being: case-studies).

7.3.1 Traditional Therapeutic Principles

In the Asklepieia, a wonderful natural resort, the luxury of the indoor environment, comforting treatments such as massages and baths, the presence of 'amusement' such as a theatre and the component of 'suggestion' were the means adopted for healing the patients (3.1.1.1 Temples and Healing Places).
Similar features are to be found in some newly built American hospitals, where a relaxing atmosphere is created by means of pictures and decoration, and appropriate furnishing/building components (4.3.1 New developing Categories of Hospital: case-studies). Luxurious building/furnishing components and arts have even been introduced in some of these hospitals, just as it happened in the Askleipeia (4.3.4 Living Standards and Arts in Hospitals: case-studies, 4.3.4.1 Quality of Life and Hospitals: case-studies, 4.3.4.2 Perception of Hospital Environment). The intention is evident of producing comfortable environments for healing.
Hospital buildings are not only going to change in their configuration but also in their function. The use of traditional therapeutic principles such as those applied by Hippocrates and later on in history has been renewed. Such hospitals (8.2.1 Present Experience: Planned and Built Examples) seem to correspond with the expectations of patients and experts of hospital design and medical care (4.3.2 Renewed Request for Natural Therapeutic Means: case-studies, 4.3.2.1 Natural Therapeutic Ingredients and Cures: case-study of Seattle, Springfields, 4.3.2.2 Physical Activity: case-studies).
These new models of buildings support the integration of analogous 'therapeutic principles' into hospital design such as the following: the creation of comfortable environments by means of appropriate building/furnishing components; the use of decoration, pictures and colours in building/furnishing; the introduction of 'natural' supporting environments by means of natural ingredients. These kinds of components are considered suitable for supporting and promoting patients' healing and well-being for the reasons above (4.3.3.1 Physical Psychological Well Being: case-studies, 7.1.3.2 Patients Well Being). Doctors and experts also manifest besides approval of these kinds of changes which also correspond to the current trends in health care (4.3.2 Renewed Request for Natural Therapeutic Means: case-studies, 4.3.2.1 Natural

Therapeutic Ingredients and Cures: case-study of Seattle, Springfields, 4.3.2.2 Physical Activity: case-studies).

7.3.2 Contact with Nature

People create, appreciate and sometimes contemplate private and public gardens for the pleasant view they offer. Plants and flower-beds in public parks, the verges of streets or highways, spots of trees are considered not only to produce psychological but also physical benefits to man. Numerous studies testify to the advantages deriving from the presence of plants and green spots.
Recent research conducted by NASA [9] ascertained that some particular plants -in a conveniently large space- purify the air in this space by converting into nourishment certain dangerous substances (such as formaldehyde and benzene, trichloroethylene, carbon dioxide and monoxide, etc.).
The air contained in a specific volume can be partly purified by a Philodendron (it would be able to absorb more than the 87% of the formaldehyde and benzene present in a determined space, in a 24-hour period). A Gerbera Daisy would reduce the quantity of benzene contained in the air of a room up to 69% in 24 hours [9].
This research asserts also that a papyrus could almost substitute an electric evaporator in the space of a room where could be used as a humidifier [9]. The same function could be performed by clorophytum, philodendron and ficus, whose need of abundant water would produce the release of humidity into the air [9].
Referring to the public parks of the big cities we use to say that plants and trees act as a "lung" in heavily residential areas. They have in fact the property of balancing the air moisture and conditioning the temperature. Trees have particular positive attributions as well. Recent research shows that a beech tree is able to absorb carbonic anhydride in the same quantity produced by 800 households [10] and only one tree can make 445 litres of water evaporate in a day, producing 230.000 calories [10]. This means that only one tree is able to refresh the air with the same capacity of 20 hours air conditioning using five domestic appliances [10].
The presence and the view of natural surroundings is a relevant component of hospital design. It was considered indispensible in the case of the Askleipeion and in Nightingale's writings. The preference of the patients for a window with 'a view' overlooking the natural landscape (7.1.3.3 Multipurpose Window) confirms the constant importance given to the green spaces in the case of hospitals.
Green surroundings were ever present in hospitals (3.1 Hospital Building in History). This was until the increase of the population and of building activity. In fact, when urbanisation started to accelerate -that is since the beginning of this century (3.1.1.10 The First Skyscrapers in the Twentieth Century)- hospitals started to be built in traffic filled areas and built-up environments, even though the lack of green spaces was complained of. The need to create environmental conditions at man's measure (4.1.1.1 Sick Hospital Syndrome: case-studies, 5.1 Choice of the Site and 7.3.3 Multipurpose window) started later on against the discomfort of those people living in the highly developed areas of the cities.
Plants are pleasant to our sight and not only for this reason, but also for their utility, their presence is integrated the urban array. A series of initiatives were recently taken to re-establish the traditional safe relationship with the natural environment. Special projects have been produced in the context of the cities to reproduce the combination of natural ingredients in the design of residential and urban areas (like small ecosystems and ponds, green spots with small animals living freely, etc.). In these circumstances, the grey rain water is often recycled through phytoprocess with the definite purpose of being re-used (for example for gardens,

toilets etc.). A project like this was developed in Germany (Oekologisches Siedlungsprojekt, Am Moorwiesengraben, Kiel-Hassee reported in Oekoligisches Bauen, Wanderaustellung der Landesregierung Schleswig-Holstein, September 1989).
The relaxing influence of natural surroundings on human psychology has been established by various research. Green surroundings and contact with an open space should be integrated into hospital design also to provide a relaxing place for hospital patients. Their necessary and positive presence should be thought of as even more positive when this includes attractive and interesting environments suitable for promoting both patients' 'activity' and well being (8.2.2.1 Special Places and Activity, 6.2.2.3 Hospital Identity: case-studies).
There are many examples of built hospitals that integrate the green areas of hospitals as a specific design component. A beautiful green park surrounds the hospital 'San Pietro Fatebenefratelli' in Rome (Italy), in which marble statues are found on pathways and in small squares. They are located at crucial points. A small zoo has also been included in the design to attract the interests of patients and visitors.
Flowers and green plants have always been interpreted as a message of hospitality and congratulations. It is also for this reason that their presence and exhibition (they are usually put in places such as entrance-halls and large corridors, patients' rooms etc.) is frequent in private clinics. For this reason a variety of plants should be provided indoors to create home-like environments and pleasant places where to stay such as winter-gardens. Here the patients could benefit from the pleasant atmosphere created by the plants, by the sunlight and warmth (provided by skylights and large glass-sheets), by the specific array, etc. The same relaxing and comfortable atmosphere should be produced which is created by designers in other modern public structures (e.g.: hotels, large shopping centres and so on).
If the benefit produced by the contact with a green space can 'add' to the design of hospitals, why not supply some of the opportunities above to patients?
Gardens and green areas should be indispensable components of hospital design. Initiatives like those mentioned have also been taken in other public structures and, for this reason, they would give a modern impression of a hospital, where their presence would be advantageous to various ends: to be a frame for the building and parking areas; to act as a filter against noise and pollution from roads; to supply fresh and shaded spaces in summertime; to offer the psychological benefit given by the relaxing view.

7.3.3 Physical activity

The Romans appreciated the positive effect of physical activities on health, as expressed by the well-known roman aphorism 'mens sana in corpore sano'. The 'revival' of natural therapeutic means and the trend towards prevention is now manifest in different ways.
The benefits gained by the performance of at least a minimum of physical activity have been highlighted by recent research. An interesting item reported in JAMA of July 1996 promoted the positive contribution provided by physical activity in the prevention of disease stating: *"in addition to its effect in reducing mortality, lifelong physical activity may promote wellness and therapy help decrease health care costs by reducing the need for hospitalisation"* [13].
Another essay supports the performance of physical activity both for prevention and for therapy. Here it is asserted:*"...moderate levels of physical activity confer significant health benefits. Even those who currently meet these daily standards may derive additional health and fitness benefits by becoming more physically active or including more vigorous activity. For those with known cardiovascular disease, cardiac rehabilitation programs that combine physical activity with reduction in other risk factors should be more widely used"* [14]. It looks as though the new attitude of experts is reminiscent of the old Roman aphorism 'mens sana in corpore sano'.

As a consequence of the recent trends in health care, which support the health and well being of the people and the prevention of disease, appropriate spaces for physical activity (at least a minimum) should be included in the design of modern hospitals. Various motivations support their presence in hospitals such as its traditional use for rehabilitation, the improved application of physical activity in health care and the traditional contribution given by physical activity as a means for disease prevention. Hospital design should particularly take into account the increasing interest in physical activity and the new policy in health care sustaining that it is better to support prevention than cure (4.3.3 Prevention Policy and Sustainability in Building).
On the basis of the previous considerations, appropriate spaces for physical activity should be integrated into hospital plan.

7.4 Improving Function and Quality of Design

The policy of the W.H.O. promotes the health and well being of the population also by means of design (4.3.3 Prevention policy and Sustainability in Building). According to the analogous criteria adopted in the realisation of Sustainable Buildings, preferences and needs of the patients should be taken into account in hospital planning. In the newly built American hospital (4.3.1 New developing Categories of Hospitals), a patient should be considered 'consumer' and 'guest' of the health care facility. On the basis of the present trends in health care and hospitals, comfort and consideration should be given to the patient by means of a patient-focused design.
Various circumstances are connected to the many activities of a hospital. Hospitals are supposed to answer the needs of a wide range of people: in-patients and staff, occasional patients and visitors including the categories of young, old and disabled individuals. The experience, opinions and needs of hospital staff and patients should be taken into consideration in the realisation of a patient-focused design. The collaboration of these people would allow a complete view of the various circumstances within hospitals.
The accomplishment of hospital design is the sum of various projects concerning different components of design (4.4 Hospital Design and Designer Responsibility), as an expert in hospital design states, *"enhanced planning is always enthusiastically preferred as being the 'better puzzle' which can offer the most useful benefits to the institution and the community"* [15]. Being the design of hospitals given by the combination of plural components, integrated decisions should support and improve its quality. The holistic collaboration and the opinion of different categories of people (experts, designers, builders and technicians) would consent to fulfil better results. But, since hospitals are dynamic structure susceptible of functional change (2.3.1 Social Background, 5.2 Hospital Design and Environmental Configuration), designers should also take into account their 'future', including previsions and criteria sustaining their functional development.
The fulfilment of design mostly depends on the regular performance of hospital function and on the maintenance of hospital building, since they make a hospital 'work'. These two components (management and maintenance) should be influenced by appropriate criteria adopted in design consenting to 'take under control' the conditions fulfilled in design. The quality of design should be improved also by integrating hospital function and design one with the other.
Some experts of hospital design state that for the design of hospitals *"there are no magic formulas except for the constant revisiting of issues"* [15]. The periodical 'revisiting' of the issues of design

supporting the function of a hospital should be integrated into a 'master' plan, including criteria for management and maintenance of the building. Not only would be this formula efficient in affording the unavoidable not-prevented circumstances, but mostly to hold the pulse of the situation in hand, and mostly to keep the conditions of design valid over time. It is also for this reason at last, that hospital planning should derive from the contribution given by all targets groups of people involved in hospital design, maintenance and function.

Conclusion of 'Enhancements in Hospital Function' Chapter 7

The traditional type of relationship between patient and hospital has changed. A different modern image of the patient is provided by some newly built American hospitals. Actually, the patients are active participators of a new health care system and structure, becoming automatically the object and focus of design. On the basis of the growing consciousness concerning health and diseases, they take on an active role also in health care where they are supposed to be 'taking responsibility' for their health.
New trends and changes have been recorded in health care, stimulated by the new politics of prevention promoted by the W.H.O. Experts, doctors and the public approve and sustain the positive use of the natural therapeutic means and the performance of physical activity which have been adopted both for therapy and prevention (4.3.2.1 Natural Therapeutic Ingredients and Cures). The renewed use of traditional therapeutic principles for therapy and prevention has been also seen in some newly built hospitals.
The new politics of prevention and the policy of the W.H.O. (4.3.3.1 Physical and Psychological Well Being) generally influence building design and should also influence the design of hospitals. On the basis of such criteria, the Hospital promoting Health and Well Being includes environmental and functional requisites focused on supporting and promoting the well-being of patients, staff and visitors.
'Healthier' more comfortable environments and atmospheres are created in the Hospital promoting Health and Well Being, by integrating a number indispensable design components, on the basis of:

- the changes actually recorded in hospitals
- the constant consent recorded in history for a number of design components
- the principles promoted by the W.H.O. in building and used for Sustainable Design

Correlated to these facts, a series of components has been identified to be integrated into hospital design in order to:

- improve the quality of design and support the function of hospitals
- respond positively to social changes and to make up for the inadequacy of design (Conclusion of Part I and II).

The aim of creating health supporting environments (against the risks related to environment and health) and the 'humanisation' of the 'cold and institutional' atmosphere of hospitals is achieved by integrating appropriate design components. Non-institutional and de-stressing environments are realised by taking into account the level of comforts found in modern public structures of large dimension and the factors which affect and support the activity of the main sections of hospitals (entrance hall and reception, waiting rooms, diagnostic and treatment areas, patient rooms). The new components of design mostly focus on supporting assistance (e.g.: supply of information, telephones and toilets at hand, other facilities such as children's areas, accommodation and comfort for different categories of people, cafeteria and shops

etc.). Relevant initiatives are introduced into hospital design as well, integrating activities promoting patient well being (7.3 Well Being and Prevention).

Summary of chapter 7

ENHANCEMENTS IN HOSPITAL FUNCTION

PATIENT-FOCUSED DESIGN
PATIENT COMFORT AND WELL BEING
PRIVACY AND SOCIAL ACTIVITY
FAMILIAR ASSISTANCE
DISEASE PREVENTION
INCREASED CONTACTS WITH GREEN SPACES
NATURAL THERAPEUTIC PRINCIPLES

IMPROVEMENT OF THE QUALITY OF DESIGN
SUPPORT OF THE ACTIVITY OF HOSPITALS
IMPROVEMENT OF THE FUNCTION OF DESIGN
HOLISTIC COLLABORATION
PERIODIC REVISION OF DESIGN AND FUNCTION

Validity of the Enhancements Proposed
Chapter 8

A study was carried out to ascertain the validity of the enhancements proposed in chapters 6, 7, 8. These concerned a number of components of design which were considered necessary to improve the conditions of hospitals on the basis of what was illustrated in Part I.
The study consisted of interviews with patients and staff of hospitals and in the collection of analogous experiences taken from present and past experiences and the future perspectives of hospital design (Part II, Part III).
Some of these components, mostly in relation to function and configuration of hospitals (e.g.: changes to be applied in hospital configuration, the introduction of activities in hospitals, patients' wishes for a number of items, etc.), were the object of an interview with the patients of hospitals.
Other questions related to components concerning environmental conditions and configuration (e.g.: flexibility of design, modularity, air conditioning, natural ventilation, etc.) were asked to the chief of the maintenance and engineering office of the Klinikum Hospital (this building was chosen since it had the requisites in question).
Some of these components concerning environmental conditions, configuration and function were found in public buildings and in a few examples of built hospitals which are illustrated in this chapter by means of a short description or by means of sketches and pictures.
The interviews conducted in hospitals to ascertain the validity of these components are also reported below.

8.1 Interviews with Patients and Staff

The approval of the patients and hospital staff was considered necessary to the introduction of specific enhancements in the Hospital promoting Health and Well Being. For this reason two questionnaires were prepared in order to have interviews in hospitals.
The opinion of the patients was needed particularly to validate components considered as supporting a patient-focused design (7. Enhancements in Hospital Function, 7.5 Conclusion of Chapter 7).
The opinion of the technical staff was necessary to validate components concerning environmental conditions and configuration (5 Enhancements in Environmental Conditions, 6 Enhancements in Environmental Configuration). In this case the chief engineer of the Klinikum Hospital was interviewed to ascertain his eventual approval for flexibility and modularity (which were integral parts of the design of this hospital) and for natural ventilation (against the large scale use of air conditioning in this hospital).
The details of these interviews are reported below.

8.1.1 Patients' Opinions

Patients' opinions were asked for in three hospitals of three different countries:
1) Ospedale Villa S.Pietro in Rome (Italy)
2) RWTH Klinikum in Aachen (Germany)
3) Diaconesse Ziekenhuis in Eindhoven (The Netherlands).

The interview, carried out in the years 1997-98, was focused on the wishes and preferences of the patients in matters of hospitals. Fifteen people were interviewed for each hospital included in the study. The questions mostly concerned the items identified for the design of the 'Hospital promoting Health and Well Being' and therefore related to environment, function and the feeling of well-being.

Eight complexes of questions were asked and the respondents were asked their opinion of the eventual presence or absence of a series of activities and circumstances. The patients were also asked what they thought about the use of colour in the building and about the presence of images (like pictures, printings, photographs etc.) in hospital environments. Their opinion was also asked regarding possible changes in the traditional image of the hospital and which could be the eventual positive/negative effects deriving from the improved environmental quality within the hospital building. A correlation was made between the 'traditional' model of hospitals (that is conventional for us in function and configuration) and an eventual more 'modern' model (which, integrating modern components in function and configuration, would give an alternative image of the hospital).

The aim was to know the opinions of the patients about:

- the opportunity of introducing changes in the traditional design of hospitals
- the typology of these changes (on the basis of concrete proposals)
- their eventual preference for specific components of design

The aim was besides to register the answers given by the patients in order to compare the possible correspondence of the results from three different backgrounds and cases.

The hospitals were chosen on the base of their having some expected analogy with the type of Hospital which is object of this study. This fact allowed the patients to have concrete ideas about the questions of the interview on the basis of practical examples.

They were were chosen on the basis of the following specific characteristics:

3) Klinikum Krankenhaus in Aachen (D) was a typical example, among other aspects, for the use of colour indoors and modern components of design. Its peculiarity was the green colour dominating indoors (walls and floor) as opposed to the usual 'white walls' of the conventional hospitals.

   Its two-levels high, large entrance-hall was supplying shops and escalators. The tables of the cafeteria overlooked the entrance-hall from a balcony.

   The assistance was supported by the provision of comforts like: physical activity for the patients in specific circumstances; different types of meals were served (dietary, vegetarian, normal) according to the preference of the patients; coffee and various types of tea were available at any time.

   Several patients usually walked in the hall and shopping area. When the weather consented, they sat and walked outside the building, mostly in front of the main entrance of the building and in the open cloisters situated on ground level.

   The building structure and technology had other special caracteristics reported below ('Interviewing the Technical Staff').

4) Diaconessen Ziekenhuis in Eindhoven (NL) had been partly renewed just at the time of the study (1997). The renewed large entrance hall, two-levels high, was made of different building materials and a variety of colour was used in its building and furnishing components. Large glass-sheets were used as well as green plants. A sort of 'window-shopping' area had been built in the middle of the reception where different goods were displayed for patients and visitors to the hospital. A display of brochures was placed close to the main entrance.

   Large glass-sheets were realised overlooking the large entrance, the renewed part of the building was made partly in plaster partly in bricks, coloured furniture and illumination

created a comfortable atmosphere. In practice this part appeared completely different from the old part of the building (which looked like an obsolete and conventional hospital) mostly for the presence of modern building components, variety of building and furnishing material, colour and green plants.

5) Ospedale Villa S.Pietro in Rome (I) was taken for the large green spaces surrounding the building sloping from the gate towards the main structure. Coloured flowerbeds and a cave with religious statues were located in front of the entrance. A few marble statues had been situated in the park according to the design of passageways and small squares.

A small zoo with a few animals (mostly goats and chickens) had been created in the green surroundings of the building to give the opportunity for a walk.

The patient rooms were facing the green spaces, but the structure had not yet been renewed though the renewal was planned.

The scheme of the interview is reported below:

A) WHICH OF THE FOLLOWING OPTIONAL REQUISITES WOULD YOU LIKE TO BE PRESENT IN A HOSPITAL TO FEEL (EMOTIONALLY) RELAXED AND SATISFIED ?

would you like

1- a room for a private conversation and privacy?
2- a patient room suggesting 'familiarity' in furniture and decoration, illumination and atmosphere?
3- a patient room with a 'view' on the natural landscape or on a 'green' area?
4- a green spot and gardens to promenade, with eventual mini-zoo or similar attraction?
5- a shopping area to visit and buy determined items?
6- a gym area equipped to do easy physical exercise?
7- a comfortable place where you could read, listen to music, play computer games or other..….....(please write your preferences)?
8- comfortable space where it would be possible to lie down and relax, with soft lighting, fragrant smells and soft music?
9- a space to communicate and talk without disturbing other patients in the same room?
10- a room to watch television and movies on cassette?
11- a personal area within the patient room where to write or read undisturbed, or where to use a personal apparatus such as a radio or other..….....(please write your preferences)?
12- a choice of attractions such as exhibitions, photographic collections, illustrations about hospital or medical history and so on?
13- the possibility to get more personal information about your case, substantially more assistance?

B) WHAT IMPRESSION WOULD YOU HAVE ABOUT A HOSPITAL WITH FLOORS LIKE OTHER PUBLIC BUILDINGS (FOR EXAMPLE LARGE SHOPPING AREAS OR HOTELS) AND COLOURED WALLS, COMPARED TO THE 'ANONYMOUS' FLOORS AND 'WHITE' WALLS OF A TRADITIONAL HOSPITAL ?

1- positive
2- negative
3- .....(please specify other consideration)

C) IF YOU ANSWERED 'POSITIVE', WHAT KIND OF ATMOSPHERE DO YOU THINK IT WOULD PRODUCE

1- satisfying to your sight
2- more relaxing, able to de-stress patients
3- .....(please specify other consideration)

D) IF YOU ANSWERED 'NEGATIVE', WHAT KIND OF ATMOSPHERE DO YOU THINK IT WOULD PRODUCE

1- disturbing to your sight
2- less relaxing for the patients
3- .....(please specify other motivation)

E) WHAT KIND OF ATMOSPHERE DO YOU THINK THE PRESENCE OF COLOUR IN FURNITURE AND BUILDING MATERIALS WOULD PRODUCE IN A HOSPITAL?

1- more modern
2- more hospitable and familiar
3- more elegant
4- more confidential, depending on the environmental 'personalization' or better, on the correspondence with an environment suggesting attention and care
5-.....(please specify other motivation)

F) BESIDES THE COLOUR: DO YOU THINK THAT THE PRESENCE OF PICTURES OR IMAGES ON THE WALLS COULD PRODUCE A MORE HOSPITABLE AND FAMILIAR ATMOSPHERE, IMPRESSING HOSPITAL STAFF AND THE PATIENTS MORE POSITIVELY?

1- yes
2- no
3- .....(please specify other consideration)

G) DO YOU THINK THAT THE ENVIRONMENTAL QUALITY COULD IMPROVE THE ENVIRONMENTAL CONSIDERATION ?

1-yes
2- no
3- .....(please specify other consideration)

H) DO YOU THINK THAT THE HOSPITAL IMAGE SHOULD BE CHANGED AND RENEWED IN ORDER TO BE RENDERED MORE MODERN, OR SHOULD IT MAINTAIN ITS TRADITIONAL STANDARDS ?

1- changed and renewed
2- maintained within traditional standards
3- .....(please specify other consideration)

Final Results

The majority of the people interviewed, though living in three different countries, confirmed the existence of a common feeling and a will for change. Their approval was almost unanimous for the 'change' and for the 'typology of changes' proposed.
Everyone, in the three different countries interviewed, sustained in a very large proportion that the image of traditional hospitals should be changed to take on a modern configuration (only very few negative answers were collected: 3 in Italy, 3 in Germany, 2 in The Netherlands).
The majority of the people interviewed, considered the presence of colour in furnishing and building material positive (negative answers: 1 in Italy, 2 in Germany, 2 in The Netherlands), resulting both 'satisfying to your sight' and 'more relaxing'. The presence of colour was

approved by the majority (only total of 3 people maintained that the presence of colour could disturb and could result in less relaxation for the patients). It was considered to produce a home-like 'more confidential', 'more hospitable and familiar' atmosphere.
People considered the presence of pictures and images also positive (negative answers: 3 in Italy, 3 in Germany, 4 in The Netherlands) supporting the increase of hospitality and familiarity.
The three groups of people approved the opinion that the improved quality of the hospital configuration could generally suggest higher respect and consideration for the environment.
Regarding the introduction of activities, a wide variety of answers was given.
This only testifies that the patients wish to have some comforts at hand, though every single individual has his/her own preferences.
Looking at the first question of the interview including a list of thirteen items (asking their preference about 'optional' items to be introduced by hospitals), the answers show that all the items were checked by the people (not even one of these items was excluded). The individual preferences though, were particularly concentrated on privacy and information reported in n. 9 and 13 (of the first complex of questions). For this reason, beyond the approval for more opportunities, it was possible to deduce that people asked particularly for more privacy and information.
A slight difference was noted about the proportion of requests between the three groups of people.
The people interviewed in Italy asked for more privacy and information (number 9 and 13 of the list above mentioned). The people in The Netherlands gave preponderantly the same result with additional answers about number 1 (increase of privacy). The people in Germany -besides number 1, 9 and 13- asked also number 3 and 7 (window with 'view' and activity).
In conclusion, this study ascertained the common will for change. This change is expected in relation to the configuration and function of conventional hospitals (mostly the appearance of the surfaces, of the components, of building technology and concept). For this reason, a number of components such as those suggested in this interview have been introduced in the design of the Hospital promoting Well Being (e.g.: colour and decoration, components of design increasing assistance and comfort, 'activities', a window with a view, familiar atmosphere, increased privacy). These components are considered:

- to correct some of the failings recently complained of about hospitals by patients, doctors and experts (2.3 Function of Hospitals, 4.3 Hospital Design and Function, 7 Possible Enhancements in Hospital Function)
- to give a positive answer to the inadequacy of hospitals in relation to social development, which supports the modernisation of hospital design and function (Conclusion of Part II).

8.1.2 Interview with the Chief Engineer of the Klinikum Hospital

The interview conducted in the Klinikum was aimed at ascertaining the validity of the structural flexibility, modularity and the natural ventilation. The choice of the Klinikum Hospital in Aachen (D) was based on the fact that:

- this hospital integrated the analogous requisite of flexibility reported in 6.1.1
- positive opinions had been voiced about the Klinikum Hospital in Aachen (D) , mentioned as a winning model of flexibility by G. Martinazzoli ('Gli Impianti Ospedalieri'- published by La Nuova Italia Scientifica 1995)
- this hospital made large scale use of air conditioning instead of natural ventilation

A number of questions were asked to the engineer Mr. Filios Basile -chief of the technical administration of the hospital- about the:
- effective utility of flexible building systems
- specific system applied in the realisation of the Klinikum
- real efficiency of air conditioning

The interview confirmed that the typology of the building helped to realise numerous adaptations in the lay-out of the building motivated by many requests from the different medical doctors working in the Klinikum. *"The structural flexibility of the building was the key to reach new needs in reasonable time"*, says engineer Mr. Filios Basile, confirming that various structural changes have occurred over time in order to satisfy the needs of different doctors and the requests of the staff.

He explained besides that the flexibility of design in the Klinikum hospital is due to:
- the modular distance of the columns
- the modular dimensions of the functional spaces resulting in more easily adaptable configurations
(contrarily to spaces varying in size)
He asserted then, that the modular square grid between the pillars of the hospital allowed methodical adaptations in the lay-out of the building and agreed that structural modularity gives the possibility of applying modular building and furnishing systems.

Filios Basile stated besides that the frequent presence of air conditioning indoor was responsible for producing poor air quality, especially related to:
- the lack of air moisture
- the difficulty of balancing the parameters of the air adequately to weather conditions
He asserted that for these reasons patients complained of the lack of fresh air indoors.

It was concluded from this study that modular building systems should be taken into consideration in hospital planning, not only because of their use through history, but also because of:
- changing needs
- easier application of refurbishment
- possibility of applying also modular furnishing systems
It was further concluded that natural ventilation should be (whenever possible) provided in hospitals owing to:
- the difficulty of adapting, constantly and properly, the parameters of the air to the different weather
conditions to ensure physical comfort
- the lack of air moisture often due to the use of air conditioning, producing physical discomfort
- the request of the patients for fresh air
The use of natural ventilation in Hospitals supporting Health and Well Being is owing to:
- the constant need for increasing natural ventilation in hospital history (3.1.1.4 The Issue of increasing Indoor Ventilation, 3.1.1.8 Constant issues: Familiar Configuration, Structural Flexibility,
Ventilation) and at present (1.1 Causes of Health Risk in Buildings)
- the presence of the delicate situations affecting the environmental conditions of hospitals (2.2

Complaints of Hospital Designers, Staff and Patients)
- the presence of risks due to air conditioning systems (4.1.1 Risks affecting the Environmental conditions, 4.1.1.2 Risk of Disease)
- the existence of failings related to the design and maintenance of air conditioning systems (4.2.1 Risks affecting the Environmental Conditions, 1.1.1.1 The Role of Ventilation)
- the promotion of natural ventilation against different causes of pollution (1.1 Causes of Health Risk in Buildings, 1.1.1.1 The Role of Ventilation)

8.2 Present/Past Analogies in Buildings

Research was carried out to collect examples of hospitals and buildings which included some of the requisites illustrated in chapters 5, 6 and 7.
The following collection of hospitals and buildings, illustrated by short descriptions or by pictures, show the possible application of specific components of design concerning environmental conditions, configuration and function.

8.2.1 Present Experience: Planned and Built Examples

The following examples of hospitals, built all over the world, were found in the literature. They include components such as for example: comfortable environments, increased contacts of the patients with the natural surroundings of the building, introduction of physical activity and other factors supposed to influence the patients positively.

CROZER-KEYSTONE HEALTHPLEX in Springfield, Philadelfia (U.S.A.).
A big Health Complex, the Crozer-Keystone Healthplex in Springfield, a suburban area of Philadelphia, is expected to be a prototype for health care delivery in the 21st century. It is supposed to provide primary, preventive and rehabilitative care *'under one roof'* [1]. The Complex includes the already existing Springfield Hospital, refurbished and implemented in function and services: *"a new operating wing, emergency room, outpatient services, ambulatory care, radiology, cardiac and cancer rehabilitation, diagnostic services, a center for occupational health, sports medicine, physical medicine and rehabilitation, a health enhancement center, and a women's health center. Services in the office building will include orthopedics, pediatrics, ob/gyn and family medicine"* [1].
What is particularly interesting is that this hospital includes the largest physical therapy department of the world, as is reported in the item 'Fit to be cared for': *"the health club will be outfitted with a six-lane, 25-meter swimming pool; a therapy pool; basketball, racquetball, squash and tennis courts; a running/walking track; aerobics studios; cardiovascular training and other exercise equipment; and the requisite steam room and sauna"* [1].
The principles leading to this kind of solution for hospital are illustrated in the same article. Usually doctors and hospitals care for illness. In this case the function of medicine, doctors and hospitals are seen '*in positive'*. Here, as they properly assert, they are *'building wellness'*.
The first step is *"to identify treatment programs, how they interact and how they could be better"* says Dr.N.DiNubile. Being an expert in fitness and sports medicine, he sustains that *"exercise can serve as the foundation for prevention and treatment of just about any malady ranging from cardiac problems to diabets"*. He believes that *"the success of that approach rides on patients taking responsibility for their own*

health care" and underlines this is *"an element that's often missing from managed care programs, but which will probably become more important in any future managed care scenario"* [1].
N. DiNubile is a promotor of the opinion that *"not enough emphasis is placed on patients taking charge of their own wellness"*. This model of Healthplex (Health+complex) takes into account the recent policy of prevention in health care. It is in practice the 'vital link' between health prevention and health care: it gives the patient healthy conditions and further possibilities towards the fulfilment of well-being.

CLEVELAND CLINIC, HOUSTON'S METHODIST HOSPITAL, WASHINGTON HOSPITAL CENTER in Washington D.C. and JOHN HOPKINS HEALTH SYSTEM Marburg Building in Baltimore, Maryland (U.S.A.)
Cleveland Clinic, Houston's Methodist Hospital and Washington Hospital Center in Washington D.C. are the type of hospitals that even 'exaggerate' in offering luxurious accommodation, excessive optional services and decoration. These hospitals *"resemble fine hotels"* is asserted by A.M.Nordhaus-Bike [3].
Marburg Building, Johns Hopkins Health System, appears now in the National Register of Historic Places. Here, a floor of the hospital was refurbished to create 16 luxurious suites and single rooms. Materials and features of first quality have been used in the building, like cherry-wood floors and panelling, oriental rugs and antiques. Assistance and services of the hospital include comforts and services such as accommodation for family members, special meals, refrigerators and VCRs, fax and home-like electrical apparatus [3].

DE BIJTJES HOSPITAL, Brussels (B)
This high specialised hospital treats Neurology, Locomotory, Cardiopulmonary and Chronical pathologies. Built in 1996, it is close to the castle of Inkendael near Brussels.
Materials and colours were studied to produce a familiar home-like atmosphere and a definite character was impressed on the indoor spaces. Some aspects of way-finding are taken into account. *"Exposed masonry alternates with plastering and ceramic tiles"* …says Foqué… *"accents in cheerful colours create fresh interiors and help people find their way and recognise where they are"*.
The design of the hospital mostly promotes the integration of the building within the natural landscape. According to the plan of the building *"the existing buildings and the surrounding landscape were integrated in the design, which is a unique combination of a highly-specialised hospital and a home-like environment."*.
The architecture of this building was integrated also with the view of the castle emerging in the landscape. *"This reference to one of the archetypical elements of the home helps the patient to identify with their environment"*, says the architect Foqué [4] sustaining that the sloping roofs of the hospital produce a feeling of familiarity. The choice of building material and colour was also addressed to supporting this integration with the land which was considered *"as part of the functional and architectural improvement"* as the architect of the building R. Foqué sustains in his description of this hospital [4].
Foqué asserts also that *"the surrounding gardens play an important therapeutic and recreative role in the healing and rehabilitation process"* [4] and reports a short description of the surrounding green spaces of the hospital.
Out of the building*, "a partially covered circuit of walkways connects a number of small theme gardens and enables a patient and his family to take a walk"*. A choice of 'themes' is given in these different and special types of garden created by the designer, such as *"a sound garden, a scent garden, a water garden, a colour-and-pick garden, an interactive garden, a small meteorological station or a picnic garden"* [4]. In this way, a series of opportunities are given to the patients, Foqué sustaining that *"around these gardens numerous therapeutic and/or educational group-activities may be organized"*.

The contact of the indoor spaces with the natural landscape is promoted by the realisation of wide windows and large glass sheets, consenting the light to permeate these spaces throughout the whole year. Foqué explains: *"the deliberate use of large window openings and glass surfaces ensures a constant atmosphere of light and openess in the interiors, and strengthens the relation with the surrounding landscape and the change of seasons".*
He also created activities for the patients inside the building, as for example *"...a painting and pottery studio, rooms where patients can learn to use a computer, a games library...".*

CHILDREN'S HOSPITAL, Sydney (Australia)
In this case, a new building was re-located to a different place twenty kilometres away from the previous hospital. One of the purposes influencing the plan of this hospital was *"to encourage a recognition of the cultural diversity of Australia using art and performance"* [5].
For this reason, special studies were conducted on colours, materials and furniture in order to inspire the variety of the Australian landscapes. Sculptures, paintings and photographs were *"donated, purchased and commissioned"* [5] also to support the correspondence between the hospital and the local culture.
The intention of the designer was to promote the contact of the patients with the natural surroundings. But the hospital was built on a *"green-.field site"* also owing to the brief of the project, which was to *"look at the hospital community in the widest sense but with major focus on children"* [5]. According to the opinion that the hospital shouldn't look like an 'institution', the design had the aim of creating a home-like environment.
A low-rise building was designed, the ward floor at the same level of the outside spaces. In this way the beds of the patients could be *"wheeled directly out"* [5] onto courtyards and gardens outside the building.
On the first floor, the 'verandas' outside patients' rooms had the same function of supporting contact between patients and the natural environment and landscape. The windows of these rooms were wide and low enough to allow the children lying on the beds to look outside.

OTHER EXAMPLES ILLUSTRATED BY PICTURES (fig.10-24)
Certain recent and older hospitals are illustrated also by means of pictures, documenting the use of specific components in hospital design (e.g.: arts and statues, contact with a natural environment and zoo in the gardens, shopping areas, murals and colours, large entrance-halls, skylights and glass-sheets).
Specific structural features are also illustrated by pictures which show the components commonly included in recently built public structures (e.g.: large entrance halls and escalators, glass-sheets, skylights, colours, arts and 'murals'). The recent common use and function illustrate partial practical 'improvements' which are considered as resulting from a natural evolution of the architecture. Therefore they are considered suitable to improve the quality of hospital design and the architecture of modern hospitals to be competitive with other public buildings (on the basis of the material in Part I, II and III).
Pictures taken in Ecolonia (NL) and prospects sketched illustrate some of the biocompatible building technologies and passive systems already included in buildings. They show various realised improvements in housing which easily should be applied also in a hospital (on the basis of what was concluded in Part I, II and III).

8.2.2 Hospital Design: Past Experience and Present Trends

Given the Current Conditions of hospitals, hospital design needs to be improved in **Environmental Conditions, Configuration and Function** (Conclusion of Part I), on the basis of:
- recent policy influencing building activity
- risks affecting the indoor environmental conditions of hospitals
- failings concerning hospital configuration and function
- social factors influencing hospital design

To fulfil this aim, the recent policy of the W.H.O. is taken into account and correlated to the failings recorded in hospitals, since it influences:
- building activity (supporting sustainable design)
- health care (supporting disease prevention)
- social development (supporting health and well being)

On the basis of the previous considerations, all the factors susceptible to improve the quality of hospital design about **Environmental Conditions, Configuration and Function** are investigated and ascertained. The past, present and future perspectives concerning hospital design are studied to identify the causes of the failings recorded in design and to identify the eventual remedies.
It is deduced from this study that (Part II):
- **social, scientific and technologic progress has always influenced hospital design**
- **hospitals are at present inadequate to the progress**
- **specific responsibility is given to hospital design**

Supporting the health and well being of the people and the prevention of disease, by means of design, the policy of the W.H.O. is considered suitable to:
- fill the gap due to progress
- give positive answers for specific failings of hospital design regarding Environment and Function

The final results of this study support the choice of specific enhancements consequently integrated in the design of the Hospital promoting Health and Well Being.

8.2.2.1 Stages of this Study

The enhancements to be introduced in hospital design are identified on the basis of the experience taken on from the past and the present trends concerning hospital design and health care. A number of case-studies support the final conclusions of this study, whose stages are briefly illustrated below:

A) EXPERIENCE TAKEN FROM THE PAST

According to the **EXPERIENCE TAKEN FROM THE PAST**, a number of factors (which designers had constantly approved and improved in history) are considered indispensable to fulfilling the aims of the Hospital promoting Health and Well Being; responding over time to the needs of patients and hospital staff (Conclusion Part II). They are:
- PRIVACY

- FAMILIAR ASSISTANCE
- HOME-LIKE FAMILIAR ENVIRONMENTS
- POSITIVE PERCEPTION OF THE ENVIRONMENT
- NATURAL INGREDIENTS SUPPORTING PATIENT HEALING (SUPPORT ALSO OF THE INCREASE OF NATURAL VENTILATION)
- LAY-OUT OF HOSPITAL FUNCTION AND CIRCULATION
- STRUCTURAL FLEXIBILITY
- ISSUES DERIVING FROM THE PROGRESS (ADEQUACY TO PROGRESS)

B) CASE-STUDIES

Many case-studies are reported in Chapter 5 which helped to identify the causes of the failings recorded in Part I. On this basis it is possible to introduce corresponding enhancements in design (5- Present Factors influencing Hospital Design).

C) PRESENT TRENDS

At the end of Part II the **PRESENT TRENDS** are highlighted which are recorded in design, in society and health care (Conclusion Part II). They are:
- PREVENTION POLICY IN HEALTH CARE
- SUSTAINABLE DESIGN PROMOTED BY THE W.H.O.
- FULFILMENT OF PATIENT WELL-BEING
- DIFFERENT ROLES OF THE PATIENT
- DIFFERENT ROLES OF HOSPITALS
- SOCIAL INITIATIVES AND PROMOTION OF ACTIVITY
- PROMOTION OF PHYSICAL ACTIVITY
- PROMOTION OF NATURAL THERAPEUTIC MEANS
- PRESENCE OF RISKS IN HOSPITAL ACTIVITY
- NEED TO COHORDINATE PLURAL ASPECTS OF DESIGN
- PARTICULAR RESPONSIBILITY OF DESIGNERS, BUILDERS AND TECHNICIANS

8.2.2.2 Final Proposal for the Enhancement of Hospital Design

A proposal for the enhancement of the environmental conditions, configuration and function of hospitals is formulated in three chapters (5 Enhancements in Environmental Conditions, 6 Enhancements in Environmental Configuration and 7 Enhancements in Hospital Function) which take into consideration:
- the criteria adopted for sustainable design promoted by the W.H.O.
- the 'EXPERIENCE TAKEN FROM THE PAST'
- the relevant 'PRESENT TRENDS' influencing hospital design and the case-studies (4- Present Factors influencing Hospital Design) necessary to identify causes and remedies of the failings recorded in hospitals (Part I)

The enhancements identified in these three chapters are:

a) Regarding Environmental Conditions, they concern specific choices of design (Summary of Chapter 5) which refer to:

- **SITE** (choice of a natural location, use of natural ingredients and resources, principles of Feng Shui)

- **TECHNOLOGIES FOR THE ENERGY SAVING** (increase in insulation, use of passive systems and appropriate building technologies)
- **BUILDING/FURNISHING MATERIAL** (renewable, hygienic/non-polluting, requiring little maintenance, easy-to-dismantle and substitute, use of recycled products)
- **IMPROVEMENT OF THE QUALITY OF DESIGN** (collaboration of experts and technicians, co-ordination of various components of design, education and information, systematic methodology of design, regular maintenance and periodic revision of design)

b) Regarding Environmental Configuration, they concern (Summary of Chapter 6):
- **BUILDING TYPOLOGY AND FUNCTIONAL FLEXIBILITY** (structural/technological flexibility, modularity, lay-out of design in relation to activity/flexibility/circulation)
- **ADEQUACY OF DESIGN TO MODERN STANDARDS** (introduction of modern means and components of design, giving of identity)
- **PROMOTION OF COMFORT AND WELL BEING** (user-orientated design, home-like components, images and colour, natural ingredients)
- **IMPROVEMENT OF THE QUALITY OF DESIGN** (co-ordination of design, holistic collaboration, systematic methodology of design, regularity of maintenance and periodical revision)

c) Regarding Hospital Function, they concern the realisation of (Summary of Chapter 7):
- **PATIENT-FOCUSED DESIGN** (supporting comfort and well being, privacy and social activity, assistance, disease prevention, contact with green spaces, natural therapeutic principles)
- **IMPROVEMENT OF THE QUALITY OF DESIGN** (support of hospital activity and function, holistic collaboration, periodical revision of design and function)

The final validation of the enhancements proposed is performed by:

- interviews and research carried out on purpose (Conclusion of chapter 8: 'Validity of the Enhancements Proposed')
- a number of components ever valid over time (Conclusion of Chapter 3: Hospital Building and Health Care in History)
- interviews and case-studies carried out by researchers and reported in Chapter 4 (Present Factors influencing Hospital Design) and in the Chapters 5, 6 and 7 (5 'Possible Enhancements in Environmental Conditions', 6 'Possible Enhancements in Environmental Configuration' and 7 'Possible Enhancements in Hospital Function').

Conclusion of 'Validity of the Enhancements Proposed' Chapter 8

The interviews carried out in hospitals and the examples of buildings and hospitals reported in this chapter (8.1 Interview with Patients and Staff, 8.2 Past/ Present Analogies in Buildings) support the introduction of enhancements like those illustrated in Chapters 5, 6 and 7.
Particularly:

1) The interviews carried out in hospitals (8.1.1 Patients' Opinions, 8.1.2 Interview with the Chief Engineer of the Klinikum Hospital) and the paragraphs mentioned in brackets support the
introduction of the following components of design:

- **colour and decoration** (6.2.2.2 Presence of Colour and Natural Light: Interview with the Patients, 6.2.2.3 Hospital Identity: Case-studies)
- **components of design increasing assistance and comfort** (see also 3.1.3 Conclusion of Hospital Building in History, 4.2.2 Need for Modern Components of Design: Case-studies, 4.3.4 Living Standards and Arts in Hospitals: Case-studies, 4.3.4.1 Quality of Life in Hospitals: Case-studies and Planetree Model, 4.3.4.2 Perception of Hospital Environment, 7.1.3.2 Patient Well Being)
- **'activities'** (4.3.1 New developing Categories of Hospital: Case-studies, 6.2.2.3 Hospital Identity: Case-studies, 7.2.2.1 Special Places and Activity, 7.2.2.2 High-Stress Reducing Formula: case-studies)
- **a window with view** (3.1.1.6 The Pavilion Hospital in the Nineteenth Century, 7.1.3.3 Multipurpose Window: Interview with the Patients)
- **familiar atmosphere** (3.1.3 Conclusion of Hospital Building in History, 5.3.4.1 Quality of Life and Hospital: Case-studies and Planetree Model, 7.1.3.4 Conclusion of Patient Rooms)
- **increased privacy** (3.1.3 Conclusion of Hospital Building in History, 4.3.1 New developing Categories of Hospital: Case-studies, 7.1.3.4 Conclusion of Patient Rooms)
- **flexibility and modularity** (3.1.2 Building Typology, 4.2.1 Lack of Flexibility: Case-studies)
- **supply of natural ventilation** (1.1.1.1 The Role of Ventilation, 4.1.1.1 Sick Hospital Syndrome: Case-studies, 4.1.1.2 Risk of Disease: Case-studies, 4.1.1.4 Risks, Design and Hospital Activity)

2) The examples reported in 8.2 Present/Past Analogies in Buildings, the sketches and drawings at the end of this chapter, and the paragraphs mentioned in brackets validate the introduction of the following components of design:

- **use of appropriate building/furnishing material** (1.1.2 Polluting Materials, 5.3 Building and Furnishing Material)
- **use of appropriate building technology** (5.2.1 Realisation of Walls, 5.2.2 Realisation of Windows, 5.2.3 Realisation of Roofs, 5.5 Conclusion of Chapter 5)
- **use of natural ingredients and physical activity for health care and prevention** (3.2.1 The Influence of Natural Means of Therapy, 4.3.2.1 Natural Therapeutic ingredients and Cures: Case-studies of Seattle, Springfields, 4.3.2.2 Physical Activity: Case-studies, 7.2.2.2 High-Stress Reducing Formula: Case-studies)
- **use of appropriate typology and lay-out of design** (3.1.2 Building Typology)
- **use of modern means** (such as escalators and lifts) **and components of design** (such as large glass-sheets and skylights, large entrance hall, murals and pictures, green plants, etc) (4.2.2 Need for Modern Components of Design: Case-studies)
- **promotion of comfort and well-being** (4.3.3 Prevention Policy and Sustainability in Building)
- **improved function of design in the support of the user** (3.3 Health Care and Building Design in History, 4.3.3 Prevention Policy and Sustainability in Building)

Conclusion of Part III

Perspectives for the Enhancement of Hospital Design

PREVENTION OF RISKS AFFECTING ENVIRONMENTAL CONDITIONS

is achieved by the

CHOICE OF THE SITE FOR BUILDING
INCREASE OF NATURAL COMPONENTS
NATURAL RESOURCES
PRINCIPLES OF FENG SHUI

ENERGY SAVING
INSULATION
PASSIVE SYSTEMS
APPROPRIATE BUILDING TECHNOLOGIES

BUILDING/FURNISHING MATERIALS
LOCAL AND RENEWABLE
HYGIENIC
NON-POLLUTING
EASY TO DISMANTLE AND SUBSTITUTE
RECYCLED PRODUCTS

IMPROVEMENT OF THE QUALITY OF DESIGN
COLLABORATION OF VARIOUS PEOPLE
CO-ORDINATION OF THE COMPONENTS OF DESIGN
INFORMATION AND EDUCATION
METHODOLOGY OF DESIGN
SYSTEMATIC MAINTENANCE
SYSTEMATIC REVISION OF DESIGN

ADVANTAGES ARE GIVEN IN TERMS OF
HEALTH AND WELL BEING, ENVIRONMENT,
FUNCTION (DESIGN AND MAINTENANCE)

PREVENTION OF FAILINGS IN HOSPITAL CONFIGURATION

is achieved by the

PROMOTION OF COMFORT AND WELL BEING
REALISATION OF A USER-ORIENTATED DESIGN
INTRODUCTION OF HOME-LIKE COMPONENTS
INTRODUCTION OF IMAGES AND COLOURS
INTRODUCTION OF NATURAL INGREDIENTS

ADEQUACY OF DESIGN TO MODERN LIVING STANDARDS
INTRODUCTION OF MODERN MEANS
INTRODUCTION OF MODERN COMPONENTS
DESIGN IDENTITY

TYPOLOGY OF DESIGN
DESIGN FLEXIBILITY
MODULARITY
LAY-OUT OF DESIGN

IMPROVEMENT OF THE QUALITY OF DESIGN
HOLISTIC COLLABORATION
REGULAR MAINTENANCE
SYSTEMATIC METHODOLOGY OF DESIGN
INFORMATION AND EDUCATION
PERIODIC REVISION OF DESIGN AND FUNCTION

ADVANTAGES ARE GIVEN IN TERMS OF
HEALTH AND WELL BEING, ENVIRONMENT,
DESIGN AND MAINTENANCE

PREVENTION OF FAILINGS IN HOSPITAL FUNCTION

is achieved by the

PATIENT-FOCUSED DESIGN
COMFORT AND WELL-BEING
PRIVACY AND SOCIAL ACTIVITY
FAMILIAR ASSISTANCE
DISEASE PREVENTION
INCREASED CONTACTS WITH GREEN SPACES
NATURAL THERAPEUTIC PRINCIPLES

IMPROVED FUNCTION AND QUALITY OF DESIGN
SUPPORT OF HOSPITAL ACTIVITY BY MEANS OF DESIGN
DESIGN METHODOLOGY
HOLISTIC COLLABORATION
PERIODICAL REVISION OF DESIGN AND FUNCTION

ADVANTAGES ARE GIVEN IN TERMS OF
HEALTH AND WELL BEING, ENVIRONMENT,
DESIGN AND MAINTENANCE

Final Consideration

Final enhancements are proposed in chapter 5, 6 and 7 (Part III), by taking into consideration the following subjects studied in Part II:
1) the new social changes influencing hospital design and function
2) the criteria applied in the realisation of sustainable design
3) the recent trends registered in health care and hospital design
4) the factors constantly influencing hospital design and health care in history
These enhancements concern:
1) The improvement in Environmental Conditions, Configuration and Function
2) The improvement in the quality of the Design itself (plan, realisation, management and maintenance of the building)

The improvement in the quality of the Design itself is needed to support:
- the prevention of the risks affecting health, building and environment

- the production of competitive hospital buildings (adequate to social, technological and scientific progress)
- the realisation of a patient-focused design
- the validity of design also in the future

It results that: on the one hand there are practical aspects to take into account (regarding Environmental Condition and Configuration and Function); on the other hand there are qualitative aspects to achieve, in order to ameliorate the quality of the Design itself.
The quality of design is also improved in function. In fact, the prevention of the risks affecting health, building and environment, the adequacy of design to modern living standards (its modernisation and adequacy to progress), the promotion of comfort and well-being for the realisation of a patient-focused design (policy of the W.H.O.), are achieved in the Hospital promoting Health and Well Being by improving the following functions of design in supporting the activity of a hospital:
- function of assisting the patients
- function of supporting their healing/well-being
- function of promoting disease prevention

Four final categories of components are introduced in the model of the Hospital promoting Health and Well Being, concerning Environmental Conditions, Configuration, Function and Methodology of Design.
The practical application of these components and their introduction in the design of the Hospital promoting Health and Well Being will be studied in Part IV.

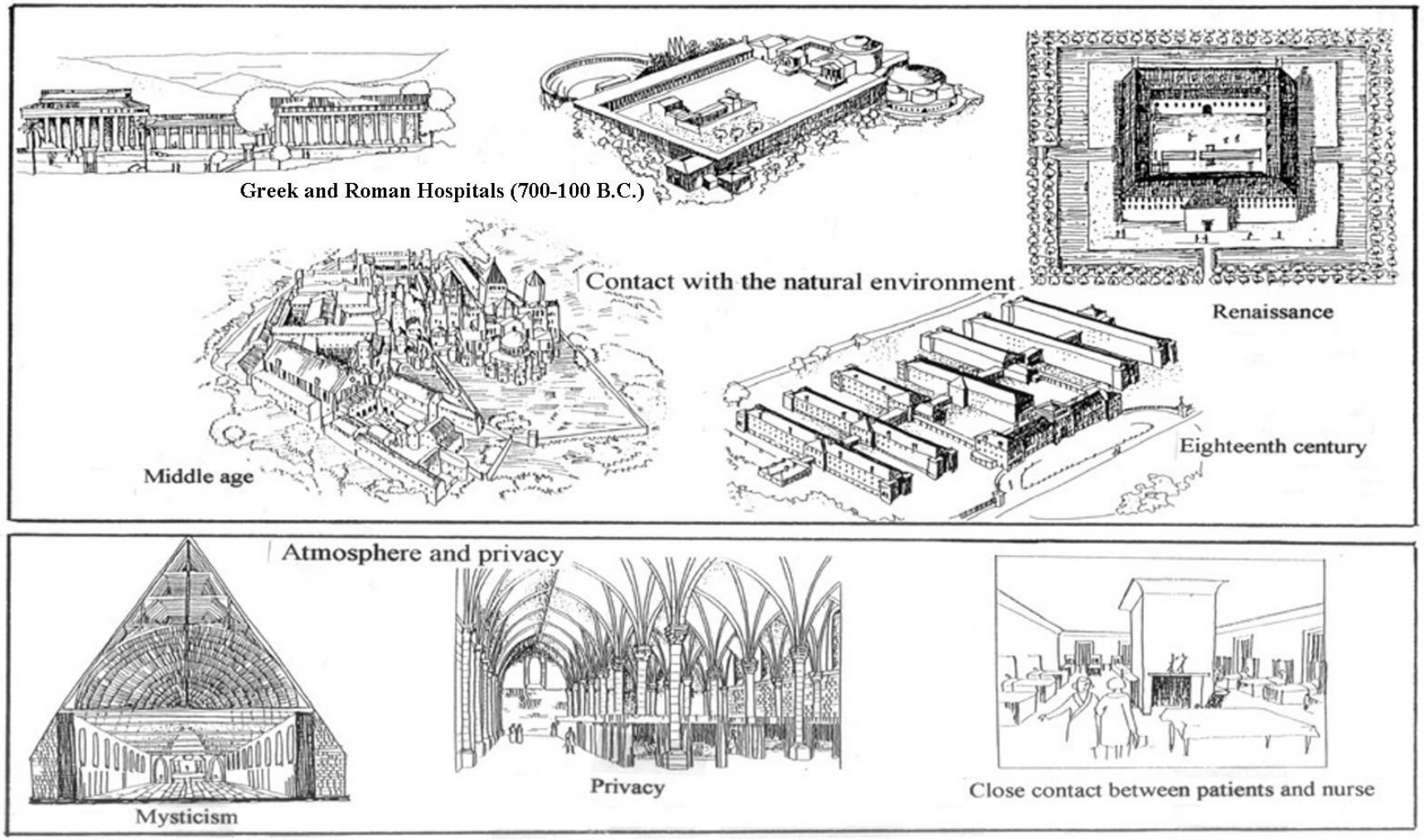
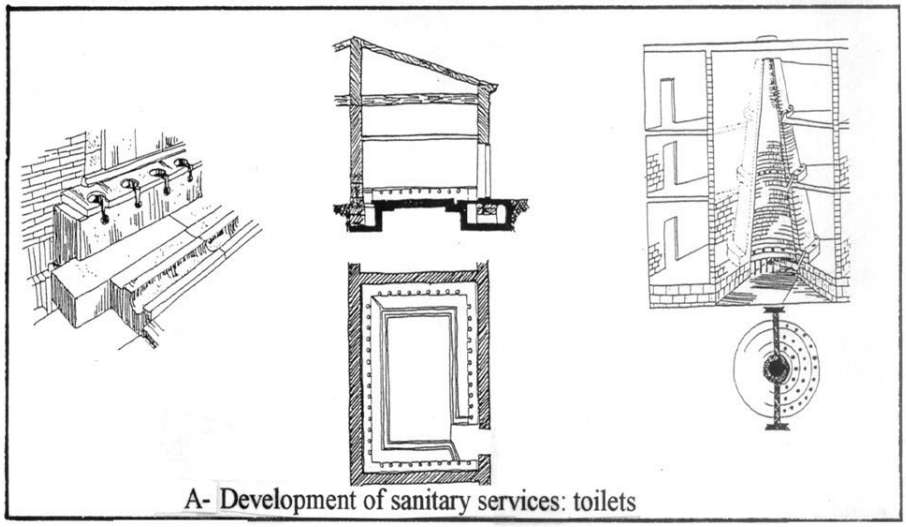


FIG. 1 - ENVIRONMENTAL CONFIGURATION AND ATMOSPHERE



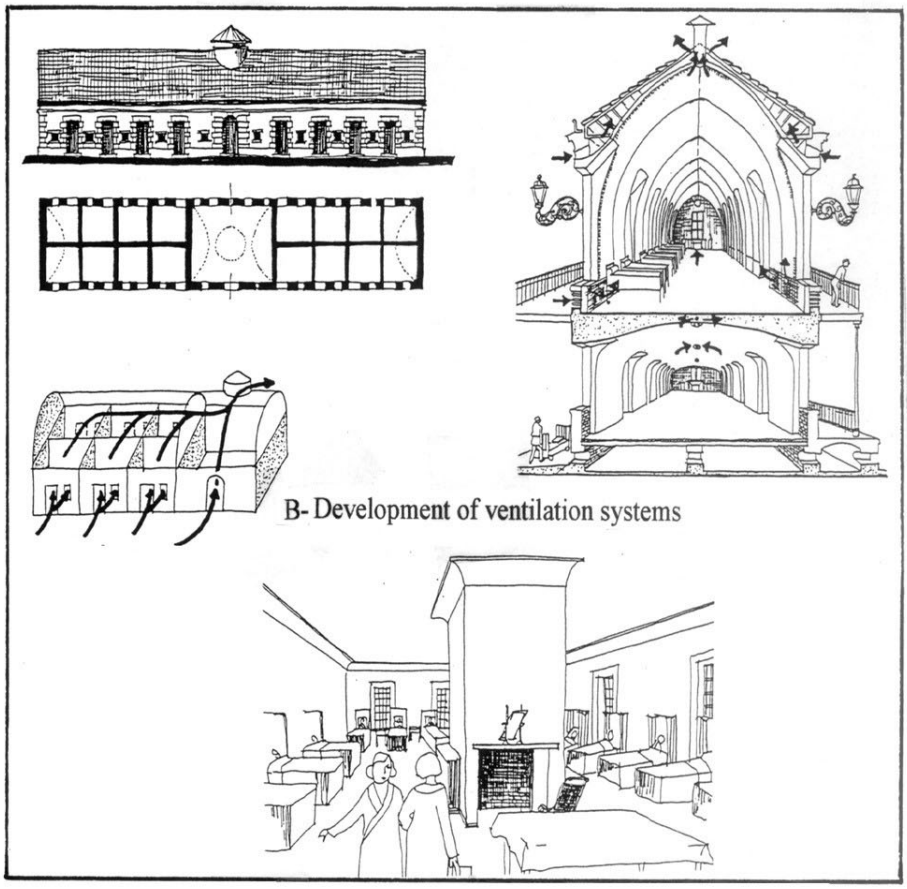


FIG. 2 - INCREASE OF COMFORT

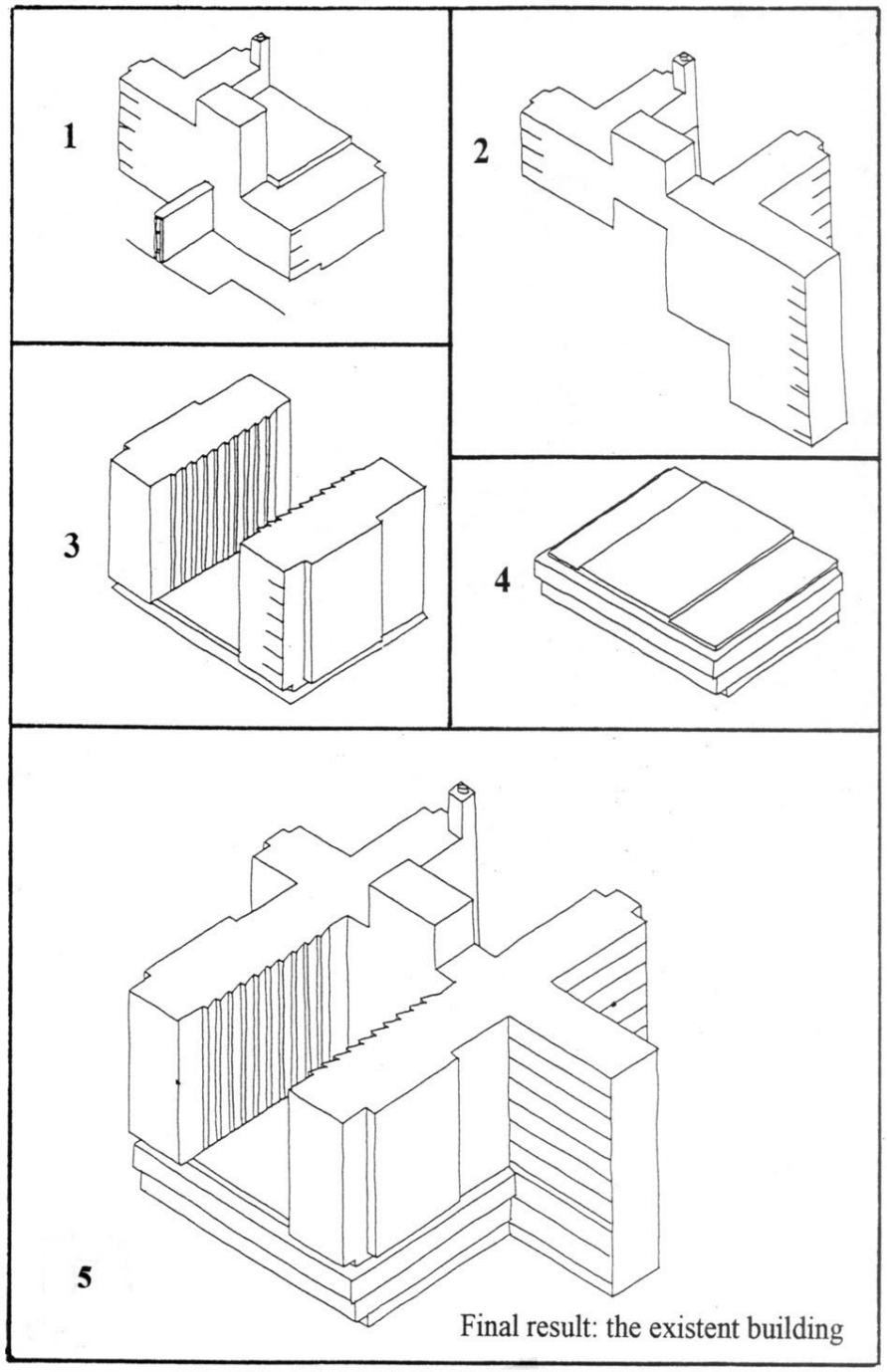


FIG. 3 - PROGRESSIVE EXPANSION OF BRIDGEPORT HOSPITAL (CONNECTICUT, USA), 1970-71

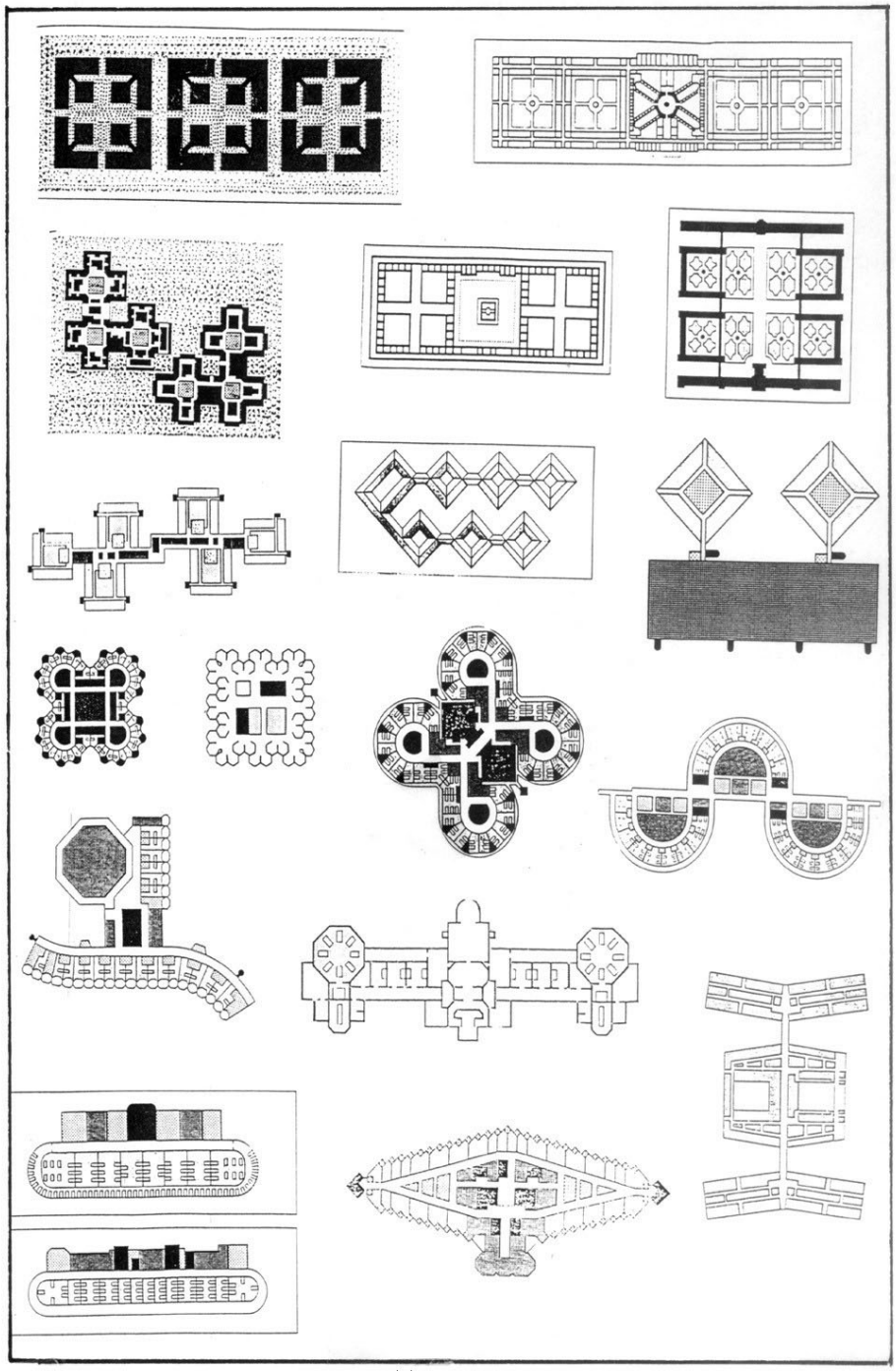


FIG. 4 - DESIGN FLEXIBILITY AND LINES OF EXPANSION IN HOSPITAL BUILDINGS. FLEXIBILITY IS ACHIEVED BY MEANS OF MODULES (TECNICA OSPEDALIERA FEB. 94 - JUNE 95)

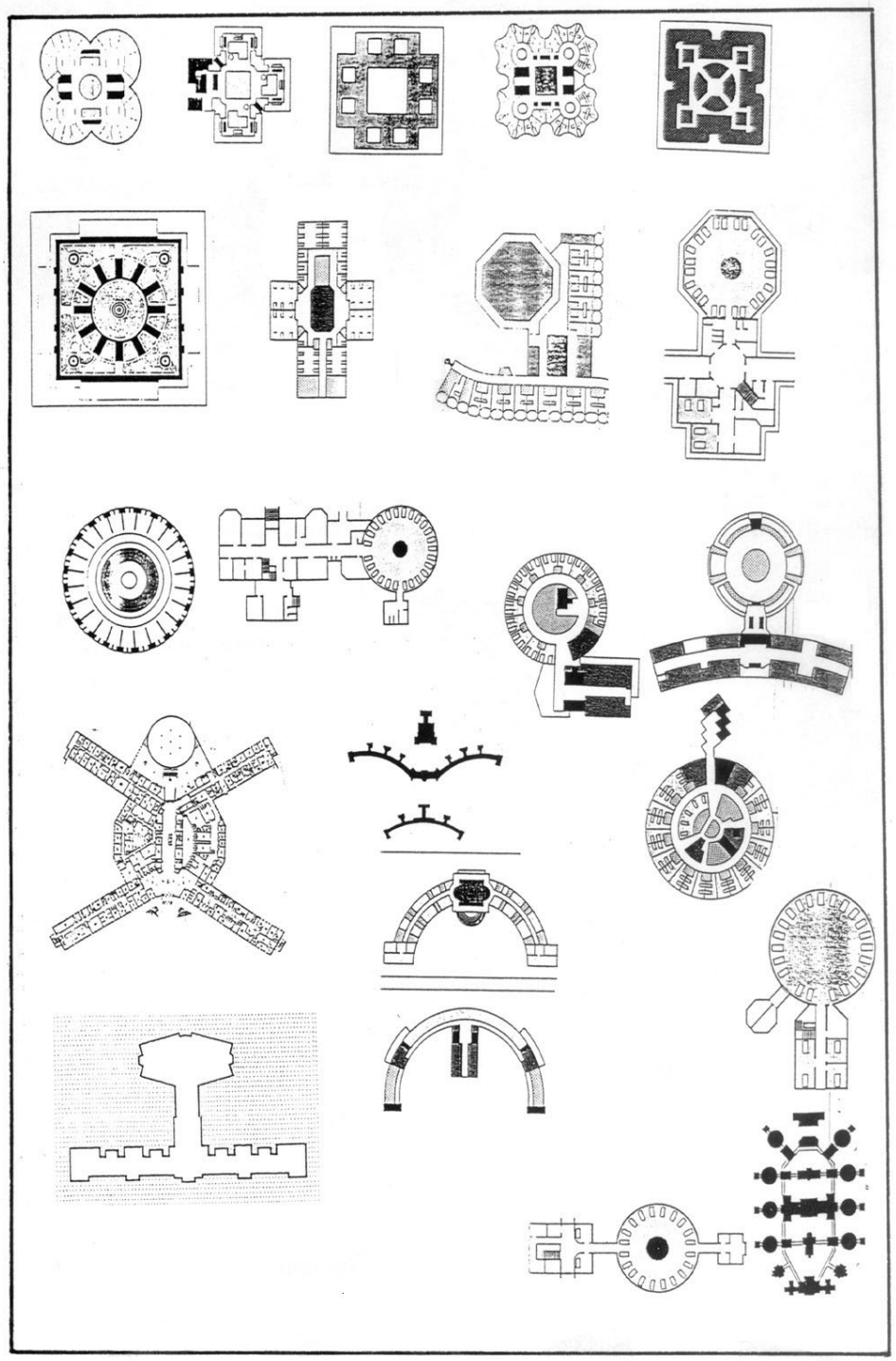
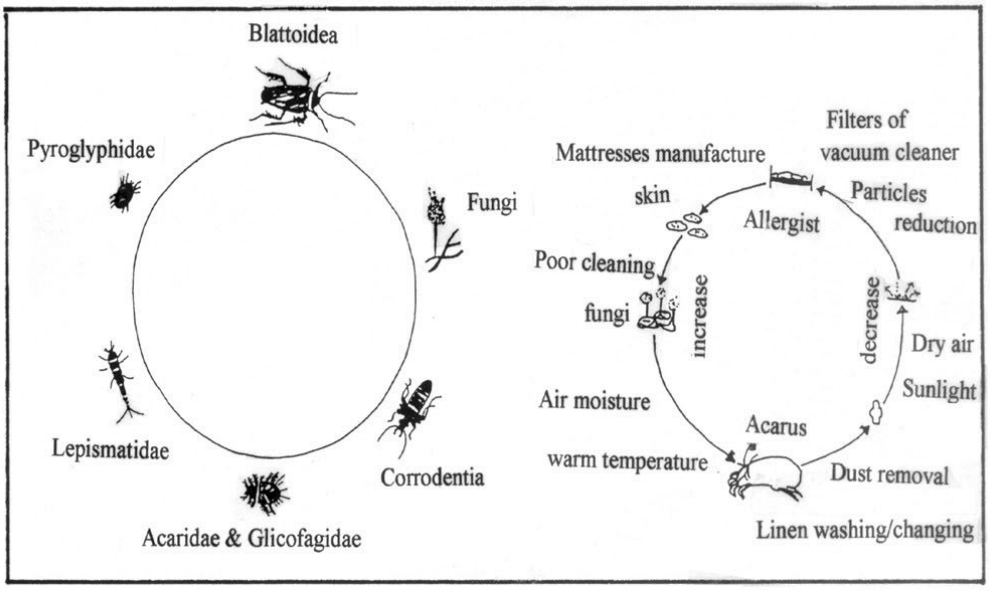


FIG. 5 - DESIGN FLEXIBILITY AND LINES OF EXPANSION IN HOSPITAL BUILDINGS (TECNICA OSPEDALIERA FEB 94 - JUN 95)



ALLERGENS AND DUST ECOSYSTEM - DEVELOPMENT OF ACARUS

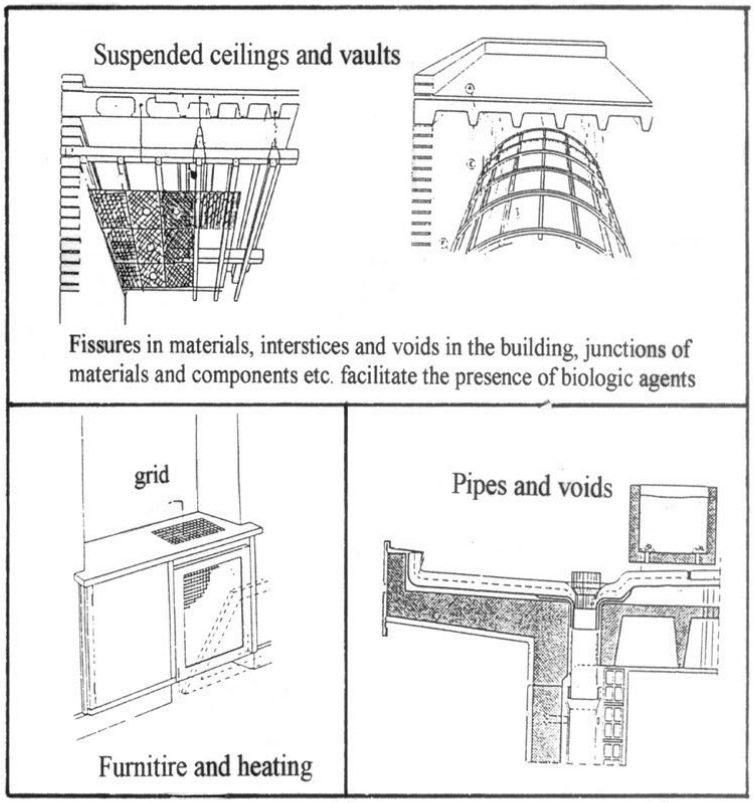


FIG. 6 - BIOLOGIC AGENTS AND BUILDING FEATURES CAUSES OF INFESTATIONS

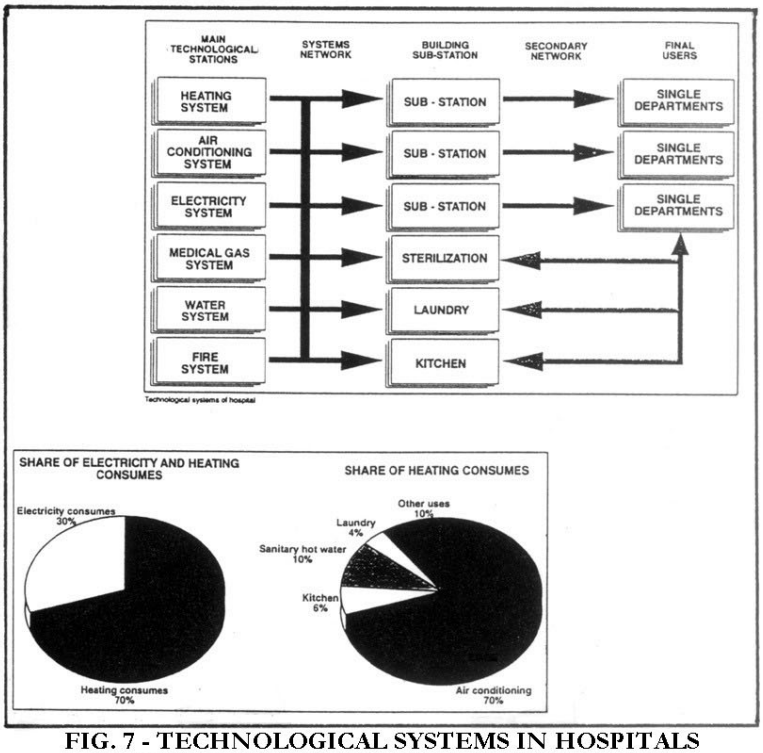


FIG. 7 - TECHNOLOGICAL SYSTEMS IN HOSPITALS
ELECTRICITY AND HEATING CONSUMPTION

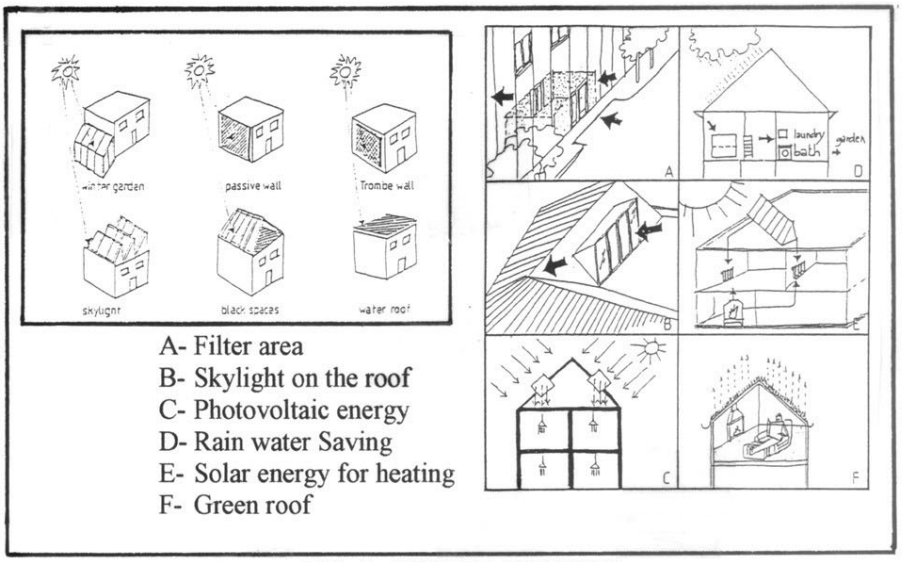


FIG. 8 - PASSIVE SYSTEMS
SUSTAINABLE BUILDING TECHNOLOGIES

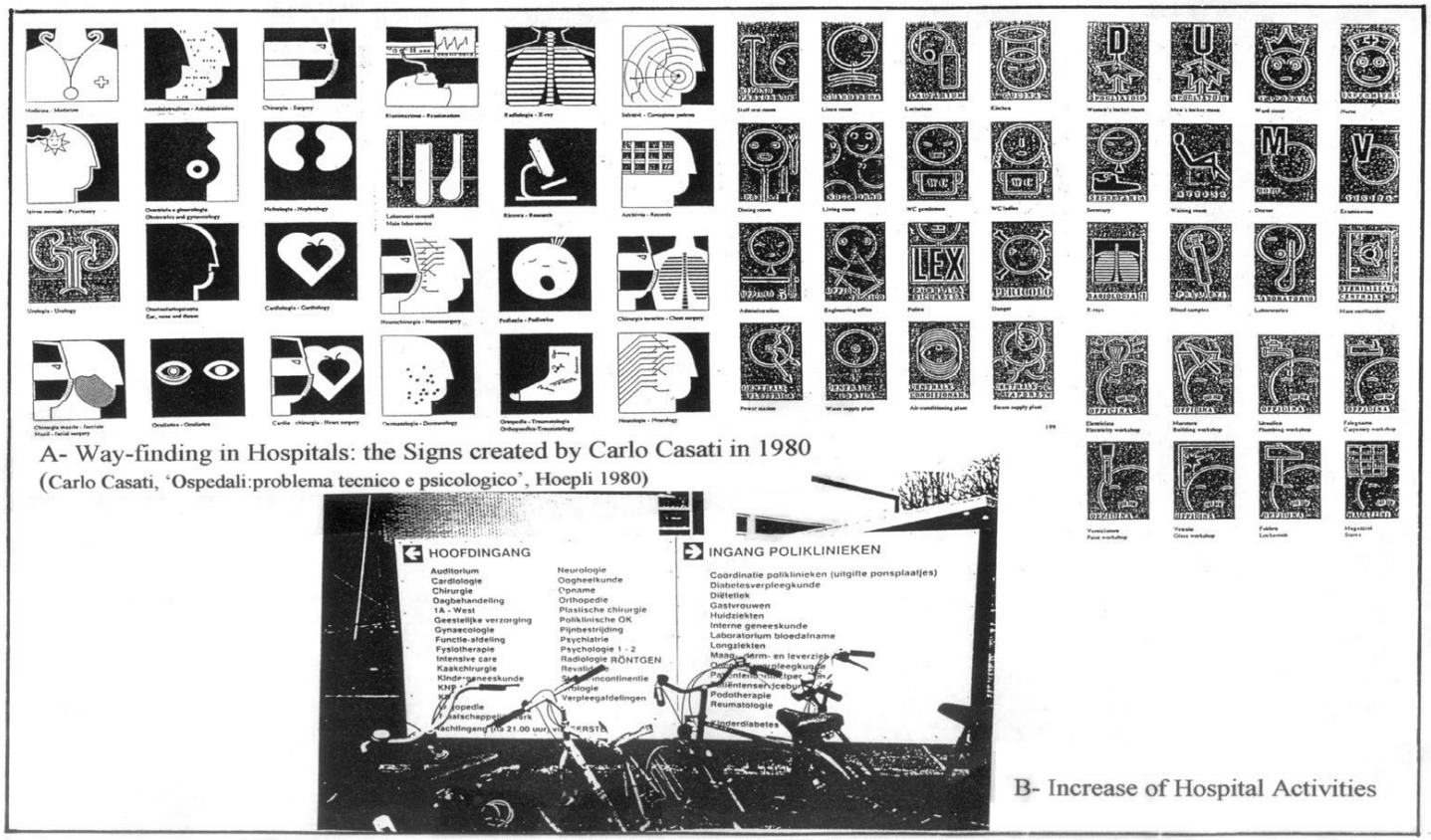


FIG. 9 - INCREASE OF HOSPITAL ACTIVITY AND WAY-FINDING

S.Raffaele Hospital, Roma (Italy)

Sick Children Hospital, Toronto (Canada)

Fig.10 ENTRANCE HALL OF HOSPITALS

Chelsea &Westminister Hospital, London (England)

Diaconessen Hospital, Eindhoven (The Netherland

Sick Children Hospital, Toronto (Canada)

S.Raffaele Hospital, Rome (Italy)

FIG. 11 - MURAL AND COLOUR IN HOSPITAL

Diaconessen Hospital, Eindhoven (The Netherlands)

Klinikum Hospital, Aachen (Germany)

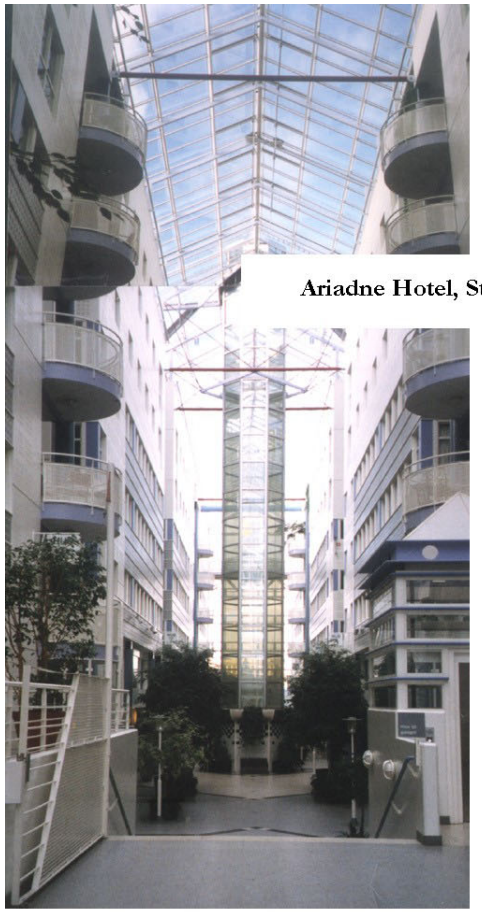
S.Raffaele Hospital, Roma (Italy)

S.Raffaele Hospital, Roma (Italy)

Fig.12 SKYLIGHTS AND GLASS-SHEETS IN HOSPITALS

Diaconessen Hospital, Eindhoven (The Netherlands)

Chelsea & Westminister Hospital, London (England)



Ariadne Hotel, Stockholm (Sweden)

FIG. 13 - GLASS-SHEETS IN A HOSPITAL AND A HOTEL

Chelsea & Westminister Hospital
London (England)

The British Museum of London W 1 (England)

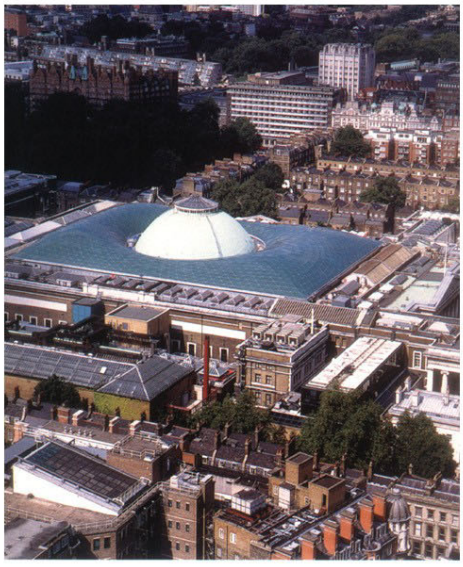


FIG. 14 - LARGE SPACES AND GLASS-SHEETS IN MUSEUMS

Fig.15 **ARCHITECTURE OF PUBLIC BUILDINGS: GLASS-SHEETS, MURALS AND COLOURS, GREEN PLANTS, LARGE ENTRANCE HALLS, LIFTS AND ESCALATORS**

Shopping Centre in Brussels (Belgium)

Diaconessen Hospital, Eindhoven (The Netherlands)

Chelsea & Westminister Hospital, London (England)

FIG. 16 - ARTS AND SHOPPING AREAS IN HOSPITALS

Chelsea & Westminister Hospital, London (England)

Klinikum Hospital, Aachen (Germany)

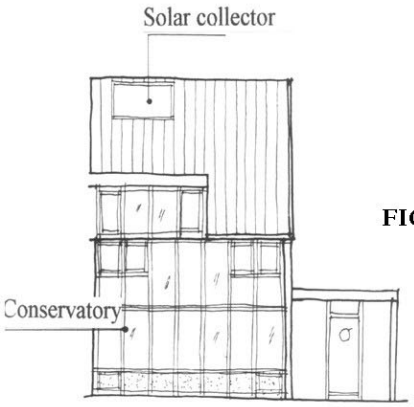
De Bijtjes Hospita, Vlezembeek (Belgium)

S. Pietro Hospital, Roma (Italy)

FIG. 17 - STATUES, POND WITH DUCKS; SMALL ZOO IN HOSPITAL GARDENS

S. Pietro Hospital, Roma (Italy)

S. Pietro Hospital, Roma (Italy)

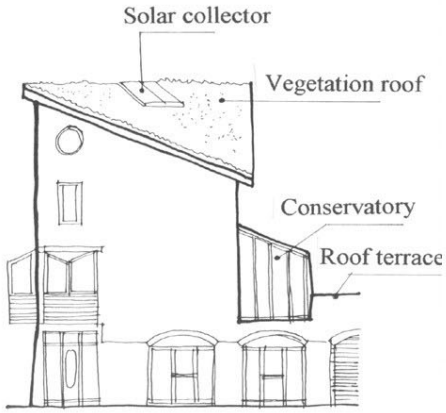


Small wall-openings on the north side
and large windows on the south side

FIG. 18 - WINDOWS: DOUBLE GLAZING; ROLLER BLINDS, SMALL OPENINGS...

ECOLONIA - Alphen ad Rijn (The Netherlands)

FIG. 19 - PASSIVE SOLAR SYSTEMS, EXTRA GLASS SURFACES



ECOLONIA - Alphen ad Rijn (NL)

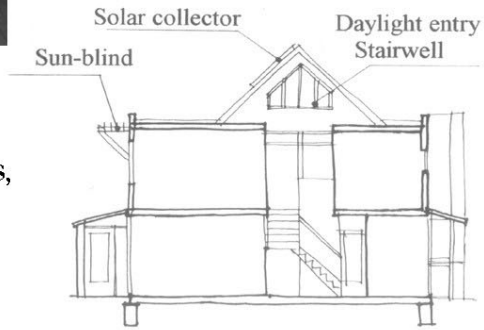
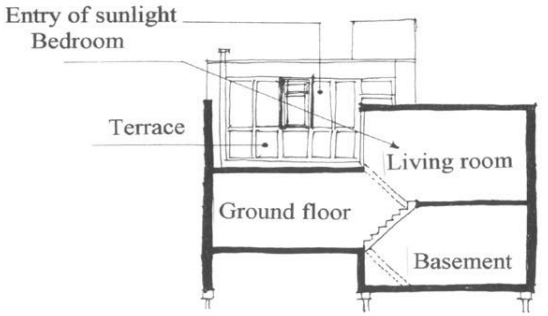


FIG. 20 - ROOFS: VEGETATION ROOFS, ROOF TERRACE...

FIG. 21 - OPTIMISATION OF NATURAL ILLUMINATION



ECOLONIA - Alphen ad Rijn (The Netherlands)

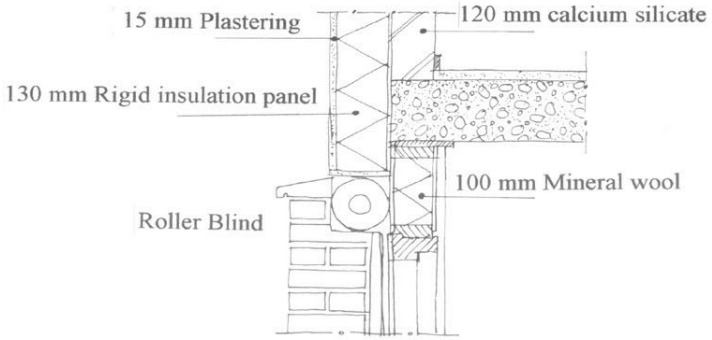


FIG. 22 - WALLS: INSULATION, MATERIAL...

FIG. 23 - FLEXIBILITY OF SPACE AND FUNCTION

ECOLONIA - Alphen ad Rijn (The Netherlands)

Adaptable to other living arrangements and combined living/working function

Can be divided into upper and lower dwellings

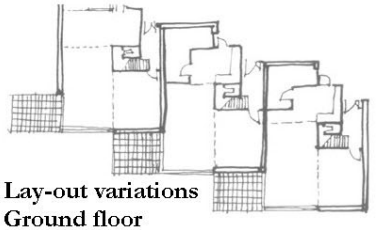
Conduits laid in floor of ground floor enable position of kitchen to be varied

Conservatory

North-South axis with garden room

Small wall-openings on the North side and large windows on the South side

Single-glazed conservatory functions as bufferzone for energy conservation



Lay-out variations
Ground floor

FIG. 24 - ENERGY SAVING AND SOLAR RADIATION

ECOLONIA, Alphen ad Rijn (NL)

Programme of requirements for the project

REDUCING HEAT LOSS: high thermal insulation, ground floor insulation, thermal isolated partition walls between dwellings, enclosed porches, separated kitchens, small wall openings on north side, etc.

UTILISATION OF SOLAR ENERGY: north-south orientation, large wall openings on south side, solar boilers for hot water supply, single-glazed conservatory functions as a bufferzone for energy conservation (separation living room/conservatory, ventilation flaps and natural sun-blinds prevent overheating in the conservatory, etc.).

LIMITING ENERGY USE FOR BUILDING AND LIVING: building technologies increasing natural illumination, split-level design, utilisation of solar energy through extra glass surface areas, heat recovery system, low energy content construction materials, etc.

LIMITING WATER CONSUMPTION: vegetation roofs with sedum planting, large roof overhangs, built-in rainwater container in enclosed porch on southern elevation, etc.

RECYCLING BUILDING MATERIAL: use of natural renewable material, recycled material, etc.

ORGANIC DESIGN, DURABILITY AND MAINTENANCE: low maintenance detailing of window frames, use of low maintenance building material, etc.

FLEXIBLE BUILDING AND LIVING: design can be extended on the garden side, adaptable to other living arrangements and combined living/working function, dwellings can be divided into upper and lower, conduits laid in floor of ground floor enable position of kitchen to be varied, heating units etc. are built into the roof structure allowing the lay-out of the first floor areas to be varied, windows can be dismantled and frames interchanged, etc.

SOUND INSULATION WITHIN AND BETWEEN DWELLINGS: dwellings built in a terrace, separate entrance, exposition of the rooms opposite to the streets, dwellings have a 'sound core' constructed from 150 mm thick calcium silicate, etc.

SAFE, HEALTHY LIVING THROUGH DESIGN, CHOICE OF MATERIAL: north-south orientation, skylight in roof structure owing to centrally located stairwell, terraced dwellings, cleanable insulation ducts, central vacuum cleaning system, etc.

BIO-ECOLOGICAL BUILDING: use of natural materials, hidden electrical wiring, bedrooms fitted with current regulators, decorated using natural paints, etc.

Part IV

APPLICATION OF THE ENHANCEMENTS PROPOSED

"Enhanced planning is always enthusiastically preferred as being the 'better puzzle' which can offer the most useful benefits to the institution and the community" [1] says Seymour Remen, American architect and hospital planner.
The Hospital promoting Health and Well Being would offer the 'better puzzle' -of the various possible solutions- for the improvement of the current hospital conditions.

Framework and Design for a Hospital promoting Health and Well Being
Chapter 9

Summary

The framework and design of the Hospital promoting Health and Well Being improves the quality of hospital design by means of the following four categories of components related to the fields of Environment, Architecture, Function and Methodology of Design:

1) ENVIRONMENT includes components which prevent the risks related to environment and health, thus supporting public health and saving environmental resources
2) ARCHITECTURE includes components which prevent the misfits of design and maintenance of the building against specific failings
3) FUNCTION includes components which support hospital function and patients' well being (physical and psychological), sustainable design and the policy of the W.H.O.
4) METHODOLOGY includes components which support validity and durability of the design final results to be kept valid also in the future

The practical application of the components identified in Part III is illustrated in this chapter.

9.1 Environmental Conditions and Prevention of Health Risks

Summary

A number of failings produce poor environmental conditions in hospitals. These failings (such as scarce air quality, noise, harsh lights, risk of infestation etc.) are mostly due to the inadequacy of hospital function (activities and maintenance) and design (plan and configuration).
They derive mainly from defects in planning and poor maintenance of the building (such as inefficient air conditioning, strong artificial illumination, too many or inappropriate refurbishments, building materials releasing pollutants into the air, nearby traffic producing pollution and noise, etc.). They also depend on inappropriate performance of specific activities (such as poor maintenance, inappropriate use of chemicals/radioactive products, etc.) and from plural situations of risk (due to the many technological systems and the variety of activities) which are found in the large public structures of hospitals.

The policy of Prevention very closely influences building design and it should also influence hospital design in order to improve the current hospital conditions (environmental conditions, configuration and function). Various technologies and criteria adopted in the design of sustainable buildings are suitable to this end. Specific enhancements are introduced in the design of the Hospital promoting Health and Well Being similar to these technologies and criteria as explained in 9.1.1 Hospital Environment and the Site, 9.1.2 Building Technology and Material and in 9.4Methodology and Systematic Approach to the Quality of Design.

9.1.1 Hospital Environment and the Site

An emergent need of 'natural' has been noted in many areas of life to counter the many risks related to health and environment (1- Health, Environment and Building Design, 2- Health, Environment and Hospital Design and Hospital Design).
Contact with green spaces and natural ingredients is promoted in the design of the hospital promoting Health and Well Being, which supports the increase of patient contact with a natural 'genuine' environment, fresh air and sun.
Pollution and noise from traffic, scarce air moisture and fresh air, are complained of in hospitals, mostly due to the use of air conditioning. The constant support of natural ventilation in the realisation of hospitals during history makes us think how important the presence of fresh air is (3.1.1.4 The Issue to Increment Indoor Ventilation, 3.1.1.8 Constant Issues: Familiar Configuration, Structural Flexibility, Ventilation, 3.1.3 Conclusion of 'Hospital Building in History). Hospital patients would also like a window with 'a view', which is often considered by experts and researchers as a positive support for their healing.
The wish of the patients for natural ventilation (the intention of increasing natural ventilation was always present in hospital history), as well as their wish for a window with 'view', find positive answers in the Hospital promoting Health and Well Being.

Temperature, ventilation, air moisture, quality and quantity of fresh air contribute to producing comfortable conditions indoor and physical well-being. For this reason the quality of hospital environments mostly depends on the choices made by designers in the design of the building and in its maintenance.
The majority of the complaints related to the environmental conditions of hospitals are due to the inadequate function of air conditioning systems (4.1.1 Risks affecting Environmental Conditions). Design and maintenance have considerable responsibility in providing the physical well-being of hospital patients and staff.
For this reason design and maintenance of the Hospital promoting Health and Well Being are integrated with appropriate criteria which support the formulation of better choices in design and which also support management and function of the building, particularly in relation to the function and use of technological systems.

The introduction of the building in a natural green area out of the city centre creates healthier conditions of life in hospitals and offers other benefits in relation to the plan and realisation of the building. (5.1 Choice of the Site). It consents increase of contact with natural ingredients, avoids traffic pollution and noise, gains free space, which enables flexibility of design and profits from the local characteristics and resources.
In the realisation of the Hospital promoting Health and Well Being, designers take advantage of the natural requisites of the site and any natural beauty, thus allowing for the best realisation of the hospital, mostly by means of natural components and local resources.

Green spots are also included in the plan, used as a barrier to the wind and as 'air filters' between the building and the road. Supporting the contacts of the patients with nature, they create a nice frame for the building and are an integral part of its array. The presence of natural components is beneficial in design for the physical and psychological well being of the patients (3.1.3 Conclusion of 'Hospital Building in History', 4.3.3 Prevention policy and Sustainability in Building, 7.3.2 Contact with Nature).
To this end, the design of the Hospital promoting Health and Well Being includes landscape components such as for example a stream of water or a pond and hills, local materials and

vegetation which are integrated in the array of the building. The green spaces are the object of design and include special places, such as special gardens or areas with fruit trees.

The configuration of the land and exposure to the sun are taken into consideration in order to profit from the local conditions for energy saving. The advantage of sheltering the building from the wind is also taken into account, according to the inclination of the land and the presence of vegetation. Designers also consider the advantage given by avoiding openings on north exposed walls and by building this side of the building underground. Natural illumination is promoted in design by large glass-sheets and skylights, the orientation and inclination of their surfaces in relation to the sun light. Designers also take into account the possible use of photocells and solar technologies on roof/prospects in order to integrate artificial illumination. Similar considerations are made also to improve indoor ventilation by profiting from wind and air draughts. They finally take advantage of specific meteorological conditions for example by the storing of rain water and its re-use for toilets and gardens.

9.1.2 Building Technology and Material

To provide healthy conditions from patients and the public is the aim of hospital design. In relation to the environmental risks discussed in 1 Health, Environment and Buildings Design, the possible factors of risk related to the environment are taken into consideration in the design of hospitals. Present knowledge and the use of natural material and 'clean' building technologies and saving on consumption allow appropriate choices also in the design of hospitals (examples are reported in Chapter 8). These kinds of alternatives and the increase in concern for the natural environment is supported in the Hospital promoting Health and Well Being: in its realisation, designers and builders take into account the use of appropriate technologies, renewable non-polluting materials and natural energy (5.2 Application of 'Clean' Technologies, 5.3 Building and Furnishing Material).
The production of 'healthier' environments is supported by designers creating comfortable physical conditions indoors. Structural elements such as windows, roofs, walls, floors are multipurpose elements to be used in relation to appropriate building technologies for energy saving. Economically advantageous solutions (hospitals are great consumers of energy owing to their many activities), contributing to patients' well being, are preferred in the Hospital promoting Health and Well Being.

The presence of polluting and chemical components in building and furnishing materials (such as insulation, paints, synthetic furniture, chemical additives in building materials, radioactive materials used in building, etc.), poor quality of the air indoors such as lack of air moisture or fresh air, insufficient or excessive artificial illumination and noise have been identified by researchers as some of the causes of the faults complained of in hospitals. Appropriate measures are taken in the Hospital promoting Health and Well Being to prevent the risks affecting the environmental conditions of hospitals since these situations mostly depend on building maintenance and/or design (4.1.1 Risks affecting Environmental Conditions).
The rapid evolution of medical treatments and the increase of advanced technological means produce numerous difficulties in the management of hospitals. The plural technological systems and activities of hospitals create risks related to the environment of hospitals. A series of failings affecting their environmental conditions depend on the design and maintenance of the building. They are often related to the use of air conditioning systems. Inadequate ventilation and/or thermal conditions and other physical disturbances for example due to excessive or inadequate illumination and noise are complained of in hospitals. Design misfits

and scarce maintenance are also responsible for these circumstances. Inappropriate design decisions and/or lack of co-ordination between experts and technicians, lack of information contribute to producing the poor quality of hospital design (4.1.1 Risks affecting the Environmental Condition).

Building and furnishing materials are chosen on the basis of their resistance to use (due to the many people visiting the hospital as a large public structure) and their requisites for hygiene (depending on the presence of biological risks). Building/furnishing components are long lasting, easy to be removed and substituted. Natural renewable material is preferably used by designers in building and furnishing also to counter the depletion of natural resources (8.1.4 Improved Hospital Planning) and the possible use of recycled materials is taken into consideration in planning.
Against a series of biological risks, it is indispensable to have surfaces and furniture which are quick and easy to clean. Building/furnishing materials have compact surfaces, easy to be cleaned and resistant to chemicals in disinfecting. Dust accumulation is one cause of the development of bacteria, insects, mites and fungi. Regular cleaning, appropriate building techniques and the appropriate choice of the furniture contribute to overcoming these risks.

The choice of building technologies and material is based on the structural flexibility of the building. The frequent refurbishment which has occurred in hospitals in the last decades has determined a series of manipulations of the building structure. These situations have produced several structural compromises, for example voids and suspended ceilings, later acting as appropriate places for the pests to live. The presence of activity like food storage and preparation also give the pests the possibility to proliferate (4.1.1.3 Risk of Pest Infestation: case-studies). Medical equipment and furniture, inappropriate building technologies are often responsible for this situation as well as structural components which offer suitable spaces for the pests to live (the connections of ducts and openings for inspections are appropriate means for them to colonise different places). The Hospital promoting Health and Well Being is planned and built by means of appropriate criteria and building technologies avoiding the risk of infestations. It is refurbished by means of technologies and criteria supporting the coherent flexibility of the building.

9.2 Environmental Configuration and 'Modernisation' of Design

Hospital buildings do not correspond to recent social changes. Against the background of quick evolution taking place in our society and the misfits recorded in hospital design and configuration, the aim of the project is 'to improve quality' from many points of view.

This is done in the Hospital promoting Health and Well Being where the following facts influencing hospital design are taken into account:
- the increase of day-hospital activities and the number of out-patients, the growth in percentage of elderly patients
- the quick development which influence hospital activities (rapid evolution of technological means and therapeutic treatments)
- the new prevention policy in health care which also influences building design (according to criteria promoted by the W.H.O.)

- the increased awareness of the new social context and of the patients (about health and disease)

On the basis of current hospital conditions, past and present experience, a number of enhancements introduced in the Hospital promoting Health and Well Being improves the quality of hospital design and particularly of environmental configuration (6- Enhancements in Environmental Configuration).
These enhancements propose:

- adequacy of design to modern standards
- a building typology that supports functional flexibility
- promotion of comfort and well being by means of appropriate components of design
- improvement in the quality of design introducing a methodology for supporting and maintaining positive results

Hospital configuration is improved in quality and function to counter the failings recorded in Part I and II, by means of the components formulated in Part III. The practical application of these components is illustrated in the following paragraphs.

9.2.1 Promotion of Comfort and Well Being

Assistance, comfort and well being are supported in this Hospital by means of:

- the components which have constantly influenced design (e.g.: positive global configuration, familiar comfortable environments, use of natural therapeutic means, etc.)
- the policy of the W.H.O., promoting the physical and psychological well being of the patients, and the recent trends which have received the consent of patients and experts in health care

These factors are supported and implemented in the Hospital promoting Health and Well Being as illustrated below.

9.2.1.1 Reintroduction of 'Natural' against 'Sophistication'

Poor quality of the air (often due to air conditioning), uncomfortable intensity of light and level of noise are complained of in hospitals (9.1.4 Improved hospital Planning). In relation to these facts, the quality of design is improved and the presence of natural ingredients is supported in this Hospital. Plants and green spaces are included in the design and array of the building to support the indispensable contact with the natural environment. The general presence of 'natural' (e.g.: building components, building/furnishing materials, 'natural' ingredients and therapeutic means supporting patients' healing) is promoted in planning, building and furnishing.

Abundant natural light and a variety of colours are integrated in design to respond to the wishes of the patients (6.2.2.2 Presence of Colour and Natural Light: Interview with the Patients). The increase of natural illumination improves the quality of the environment and consents green plants and flowers to live indoors.
Natural ventilation is used as unanimously recommended at present by experts and researchers (but also throughout history) as a mean of reducing different causes of indoor pollution (traffic pollution, emissions from chemical products and building materials, radon radiation, etc.).

The new trend towards the renewed use of natural products and natural therapeutic means are taken into consideration in this Hospital. Patient healing and well-being are supported and

promoted by taking on special initiatives to improve patients' healing and well being (based on positive perceptions and relaxation systems created making use of appropriate colour, pleasant smells, relaxing images and green plants, contact with green spaces, etc.).

The Hospital promoting Health and Well Being includes comfortable, home-like environments, which correspond to the 'natural condition' and living standards the patients are used to. This gives the patients the feeling of living every-day life, promoting the positive approach of the patients to the hospital (4.3.4.1 Quality of Life and Hospitals: Case-studies and Planetree Model, 4.5 Conclusion of Chapter 4, 6.4 Conclusion of Chapter 6).
In conclusion, the following components are integrated in design:

- natural ingredients in building realisation and function
- increased contact with sunlight and fresh air
- natural means to support patient healing and well-being
- components of design that create home-like environments
- green spaces outside and plants inside the building

9.2.1.2 Parameters of 'Comfort' and Improved Social Standards

Owing to improved social standards, people have many comforts at hand in their private life and at work, quick means of transport and information suitable to the modern rhythm and style of life. Patients should also have adequate facilities at hand.
In this Hospital, a patient-focused design is promoted by giving positive responses to individual needs and wishes. A user-orientated design considers the professional activity of hospitals and also gives generous consideration to the condition of the patients.
On the basis of the interview with the patients and other documents which demonstrate patients' opinions, a variety of initiatives can be taken in this Hospital to provide a greater level of comfort. Components of design such as useful items and activities should be integrated in order to meet individual wishes and preferences.
Greater privacy on the one hand and socialisation on the other can be provided by creating appropriate spaces for living. A familiar atmosphere is created by means of design and means supplying information to support the assistance.
In conclusion the improvement proposed in the design of the Hospital promoting Health and Well Being can be summarised as the following:

- facilities and activities at hand - such as opportunities provided in every-day-life
- patient-focused design and increase in comfort -such as assistance for every need
- familiar atmosphere -such as the feeling of being 'at home'
- higher level of privacy -such as availability of private spaces

9.2.2 Adequacy of Design to Modern Living Standards

Modern components/means frequently adopted in other modern public buildings (fig.13, 15) and specific components of design giving 'character' and 'identity' to the building are integrated in the Hospital promoting Health and Well Being.

9.2.2.1 Modern Means and Multifunctional Components of Design

Escalators, large modern lifts, systems for way-finding and computerised information are incorporated in the design of this Hospital. Special components (such as lifts, panels or murals, fountain, etc.), colour and materials become components of the array and of the architecture of the building.
Large glass-sheets and skylights, large entrance-halls make the design of this Hospital. Modern means of information and transportation are integrated in this Hospital as they are commonly found in other large public structures and closer to modern living standards. The same components of design are preferably used towards plural aims (e.g.: for transportation, information, energy saving, array of the building, improvement of the environmental conditions, support of assistance and comfort, promotion of well being, etc.). Glass-sheets and filter areas at the entrance for example can contribute to supporting the modern standards of design and the technologies for energy saving. Lifts and escalators become part of the array of the building (e.g.: made of appropriate materials and colours, decorative panels and so on).

In particular, these components of design are integrated in the Hospital promoting Health and Well Being:
- quick means of communication and information
- modern means of transportation of patients, staff and visitors
- building components supporting the adequacy of design to modern standards
- multifunctional components of design which respond to plural aims

9.2.2.2 Introduction of 'Identity' against 'Anonymity'

The presence of a variety of items and colours is approved by both, the researchers and the patients in hospitals. They give a positive impression and create atmosphere which is also the case in other modern, large public structures and support the comfortable home-like atmosphere through 'richness' of the environment.
It has been asserted that arts *"help to integrate and* add *to a healing environment"* [2]. In this case, not only arts but also architectural components, building/furnishing materials and 'special' items of design *'add'* towards various purposes.
Building/furnishing materials, colours and images, 'special' items contributing to the array of the building improve the standardised level of design. Their presence, the implied concept of 'special' place and sometimes the existence of a special 'activity' give the following advantages:
- the presence of initiative and the choice of a specific item
- the fulfilment of the array of the building
- the adequacy of the hospital to modern living standards
- the positive feeling given by the improved environmental configuration in contrast to traditional standards

Architectural components and decorations, images and colours are integrated in design also to express the references of the hospital and/or to attribute 'identity' to the building against 'anonymity'. Special 'items' such as a fountain or a mural or a permanent exhibition are adopted in design, giving the 'identity' of the hospital and sometimes 'references' about its speciality.
In conclusion, in the Hospital promoting Health and Well Being, special components, decorations, pictures and colours:
- array the environment and give the 'identity' or 'references' of the hospital
- respond to patients wishes

- contribute to producing a more relaxing home-like atmosphere
- support the adequacy of design to modern living standards
- support the realisation of competitive hospital buildings as large public structures

On the basis of the above considerations, the following components are finally integrated in the Hospital promoting Health and Well Being:

- decoration, images and colours
- combination of image and colour with other items of design
- assumption of identity or qualification of a hospital by means of special components of design

9.2.2.3 Combination of Information and Image

Colours, architectural components and/or images can be also associated with way-finding and/or other items of design such as for example information systems.
Some 'special' building/furnishing components and the use of specific materials and colours support way-finding and the supply of information. The same components (e.g.: a special fountain, sculpture, mural or decorative panel, etc.) are taken on as 'significant/crucial points to understand the lay-out of the building and to better identify a place. A few of these components are integrated inside and outside the building to create significant places and activities for the patients (e.g.: apposite spaces for the use of computerised systems for information).
They combine aesthetic sense and support the assistance of the patient, becoming multifunctional components which:
- answer objective needs and support patients' well being (according to the policy of the W.H.O.)
- support the adequacy of design to modern living standards (producing comfortable environments also supplying furnishing/decorating complements of the array)

In this case, the advantages would be:
- the immediate availability of information given by the instinctive quick perception of colours and images (achieving of quick information improves the assistance)
- the enrichment of the array (provided by the addition of colour and decoration)
- the achievement of more modern patterns (produced by the use of modern means such as way-finding and the quick supply of information, by the colour and decoration).

In conclusion the introduction of special components, decoration and colour:
- contribute to the array of the building
- help in finding a destination and in providing meeting points
- produce a relaxed approach of the patients to the hospital
- provide activity and crucial points for the supply of information

9.2.3 Typology of Design

Owing to the changes produced by Science, Technology and Social context, new components are continuously integrated in hospital function and design.
For this reason, the Hospital promoting Health and Well Being must be flexible in function and configuration, both on a large and a small scale.

9.2.3.1 Variety of Typologies

Attempts have been made over time to find the ideal typology for a hospital: square format, square modular components or complicated typologies based on the circle (fig.4 e 5). But every typology has been chosen for its 'originality', in relation to specific needs of the moment, and every typology at first approved of would later on often be criticised. There has never been a particular shape so 'perfect' as to be adopted in hospital design as 'special'.
Numerous typologies can be found in manuals on hospital design, but their application mostly responds to the needs dictated by specific historical circumstances. The evolution of times instead, is constantly proposing a range of interrogatives that cannot always be met in the same way. Sanitary needs and means have gradually increased, new activities have emerged.
Constant social and cultural development, the growth of population and of knowledge have created new practical needs looking for practical answers. These and other related facts have over time been conditioning the choice of the proper typology.
The development of science and technology constantly influences hospital design. A new background of scientific and technological information now exists, which has almost nothing to do with any other type of hospital built before in history.
Our social context has also changed in quality. For these and other similar reasons, the many standardised typologies taken as models in manuals are now obsolete.
What is certain on the contrary, is that hospital buildings should be seen as dynamic structures constantly reflecting social and cultural evolution.
For this reason, the typology of the Hospital promoting Health and Well Being responds to the many needs typical of the modern social context, being ready at the same time to be adapted to the issues dictated by progress.

9.2.3.2 Typology and Functional Lay-out

Hospital function has always influenced the building typology and configuration (3.2.2 Building Typology). The gradual increase in activities has always found correspondence in the growth of the building.
The structural complexity of hospitals started to be evident however only from the eighteenth century on when, after numerous scientific discoveries, the complexity of hospital function and technology was finally very significant.
The development of diagnostic/therapeutic equipment and technological systems was the object of rapid scientific and technological progress in that century. Hospitals, as a consequence, were influenced by numerous changes taking place in too 'short' period of time and, if hospitals are unable to fill the gap produced by progress in other activities of life, it also depends on this very rapid change.
These premises imply that a 'recognition' of design is needed to improve the quality of hospital design. The factors have been previously highlighted in this study, which have constantly influenced hospital design and which particularly can still condition the typology of hospitals.
On the basis of the previous studies, the following preferable aspects are identified which positively influence the quality of design regarding lay-out and typology of the building:

1) <u>Lay-out</u>
The activities of hospitals have prominently been extended in horizontal and the wards in vertical. This configuration gave the advantage of increasing the privacy of the patients and the opportunity of extending the building on the ground level. The location of the main functions on the ground floor remained almost unaltered over time, while the wards were positioned on

the upper levels. This configuration gave many advantages: a greater possibility to extend the building on free land; direct connection between the activities of the hospital; the privacy of sleeping-in-patients; the connection of various departments, the movement of people and means would be advantaged by the position of the activities on one level.
Now, the horizontal development of the building is still preferred in the Hospital promoting Health and Well Being, not only in order to get the same advantages, but also because it creates direct contacts between functional activities and out-patients (which have recently increased) and between in-patients and green spaces. Increased privacy of patients is also provided by means of the separation between hospital activity and wards.

2) Typology
With the increase of hospital functions, the need to create a clear physical distinction between the different activities became evident. At first it was achieved by realising separate sections within the building itself. Later on, it was reflected by a clearer physical separation by the realisation of distinct departments, self-standing pavilions or units connected (physically or functionally) to a central main building, which was the main structure of the hospital.
This typology is maintained in the Hospital promoting Health and Well Being. To support the structural flexibility of the building, a distinction is made between the functions likely to develop and other stable functions. The activities likely to grow are located on pre-determined lines of expansion, corresponding to the eventual physical direction of growth of the building. This also allows increased contact with the natural environment of the site.
On the basis of the previous considerations, a 'nucleus' containing centralised 'stable' functions is designed as the 'fulcrum' of the lay-out of design and the 'heart' of the building. From this starting nucleus, typology and lay-out are built up on the basis of a rational distribution of activities. Their individual relationships with other functions is taken into account and their functional distribution in order to improve the quality of assistance and design (e.g.: the direct connection of day-hospital activities with parking areas and main entrance, the functions likely to grow are built adjacent to free areas, etc.).
Many activities of the hospital are on the ground floor and second level, whose structures are mostly developed horizontally. This allows diminishing gaps between blocks and avoiding lifts. It facilitates the mobility of the patients and supports the use of mechanical means (wheel-chairs, trolleys, stretchers, etc.), which are moved only on flat surfaces and ramps.
On the basis of these premises, the indispensable items to be included in hospital design are as follows:

- distribution of the activities mostly on the ground level
- distinct separation of patient's room (on the ground or upper levels) from the activities (on the ground
  floor)
- centralisation of the main functions
- distinction between activities likely or not to grow
- main lines and direction of growth of the building

9.2.3.3 Flexibility of Design and Refurbishment

The need for hospitals to be able to answer changing needs and social circumstances has very often encouraged designers to look for flexibility. They invented different methods for the production of flexible typologies for hospitals, such as: the use of repeatable patterns (ex.: cross-ward of the middle ages) or separated pavilions (e.g.: pavilion model of the nineteenth century) or specific structural models with smaller modules annexed to a main building (e.g.: T

shaped module combined in the 'comb' of the lay-out of the building; small units combined into a cluster as in the case of the 'pillbox in a waffle').
Designers have often combined modular components to increase the flexibility of the building. They were often combined to centralised services and activities (e.g.: administration offices, laundry, kitchen, operating theatres, etc.) built on the contrary in a main building or in part of it (e.g.: in the main floor of the hospitals built before the Renaissance, in the main building of the pavilion hospital, in the spine of the 'comb' in the T shaped building, in the basement of the skyscrapers of the 1900s', etc.). In the end the building was able to grow in different measures and at different levels. On this basis, it is possible to conclude that, if flexibility needs to be increased, this mostly depends on the cutting of the structure into smaller parts, which also consents operating individual changes in different section of the building (depending on the development of the activities, therapies and means).
The criteria of dividing the structure into smaller components has been adopted in the design of the Hospital promoting Health and Well Being, which supports the flexibility of the building on a small and on a large scale.
Structural/technological main lines of expansion are identified on the basis of the perspectives of development concerning the various activities of the hospital. A main centralised structure for more stable functions is created as the central nucleus of design, while a number of smaller units support the flexibility of activities and wards.
The design of the building consists of a main structure (adopted for stable centralised activities/services supporting hospital function) and includes a number of annexed units for flexible activities capable of development and change; the latter aligned along the lines of expansion.
Criteria are established as well, to realise future refurbishment and/or extensions in conformity with the original project according to common terms of reference. Structure, installations and systems are studied and/or dimensioned within the perspective of their possibility to change.
On the basis of the previous considerations, the typology of the Hospital promoting Health and Well Being includes:

- main structure and smaller units capable of further development on the lines of expansion
- criteria for structural flexibility
- criteria for technological flexibility

9.2.3.4 Modularity and Quick Aggregation of Parts

Hospitals are dynamic buildings, evolving continuously in parallel with social development, the development of technological means, therapies and sanitary regulations. The rapid evolution of science and technology have recently produced substantial change in the function and structural configuration of hospitals, mostly due to the introduction of new therapies and means. New activities have recently emerged in hospitals and the number of out-patients has increased. These and other functional changes have produced plural consecutive refurbishment of hospitals (structural and technological), many difficulties and sometimes the impossibility of refurbishing of the old buildings. These circumstances, the improved habits of the people and their increased request for comfortable environments, the policy of sustainability supporting the production of a patient-focused design, suggests creating flexible environments suitable to a variety of needs and individuals. The need is evident to support refurbishment and changes by means of appropriate criteria of design.

This need is taken into account in the design of the Hospital promoting Health and Well Being. To reduce into 'small modules' the components of design and furniture give better opportunities to act either on a smaller or larger scale. The application of modularity in spaces is in fact integrated in design in order to support the functional flexibility of design and the flexibility of the array, which consents quicker and easier refurbishment and change.
Finally the application of modular building/furnishing systems facilitates the changing of array/furniture according to specific functional changes, consenting at the same time an easier removal/substitution of parts in the maintenance of the building.
On the basis of these facts, the use of the following is recommended:

- modularity of functional spaces
- modularity of building/furnishing systems

9.2.3.5 Special Requisites of Hospital Typology

Building typology has over time reflected the evolution of the specific needs of hospital patients and staff. For example the ward adopted gradual changes in space and privacy, furniture and atmosphere. The transformation of its name into 'patients room' makes evident the realisation of a series of adjustments focusing mostly on offering a higher level of comfort and privacy. The general intention of improving 'the level of comfort' in hospitals has always been present in design and the identical intention is still evident today. The size and shape of the patient's rooms have been changed in order to gradually improve the situation, as well as the array and the disposition of the furniture. Other enhancements have been introduced in order to improve the level of assistance such as the bell near the bed, telephone and television. The nurse station has been moved closer to the ward to improve the level of comfort and assistance. The number of patients has gradually diminished. At first the ward was a large single space for more than 30 patients, it has now become a more comfortable room for a maximum of 6 or even 4 patients.
The recently built American hospitals are greatly improved in comfort and assistance. These and other special hospitals have highlighted the aspect of creating a home-like environment as is also the policy of sustainability promoting the realisation of healthy buildings. These hospitals still express the will to improve the level of comfort, assistance and privacy, which is provided by the size of this space, its furniture and array.
In the Hospital promoting Health and Well Being the increase of comfort and assistance is still supported in design. Increased privacy is for example provided by means of the array and furniture. The assistance of the nurses is finally centralised and patients' rooms are within sight of the nurse, at a close distance. Increased individual facilities are provided such as accommodation for family members. Private toilets and comfortable items are available such as electrical equipment, free tea and books.
Other components increase the level of comfort. For example, relaxing schemes are introduced in design by means of a number of ingredients such as natural light, colour and array, comfortable environments and comfortable physical conditions. Contact with green spaces is promoted and a view of the landscape is integrated in design by the use of glass-sheets with a 'view'.
In the end, the building typology and configuration support:

- greater privacy in the patients' rooms
- home-like comfort and assistance (proximity of the nurse, facilities for the family, etc.)

- comfortable environments and atmosphere (relaxing schemes, comfortable items at hand, a window with a view, increased contact with green spaces, etc.)

9.3 Improvement in Hospital Function

The rapid evolution of technological means and improved scientific knowledge have given rise to the development of new activities mostly concerning the function of day-hospital. In relation to this fact the number of out-patients has greatly increased in hospitals.
Also the cultural growth has changed the traditional typology of hospital patients.
On the basis of these changes, specific components are being integrated in hospital design.

9.3.1 Institutional Changes

The number of out-patients has already increased and, according to the experts forecasts, the number of elderly people is going to increase in the future promoting the introduction of new day-hospital activities. Hospitals have already changed in activities, number and quality of the patients. These objective facts influence the design of hospitals.

9.3.1.1 Prevalence of Out-Patients and Day-Hospital Activities

The increase of day-hospital activities and ambulatory care have created the introduction of new functional areas regarding for example surgical treatment and therapeutic applications whose performance doesn't require for hospitalisation. Improved therapeutic means and advanced surgery often make it possible in fact to treat the patients without hospitalisation. In relation to this, a great increase in the number of out-patients has been recorded in hospitals versus the diminishing number of in-patients. But recent data reveal that the number of elderly people is increasing consequently supporting a further increase of day-hospital activities.
Due to improved welfare and fast life-style, people have become more and more impatient with any kind of illness. They do not accept being ill or spending time to recover. Because of this and their improved knowledge, many people have become aware of the advantages of prevention of diseases.
Patients ask to get more information and to learn more about health and disease owing to their improved knowledge and participation. Having a higher consciousness of medical knowledge, their approach towards health has changed. Patients' relationships with doctors have consequently changed since they are more aware and responsible of their health. In practice, the relationship between individual and health now has a new configuration and a new slogan which *"rides on patients taking responsibility for their own health care"* [3].
Hospitals deliver a bigger proportion of ambulatory care and consequently they are going to deliver intensive, acute and in-patients care in smaller proportion. Finally day-hospital activities, elderly care and health prevention are likely of increase. The reality of traditional hospitals is consequently the object of constant transformations concerning type of assistance and typology of patients. This versatility (so often typical of hospitals) concerning hospital function, number and quality of patients is supported by flexibility and design in the Hospital promoting Health and Well Being.
In particular, the constant change of the social background of hospitals suggests taking into consideration:

- decrease in the number of sleeping in patients
- increase in the number of out-patients
- increase in day-hospital activities
- need for functional flexibility

9.3.1.2 Introduction of Activities supporting Prevention and Well Being

Objectives like supplying health education and supporting prevention are aims of the new policy promoted in health care. In conformity with the issues of the W.H.O., the aim of a Hospital promoting Health and Well Being is to fulfil the well-being of its occupants. For this reason, the Hospital promoting Health and Well Being supports the treatment of diseases, their prevention, patient healing and well-being all at the same time.
Physical activity is supported and promoted and other initiatives have been introduced in the Hospital promoting Health and Well Being aimed to correspond to the new policy in health care and modern patterns also in relation to the improved social welfare.
For example 'de-stressing' activities and natural ingredients have been introduced in design to support patient healing and well being. Natural therapeutic means and special physical environmental conditions have been adopted to this end, such as relaxation systems, which help the patients to reduce the feeling of anxiety towards suffering and disease and physical activity (encouraged and supported by creating special environments and activities).
Computerised systems have been introduced in design, which support education and the increase of assistance by the supply of information.
The diversity of needs depending on different individuals and situations are practically taken into consideration by thinking from the different point of view of the patients, the staff and the visitors.
In conclusion assistance and function of hospitals are supported by:
- activity for prevention and health education
- activity supporting patients healing and well-being
- closer consideration of the individual conditions of patients, staff and visitors (in terms of assistance, information, supplying of comfortable items according to various situations, etc.)

9.3.2 Patient-focused Design

The patient requesting privacy and comforts, familiar and closer assistance, has always existed. In fact, a constant interest in privacy, familiar atmosphere, comfort and assistance has been recorded throughout history.
Continuous attempt to improve the quality of these components has been made by designers, and their gradual improvement during history is evident until today in hospitals. The same components still respond to patient's wishes, as also results from the interview with patients.
But the 'quality' of these components has been always paid for by the patients, until very recently, being the privilege of paying patients in hospitals and in private clinics. In fact, patients have always paid as an 'extra' benefit for a real 'private room', 'assiduous' assistance and 'additional' comfort.
However, the word 'quality' itself is meaningless: what the patients could expect from hospitals has always been in relation to the limits established by the social, scientific and technological context. Hospital function and design are always very closely linked to the culture of the time and strictly related to the level of social growth. For this reason, present and constant needs of

the patients should be faced by designers, according to the issues of the social, scientific and technological context.
On the basis of these facts it is possible to conclude that:

1) if hospital buildings are supposed to fulfil present and future expectations in health care - and to support the development of health care structures as buildings and institutions- adequate correspondence should be created between hospital design and social development.

2) owing to the long-lasting established wish of patients for the same components throughout and to their gradual improvement in hospitals, it is actually possible to say that:
   - hospitals are getting ever closer to the formula of the 'paying-patient' type of assistance
   the same components, gradually improved over time, support the quality of hospital design

3) corresponding to the constant process of development concerning identical components, the Hospital promoting Health and Well Being is aimed at:
   - supporting a patient-focused design (on the basis of a 'paying-patient' type of assistance)
   - ameliorating the quality of design by means of:
   the improvement of the same component components
   the introduction of components which answer the present living standards

On the basis of these considerations, the following criteria are integrated in the Hospital promoting Health and Well Being.

9.3.2.1 Supply of Assistance by Means of Design

The Hospital promoting Health and Well Being fulfils an occupant-focused design and the 'complete' -physical and psychological- well-being of the patients.

Physical well being is fulfilled by creating health supporting environments, where the presence of natural ingredients is renewed and promoted by the introduction of special activities of relaxation, by the integration of green spaces with function and design of the hospital, by the proper components of design. To this end, it is integrated in design:
- the methodical use of appropriate building technologies and characteristics of design (fulfilled by means of the collaboration of all target groups involved in hospital design, realisation and function)
- the full accomplishment of design (including maintenance and organisation of the hospital and awareness of patients and people supposed to care for the physical environment of a hospital)

Psychological well being and all the practical aspects implied within the concept of 'assistance' are supported by design. Positive answers are given to the preferences of the patients by including appropriate components in design.
Various considerations allowed the identification of appropriate components to be integrated in hospital design to improve the level of comfort and assistance in hospitals. They are incorporated in the design of the Hospital promoting Health and Well Being and support the needs and well being of various categories of people, and above all the patient's condition. The patients are finally assisted materially and supported psychologically.

The main functional areas of the hospital were taken into account in order to identify their components in relation to the characteristics of their specific activities and environments. The final specific enhancement and the components to be included in design are illustrated in the following paragraphs.

Entrance hall and receptions are the identification card of the hospital and central points of reference for the patients. These places give the first immediate impression of the whole, influencing the opinion of the patents about the environment and function of the hospital. A comfortable and modern configuration supports the positive approach of the patients to the hospital, contrasting their frequent typical attitude of 'diffidence' and preoccupation concerning therapy and disease. To this end, the requisites of design are adopted which are in other 'modern' public buildings such as colour and natural light, large spaces and volumes, comfortable furniture and atmosphere, etc. According to the new technique of 'neighbour-hooding' -recently more often applied in the large public structures- the reality of our every-day-life is introduced within the hospital, a shopping area of adequate dimension and modern stairways where necessary. Way-finding and information system are also introduced in this area where numerous people pass by. This aspect and the colour and light -provided by more modern items of design such as large glass-sheets- create a modern configuration of design. Increased assistance is given by means of modern means for information and transportation.
The presence of daylight and plants, functional spaces having the requisites preferred by the patients, promote the positive physical and psychological attitude. Better assistance is given by means of information systems and way-finding, a higher level of comfort and increased hospitality are globally given by the components of design.

Waiting rooms are found in different parts of the building. There are more 'private' waiting rooms annexed to specific ambulatories and other larger spaces for the utility of the patients (e.g.: they are in the entrance hall of the building, near the shopping area, and near 'special places' outside the building).
From these areas signs and cues of way-finding give immediate information necessary for the patients to reach various destinations (e.g.: cafeteria, toilets, entrance/exit, reception, medical cabinets etc.). People may spend longer or shorter periods of time waiting. For this reason people should feel at ease and 'entertained' to a certain extent. The familiar configuration, the quick answers for every need (such as drinking water, baby changing, telephone, etc.) support a 'comfortable and easy' approach to therapies and examinations.
A few opportunities are given to spend this time, such as the possibility of getting general information (e.g. about hospital specialisation, timetable, etc.) and special information (e.g. about therapeutic treatments, disease prevention, etc.) by means of electronic systems.
Hospitality and comfort are expressed by means of the environmental configuration whose components (such as pictures on the wall, array and colour, warm illumination, etc.) give confidence to the patient. De-stressing environments are created by means of various items such as plants and daylight, the possibility of looking at a natural landscape from the window.

In the **diagnostic and treatment areas**, the patients are assisted not exclusively regarding their case, but they are also supported emotionally: 'solidarity and comfort' is communicated also by means of design. A series of considerations is made in planning and suitable solutions are studied case by case for expressing comprehension and reward for the patients in various circumstances.
The aim is fulfilled of making the patients feel at ease and comfortable in every situation. Comfortable environments and items at hand for the various needs give the patients support

and the feeling of being assisted (for example in the dressing rooms: enough space to move and for hanging clothes, warm home-like illumination, comfortable armchairs, small tables, serviettes and mirrors, etc.).
Diagnostic and treatment areas are planned to be hospitable and comfortable. In different situations appropriate furniture and atmosphere, the supply of appropriate items and comforts are provided (e.g.: comfortable temperature, warm illumination, colour and images on the walls, useful items and comforts at hand, etc.). Modern means are provided also in this case to give the patients the same level of comfort people are nowadays used to. Supply of computerised information, illustration of the treatment (by means of slides and recording of the explanation) is included in these sections.
Way-finding supports the patients in their passage from place to place. Entrance, waiting rooms, annexed services, consecutive passages (e.g.: from a cubicle to another according to the treatment, etc.) dressing-room and exit are clearly indicated as well as any other place for the utility of the patient.

The **patient's room** is the place where the patient spends the largest part of the day and the night. Special comforts and facilities are concentrated here to support healing and well being. The possibility is provided to increase privacy by means of the array and to provide accommodation for family members. Greater privacy and family assistance are provided (e.g.: the accommodation of a familiar, useful items are at hand according to individual preferences, quick contact with the nurse by means of the array and inter-phone, etc.), natural ingredients and home-like components (e.g.: plants and flowers, furniture and decoration, illumination and colour, etc.).
Abundant natural ventilation, sun light, natural ingredients -also a nice view from the window- are provided by means of design. The room has a window with a view on the natural landscape and the window is so low and large that the patient laying in bed can see outside. The intensity of light or shade can be adjusted according to the need of single individuals. The patients for example can also adjust the furniture (e.g.: change the position of the bed and the inclination of the mattress, position of the armchair and table, curtains and screens in order to modulate the natural/artificial illumination, draughts etc.).

Social progress has created a new concept of patient, hospital and health care, a new relationship between hospital and patient. Hospitals are intended to be flexible, 'open' structures supporting assistance and prevention, not as institutions, but as modern buildings. The Hospital promoting Health and Well Being is flexible in function and alternative in its structure in order to support the new relationship between health care and patients. Physical and psychological benefits are provided by plants and **green spaces**. The 'therapeutic' relaxing effect of a natural landscape on the patients is taken into consideration in design, given for example by the view of a natural landscape from the patient's window. But large glass surfaces and skylights are adopted also in other parts of the building, allowing more light and air also in the more dark areas of the building, such as corridors and roofs. A winter garden is created indoors as a relaxing 'oasis', made of sunlight and plants, where patients and visitors can sit and relax, have a conversation or read a book.
Gardens and green areas provide fresh and shaded spaces in summertime and produce psychological benefits by supporting relaxation. Gardens are also part of the array of the building They are annexed to large green areas where the patients can relax and do modest physical activity.
Special places are created outside for the use of patients, visitors and staff of the hospital. Contact with the natural environment is supported and promoted. The patients can profit

from the presence of 'green' surroundings and special activities. Special components of design are integrated within the configuration and array of the green spaces. These are intended as **special places and points of interest** to be visited by patients and visitors (such as: flower gardens, particular plants and fruit trees, small zoos, etc.).
Some 'special place' and 'activity' is also given within the building (e.g.: permanent exhibition, a collection of items, illustration/information about the hospital activity, etc.). These kinds of initiatives also have the final purpose of giving the patients opportunities to be mentally and physically active.

9.3.2.2 Supply of Information

Owing to social growth and improved popular knowledge of science, the new typology of patients is aware of health problems and able to participate in dialogue with doctors. Patients are informed about the events and know the current facts influencing their health. In the Hospital promoting Health and Well Being the patient is considered an 'intelligent' patient, not only the object of the therapy and a passive individual; the patient is thus a more active participant in hospital life. Patients' needs and preferences influence the choices of design that supports and promotes education and prevention. For this reason the opportunity is given to the patient to learn about the cure and prevention of diseases by means of 'special activities' which support education and computerised systems which provide general information (about hospital activity) and special information (about health education and prevention).
A series of aspects –such as the increased activities, better social welfare and standards of life, the policy of prevention- support the improvement of the function of hospitals in order to correspond to the present needs of the patients and the institutional tasks of hospitals. In the Hospital promoting Health and Well Being computerised systems contribute to supporting the supply of assistance, activity and education, 'modernisation' of design (adequacy to be in line with present times), and patients' well-being.
As in the large modern public structures, modern technological means, including way-finding and computerised information, give the patients the advantage of avoiding queues and possible misunderstandings. They also allow a better use of resources in the matter of personnel, while contributing to the modernisation of hospital function and configuration.
The possibility is provided of getting:

a) quick general information (e. g.: registration, data and documents, payment, table time of activities, presence of doctors, etc.)
b) quick answers about the basic questions generally asked by the patients (e.g.: therapeutic performances, specific instruction about treatments, possibility of getting special assistance/treatments, delivery of items to the patients, choice of meals delivered to the patients, etc.)
c) education about prevention (e.g.: answers to special requests, prevention of special diseases given in form of computer games in the waiting rooms, etc.)

9.3.2.3 Supply of Special Places

The well being of the 'occupants of the building' is considered the indispensable objective of sustainable design in private buildings and public institutions.
Hospitals have the specific function of supporting the health and well being of the population. The Hospital promoting Health and Well Being has the aim of fulfilling health and well-being of patients and people by means of appropriate design solutions. Various categories of people live and work in hospitals and visit hospitals. A variety of functions is combined in one

building (e.g.: routine of the performance of hospital function, the activity of every day life, etc.) and a large public relates to various activities and situations. The Hospital promoting Health and Well Being assumes the 'best possible' compromise to support the health and well being of different categories of people by integrating the following initiatives and components of design.

The opportunity of visiting a few **comfortable nice places** is provided outside and inside the building. For the large public of hospitals -living-in and out patients, staff, visitors and occasional clients- special places are realised in order to communicate a message of 'hospitality and welcome'. Close to the waiting rooms, the opportunity for something 'special' becomes 'entertainment' as happens in the special 'areas for children' within public buildings. This configuration contributes to a unique 'identity' for the hospital and suggests the combination of these components of design with way-finding (e.g.: colour, images and 'special' items help also in way-finding).
The more 'modern' configuration, improved 'comfort' given by the presence of something 'special' produce the more 'positive idea' of the hospital. The building is similar to any other modern public structure. Instead of an institutional building, it looks more 'attractive', for example like a large hotel or a modern shopping centre.

A few **special components**, intended as de-stressing activities, support physical and psychological well-being. They give the patients a pretext to move and to have an interest in something out of the monotonous routine of hospital life (e.g.: a quiet place for music-listening, reading a book, using computers for information and games). A shopping centre of adequate dimensions is integrated for the utility of the various typologies of consumers.

In order to improve the 'quality' of the assistance, **the supply of** '**closer assistance'** is also promoted by design (for example: the 'centralised' position of the nurse-station; the presence of glass-sheets to have the patients within sight distance; the reduced number of the patient beds to be assisted more closely; means of communication including visual connection and so on).
Better assistance is also given in other ways, such as by supplying accommodation for family members helping the patient.

Special components allowing '**higher privacy**' are introduced in design. For example, the patient's room contains two beds and the possibility of dividing the space into two separate parts by means of the array. In the end two different areas are created, one bed far from the other, increasing the privacy of the patients. The patients have a space to sit, an armchair and a small table, wardrobe and television. A quiet room is nearby, annexed to the corridor, where the patients read or listen to music or just relax. A room for private conversations is provided for the patients and their families, families and doctors. This place is also suitable for the family's need of a private space in the case of death of the patient.

The presence of a **natural environment and natural ingredients** and the traditional principles of cure which are still today promoted in health care are integrated in design, as in ancient times in the Askleipieia. The benefits of contact with 'nature' is supported. The Hospital promoting Health and Well Being includes in fact the realisation of special gardens and green areas which form part of the array of the building. They include components such as a green spot, scented flowers or fruit trees, small green-gardens or small zoos, some special items (e.g.: a special fountain, clock, sculptures, exhibitions of images/pictures, etc.).

In order to support health and rehabilitation, well being and prevention, **physical activity** is supported by means of special components of design. They are the traditional swimming pool (already used in hospitals mostly for rehabilitation) and a gym of adequate dimensions. Special areas outside the building are also created for physical activity.

Natural remedies and cures have always succeeded; even if it is undoubtedly science that prevails, patients have always appreciated their benefits.
In the Hospital promoting Health and Well Being, the patients might also combine the benefits of natural treatments, remedies and cures with allopathic specific therapies. 'Activities' are created -such as a room for relaxation with the use of de-stressing natural ingredients (e.g.: teas, oils, smells, etc.), soft music, colour and images of nature. They have the aim of supporting well being and relaxation, giving the patients an opportunity for 'moving' and doing something special, of increasing the level of comfort of the hospital, improving its function and configuration.

9.4 Methodology and Approach to the Quality of Design

The planning and building is globally improved in the Hospital promoting Health and Well Being as well as the durability of the results fulfilled in design. This is done by the methodical approach to design, supporting the maintenance of the building and function of the hospital, improved technology in building.

9.4.1 Performance of Hospital Planning

Construction, maintenance and design of the building are deeply involved in various risks related to health and environment. Designers and builders apply technologies and materials in buildings focused on reduce and prevent the risks directly influencing the health of patients and hospital staff, and more generally the health of the population. Designers and builders, hospital staff and materials producers collaborate to prevent and eliminate these risks. For this reason, a methodical approach to design supports the improved quality and validity of hospital design.

On the basis of the previous considerations, the following criteria are finally introduced in the Hospital promoting Health and Well Being to prevent risks related to health and environment:

- the coherence of design to criteria of sustainability supporting disease prevention in planning and building, which include: the appropriate use of building technologies and materials, the choice of the site for the building, choices of building materials and systems facilitating the maintenance of the building, etc.
- the improvement of the quality of design by means of methodical approach, including design, construction, management and maintenance of hospitals enabling the future validity of design

9.4.2 Methodology of Design and Prevention of Misfits

Hospitals are dynamic in function and structure owing to the development of scientific, technological and social progress. For this reason, present and future validity of design is supported in the Hospital promoting Health and Well Being, according to the growth of the building, against the background of:

- a policy of sustainability and prevention
- the collaboration of different categories of people
- co-ordination of various components of design
- supply of education and specific information
- continuous up-grading of function and design, etc.

9.4.2.1 Policy of Sustainability

A methodology of design is integrated in the Hospital promoting Health and Well Being supporting a systematic approach to design which includes design, maintenance and function of hospital buildings. It also supports the fulfilment of the numerous aims of hospital design - including health and well being of the people in relation to building and environment- by means of integral components of design.

The various possibilities for energy saving are promoted in design, function, maintenance and refurbishment of the building. The use of natural energy, passive systems and any other alternative is taken into consideration in building, including integration and recovery of energy. Appropriate building technologies and the principles of vernacular architecture as well as any other initiative towards energy saving and the use of renewable resources are taken into consideration at different levels -not only by designers- but also by builders, politicians and researchers.

The use of local renewable material and clean technologies is promoted in design to counter the depletion of natural resources and environmental pollution.

Preference is given to the use of those 'multipurpose' components and building materials, which are an economic convenience at present and in future perspectives, to be used for more purposes at a time, such as: water depurative systems integrated with the architecture of the gardens (they support water recycling and integrate the array of the green spaces); water saving systems and sod-roof (they also support water recycling and the array of the building); integrated large glass-sheets provide a nice view of the landscape and photovoltaic cells contribute to energy saving; integrated way-finding systems contribute to providing information and array of the building (e.g.: images or murals or arts, a variety of building material or use of colour in building components, special manufactures such as fountains or panels, etc.); insulating material and passive systems are integrated in the architecture or array of the building (e.g.: by means of type and colour of material, creeping plants or insulating panels in facades, etc.).

Information and education, the collaboration of different individuals in line with the recent policy of prevention in other sectors of life. This happens also in the prevention of the risks related to health and environment, at work and in building activity. For this reason, education and prevention support the design and function in the Hospital promoting Health and Well Being.

9.4.2.2 Up-grading of Function and Design

The Hospital promoting Health and Well Being contributes to 'prevent' the failings which might occur in relation to hospital design, maintenance and function. Prevention is supported from different points of view, since to 'think in advance' in terms of functional and practical

aspects produces many advantages. It allows misfits and re-doing. It supports the gradual growth of the building on the basis of the proportional development of scientific, technological and social needs.
The periodical re-visiting of hospital issues produces a methodical growth of the building. This is performed also on the basis of advice and opinions of all the people responsible for the functional, structural and technological conditions of the hospital. At the same time, regular maintenance of the building and appropriate performance of activities improve function and design.

9.4.2.3 Holistic Collaboration and Education

In the substantial research carried out in hospitals on the S.H.S., the researchers maintained that lack of co-ordination is mostly the cause of failings attributed to design and maintenance of hospital buildings. Beyond the prevention of risks and misfits, the need emerged to supply more modern patterns to counter the recent poor quality of hospital design.
'Higher quality' is expected from design concerning environment and function, supposed to correspond with the improved quality of life and competition found in other sectors of life. The holistic collaboration of different people is integrated in the Hospital promoting Health and Well Being also to improve the quality of design.
Hospital design includes a number of different projects such as administrative offices, specialised medical cubicles, operating theatres, patients' rooms, kitchens and supporting services for a large public, etc. Different objective situations and the needs of different categories of people, many technological and technical aspects, regulation in the matter of safety and prevention are integrated in one plan. The responsibility of many people is involved in the prevention of numerous hazards that influence the environments of the hospital. Different people usually work separately towards the realisation of one project, unavoidably interfering with the 'identical' environments.
The Hospital promoting Health and Well Being is produced as the sum of many individual contributions deriving from the holistic collaboration of all targets' groups involved in hospital design and function, which is considered indispensable to the best accomplishment of design. For these reasons the collaboration of various people and the co-ordination of various components support the design, realisation and function of the hospital.

9.4.3 Integrated Design, Maintenance and Function of Hospitals

Management and maintenance of hospitals play an important role in avoiding or reducing determined risks affecting their environments. It results that:
- the risk of pest infestation depends on hospital activity and equipment, air quality and cleaning of hospitals
- the presence of biological agents and release of pollutants depends on work performance, treatments and disinfecting procedures
- chemical substances and radioactive products used in the activities of hospitals, represent potential hazards which also depend on the performance of these activities

Systems of ventilation are usually present in hospitals not only in special sections (such as operating theatres, nursery, etc. requiring specific temperature and special filters to clean the air) but also in other parts of the building such as wards, medical cubicles and so on. However:
- ventilation systems and consequently the regularity of their function and maintenance influence the quality of the microclimate and the physical well being of the patients

- air moisture and temperature often create favourable conditions for micro-organisms to live and proliferate, encouraging the spread of disease

For these reasons, the large scale use of ventilation systems and the presence of chemical/biological hazards in hospitals invite designers to awareness in planning. In fact, the appropriate planning, realisation and maintenance of these systems contribute to the health and well being of the public.
In the design of the Hospital promoting Health and Well Being, designers and builders, personnel and technicians of the hospital, are supposed to be informed on the factors of risk in hospitals, mostly in relation to their activity. To produce 'healthier' hospital buildings, the large scale use of air conditioning is reduced or integrated with openings to increase natural ventilation where possible (in conformity with the health regulations). The regular maintenance of technological systems is performed and a general co-operation at every level is established in the Hospital promoting Health and Well Being to achieve the best hospital design and function. Information and education is supplied to the personnel, designers and technicians about the risks connected to their activity.

9.5 Final Components of Design

The Hospital promoting Health and Well Being takes into consideration the strong influence of design on the situations affecting the current conditions of hospitals and the policy of sustainability in building. It takes also into account the correlation existing between social development, environment (physical and built) and function of hospitals.
The prevention of misfits and the systematic approach to design improve the quality of design by means of four main categories of design components which are integrated in the Hospital promoting Health and Well Being: Function, Environment, Architecture and Methodology of design.
The components which make part of these categories help to prevent the risks related to health and environment; they contribute to produce a patient-focused design, adequacy of design to modern living standards and design methodology, which supports the validity and durability of the results fulfilled in planning and building hospitals.

ENVIRONMENT
Hospital Environment is affected by a number of risks properly depending on the particularity of the activities of hospitals; it is also affected by other general situations at risk generally influencing health, environment and building design. Appropriate components of design are introduced in the Hospital promoting Health and Well Being for the prevention of these risks: criteria for the choice of the site, building technologies and material; the systematic methodology in planning and building, and in the performance of hospital function; criteria for sustainability in hospital design; education and collaboration of different people.

ARCHITECTURE
Hospital design and configuration are affected by specific failings that produce inconveniences and difficulties in the refurbishment of these buildings, inadequacy to modern living standards and disappointment of the patients. The prevention of these misfits is achieved in the Hospital promoting Health and Well Being.

Hospital typology includes structural and technological flexibility. Defined lines of expansion for the building and appropriate criteria of design are established allowing the development of the hospital as building and as institution (more stable and centralised functions are the 'heart of the building' from which the design of the hospital starts to be developed; other activities likely to growth are situated along the lines of expansion of the building).
The typology of design contributes also to creating comfortable environments and to increasing the assistance. Facilities and activities are integrated in design to support patient healing and well-being, based on natural ingredients and means. Greater privacy and a comfortable atmosphere are promoted by means of design.
Specific components of design contribute to support identity and qualification of the hospital.

FUNCTION

The recent social changes influencing hospitals as building and institution are taken into consideration and integrated in design. To this end, a new environmental configuration and new activities are integrated in the patient-focused design of the Hospital promoting patient healing and well-being (which is the principal hospital function and the policy of the W.H.O.).

METHODOLOGY

A methodology of design supports the prevention of health risks against the background of a policy of sustainability. Education and holistic collaboration, building technology and regularity of the maintenance contribute to improving the quality of design and function of hospitals. Closer integration of design with function and the continuous up-grading of design/function contribute to keeping the final result valid also in the future.

The components to be integrated in hospital design are reported in the following scheme.

Environmental Conditions

use of natural means as support of patient healing and well-being
choice of a natural resort for the building
use of renewable resources and clean technologies
natural materials and energy saving
prevention of negative effects on the environment
introduction of every possible benefit derived from the environment
production of appropriate physical environments
increased awareness of all target' groups
co-ordination of experts and people in relation of various items of design

Hospital Configuration

improvement of building's environments and design
identity or qualification of hospitals by means of items of design
natural ingredients in the building realisation
natural means as support of patient healing and well-being
special items of 'welcome and entertainment'
items supporting physical activity
items supporting the employment of natural relaxing remedies
facilities and 'amenities' at hand
comforts proper to a hotel
home-like hospitality, familiar atmosphere
items promoting assistance
items promoting privacy
higher level of privacy in the patient room
decoration, images and colours
combination of image and colour with other indispensable items of design
structural flexibility
technological flexibility
structural and technological lines of expansion
rules of design, terms of reference
distribution of day-hospital activities mostly on ground level
distinction between main and secondary functions
distinction between activities likely to grow and not
identification of sectors likely to grow
modular building and furnishing systems

Hospital Function

decrease of in-patients
increase of out-patients
functional flexibility
activity of prevention and health education
activities promoting patient healing and well-being
closer consideration of the individual conditions of patients, staff and visitors
modernisation of building's environments and design
special items of design giving a hospital its identity
improvement in quality and function of design
way-finding
information systems supporting patients' education
fulfilment of physical psychological well-being of patients, visitors and staff
increased privacy, assistance, comfort and familiarity by means of design
special items of 'welcome and entertainment'
items promoting assistance
items promoting privacy
items supporting physical activity
items supporting the presence of natural ingredients
items supporting the employment of natural relaxing remedies

Methodology and Systematic Approach to the Quality of Design

methodical approach to design, maintenance and management of the hospital
continuous upgrading of the building in function and structure
collaboration of designers, experts and technicians
closer co-ordination of the many components of design
regular maintenance of the building and appropriate performance of activities
improved education of the people working in the design and function of hospitals
application of criteria towards sustainability in design, management and maintenance (e.g.: use of multipurpose components of design, energy saving in design and maintenance, use of local renewable materials in design and maintenance etc.)

9.6 The Hospital promoting Health and Well Being

Building design is affected by a number of factors which influence our environment and health**.** At the same time, the policy of the W.H.O. is to promote prevention of disease and the well being of the population, which influences health care and building design.
The 'sustainability' of building design is promoted all over the world to prevent the risks that can affect our health and environment, and to support the health and well being of the population. This supports the idea of creating appropriate solutions also concerning hospital design (Part I).
Society (social context and culture), Science (medical knowledge and sanitary regulation) and Technology (in building and in means for diagnosis and therapy) have always influenced hospital design. A series of failings have been recorded regarding hospitals related to their environmental conditions, configuration and function (Part I and II). Closer investigation of the nature of these failings reveals that hospital design is mostly responsible for this situation and that hospitals are inadequate to respond to the issues of progress (Part II).
The quality of hospital design needs to be improved on the basis of the facts identified that affect building and hospital design. The following factors are studied in order to identify the components of the so called Hospital promoting Health and Well Being, which is created to counter the above failings (Part II and III):

- problems generally affecting the building and the environment
- policy of the W.H.O. (influencing health care and building design)
- nature of the failings recorded regarding hospitals and their causes
- social changes which influence hospital design and function
- factors which have influenced hospital design in the past and at present
- present trends in the development of hospitals

Formulated on the basis of the above, the Hospital promoting Health and Well Being includes four categories of components necessary for improving environmental conditions, configuration and function of hospitals. The four categories are:

- Prevention of Risks in relation to the Environment (by including components of design related to the choice of the building site, energy and building material)
- Improvement in Architecture (by including components of design related to the configuration and typology of the building)
- Improvement in Function (by including components which support the function of hospitals as institutions and as buildings)
- Methodology of Design (by including components which improve the quality of design and the production of hospitals)

These four categories include specific components which are illustrated below.

9.6.1 PREVENTION OF ENVIRONMENTAL RISKS

Appropriate choices should be made in the design of the Hospital promoting Health and Well Being in order to avoid and reduce the risks related to Health, Building and Environment. Not only those generally affecting building design (such as radon radioactivity, electromagnetic fields, toxic emissions from building materials, etc.) but mostly specific risks related to hospital

environments (such as pollutants and biological agents due to poor design and maintenance of the building, design and use of ventilation systems, air and noise pollution from traffic, etc.).
The multifunctional structure of a hospital is influenced by the environmental context of the building in terms of environmental pollution. It is affected by the presence of the built context which means noise and pollution, the presence of many activities and traffic. At the same time, the urban context and the people living nearby are influenced by the performance of hospital functions.
One of the tasks of designers and builders is to create the appropriate environmental circumstances to achieve the health of the patients and the well-being of patients, visitors and staff of the Hospital. promoting Health and Well Being Prevention of risks related to the environment is achieved by preserving, supporting and allowing healthier conditions of life for the individual. This is made possible by the use of the following components integrated in design in relation to the choice of the BUILDING SITE, ENERGY AND BUILDING MATERIAL:

A) BUILDING SITE

1. Choice of a Natural Setting.
The realisation of the building within a 'healthy' natural setting creates healthier conditions of life for patients and people, and increases the contact of the patients with a natural environment and natural ingredients. The preponderance of green areas over the built areas, the integration of natural components support the realisation of comfortable environments at man's measure. A 'green frame' for the building acts as a filter area between the building and traffic.

2. Conservation of the Natural Environment and Ecology.
The harmonious organic architecture of the Hospital promoting Health and Well Being preserves and includes the natural beauty and characteristics of the site, which are integrated in the plan of the building with concern for ecology, living organisms and natural resources. The realisation of cubic meters of construction which appear superfluous at present but reasonable in the future can be avoided in planning. This is done by the assumption of criteria of flexibility in building.

3. Profit from Natural Advantages.
The new hospital building coming to life should be considered a 'living organism' which has a close relationship with local natural resources, morphology and landscape, weather conditions and geological characteristics. The patients, staff and visitors of the Hospital promoting Health and Well Being can profit from advantageous situations given by the specific characteristics or requisites of the site. Possible benefits deriving from the natural configuration, the use of local material and energy and the natural advantages of the site according to the principles of Feng-Shui, are taken on in building. Hospital indoor and outdoor spaces are dimensioned and designed according to relaxing schemes.

B) ENERGY

1. Use of the Local Resources.
A durable relationship between the building and site is established through the use of local renewable resources in the design, realisation and maintenance.

2. Energy Saving and Passive Systems.
The numerous technological systems in hospitals produce high consumption of energy and production of pollution. For this reason the possibility is taken into account of applying the local energy during the whole life-cycle of the building according to the needs of realisation, function and maintenance.

3. Recycling Procedures.
The use of natural and recoverable energy from combustion procedures and combined systems are introduced in the Hospital promoting Health and Well Being on the basis of analogous systems more generally applied in buildings.

4. Bio-compatible Building Technologies.
The use of 'clean' technologies is promoted in order to fulfil ecological advantages and social benefits, supporting the individual well-being which is the aim of design. They take into account the principles of Feng-Shui (e.g.: advantageous orientation of the building to the sun, possible profits deriving from specific geological or meteorological conditions of the site, providing shelter to the building from the wind/cold by means of a specific configuration of the land, etc.) and every other technology used in building for Sustainable Design (e.g: conservatory and skylights, low consumption illumination, openings promoting natural ventilation, reducing the number of windows on north-exposed walls, creating protection from the cold by building partly underground north-exposed walls, creating shade from the sun by means of plants and green-walls, etc.)

C) BUILDING MATERIAL
(See also 9.6.4 Methodology of Design)

1. Natural Renewable Materials and Local Resources to avoid the depletion of our natural resources.
The natural resources of the site are preferably applied in the Hospital promoting Health and Well Being, natural products which are renewable in nature, recycled building and furnishing material.

2. Use of Biologically Safe Materials.
Easy to clean biologically safe products which have the characteristics of resistance and integrity are used in building and furnishing, ensuring the continuity of their surfaces, which hampers the proliferation of micro-organisms.

3. Use of Non-Polluting Material.
Natural non-polluting material is preferably employed in building and furnishing in order to avoid or reduce environmental pollution due to heavy chemical procedures and high energy consumption in their manufacture, application and function.

9.6.2 IMPROVEMENT IN ARCHITECTURE

The Hospital promoting Health and Well Being responds to the issues of social development and a patient-focused design by including modern criteria for the development of sustainable hospital buildings. The hospital failings recorded and the policy of the W.H.O. to promote health and well being motivated the need of producing alternative typologies for hospital buildings and the introduction of natural components. The aims of hospital design, the new

policy and a number of assumptions taken from history point to relevant criteria in the choice of hospital configuration and typology. Finally, the quality of hospital design is improved in its architecture (that is environmental CONFIGURATION and TYPOLOGY of design) by the introduction of specific components of design which respond to the aims of this study.

A) CONFIGURATION

1. Integration of Natural Components.

Natural prerogatives and components, such as green plants and increase of natural illumination, improved contact with nature support patients' healing.

1.2 Local Ingredients and Nature

The closer correspondence of the building with local landscape and cultural habits integrates in design material, colours and characteristics of the place such as natural beauty and resources.

1.3 Green Spaces.

The natural environment and special places in the open space are integrated in design giving the patients the opportunity of benefiting of contact with nature, which support their physical and psychological well-being.

2. Trust and Comfort are communicated by the Building Configuration.

The components of design are alike the components used in other modern large public structures. Building design and configuration, material and colour, the 'quick legibility' of design (in main lines) combined with way-finding create the atmosphere proper of other large modern public structure.

2.1 Clear Evidence of the Building Components within the Hospital Complex.

The immediate positive perception of the hospital is given by quick, easy way-finding. From the surroundings of the building and the parking areas, it is already possible to have a general idea about the lay-out of the hospital and the location of its main functions (administration offices, reception, patients rooms, ambulatory, church and morgue etc.). Visual information help visitors and patients to better participate in 'hospital life' and supports the patients in experiencing the plan of the hospital.

2.2 Hospital 'Identity'.

'Personality and character' are achieved in design by the use of specific characteristics and colours, special components are introduced in design (such as a sculpture, a fountain, a permanent exhibition and so on). A positive message is sometimes communicated to patients and visitors by these components illustrating specific subjects (such as a sculpture showing a hospital speciality; a permanent exhibition about natural therapeutic methods or the evolution of therapy through history; pictures testifying to the various stages of the building construction or historical facts that occurred in that place and so on).

3. Relaxing Schemes.

The expectations of patients and staff are taken into account to improve the assistance and the realisation of a patient-focused design. The need of single individuals, assistance and the comfort of a large public are taken into consideration in the optimisation of functions and spaces. Special components contribute to creating a modern configuration, comfortable spaces and furniture, in conformity with the standards of other large public structures which are focused to improve comforts and assistance. The lay-out of the circulation (people, equipment

and means of transportation) is more often integrated in design in order to improve the performance of the activities.

3.1 Introduction of Modern Items and Means.

The increased awareness of people about health and diseases and the wide scale use of technological means in every activity of life support the introduction of modern requisites of design. A modern context is created in the Hospital promoting Health and Well Being by the introduction of increased facilities (such as way-finding and computerised means of information, etc.) and modern components of design (such as wider spaces and volumes, larger glass-sheets and skylights, escalators etc.).

3.2 Lay-out of the Indoor Circulation.

Coherent circuits are created in the circulation of the patients, staff and visitors. The patients are taken to their destination on the basis of consequential passages given by diagnostic and therapeutic treatments. In this way the patients avoid to ask information or to take a wrong direction, to see something unpleasant, to meet unpleasant smells, etc.

3.3 Comfortable Configuration of the Indoor Spaces.

The building and furnishing components create a human scale: comfortable materials and furniture, decoration and paintings, a warm illumination and plants produce a home-like atmosphere.

Each section of the hospital reflects different needs in relation to different situations. Proportion and requisites of design are identified case by case in order to support and improve function and assistance.

B) TYPOLOGY

1. Choice of Hospital Typology.

Different typologies have been used in hospital history to fulfil the different needs and issues dictated by social development, but specific characteristics have been constantly taken into consideration. These are maintained without any restriction concerning format and shape of the building. They are the following.

1.1 Flexibility

Not only the present circumstances and needs influencing hospital design are taken into consideration in the Hospital promoting Health and Well Being but also the future. Thinking of the continuous evolution and growth in dimensions of our society, appropriate criteria are introduced in design supporting the parallel gradual development of hospital buildings. The structural and technological flexibility of the building is indispensable to support refurbishment and/or growth, and to preserve the coherence of design to the original project. It produces advantages from the economical, conceptual and technological points of view.

1.2 Layout of the Plan.

The layout of design shows which is and which will be the general organisation of hospital activity, at present and in the future. For this reason the layout of design integrates criteria for change and main lines for possible expansion.

1.3 Horizontal Development of the Building.

The horizontal extension of the building supports flexibility and it is preferred in hospital design to the reduction of mechanical transportation, energy consumption and costs of maintenance, gaps and stairs between plural structural levels. Disabled people and the patients are advantaged in this configuration, which facilitates the movements of staff and equipment. In this case (e.g.: if the building is preponderantly developed on one or two levels) the possibility exists of further extension of the building in a vertical direction.

2. Criteria supporting Flexibility for the Future Up-grading of the Project

Specific components of design are identified as responsible for the growth and/or change of the building and appropriate criteria are introduced in design, which support structural/technological flexibility.

2.1 Flexibility on Large and Small Scale.

Flexibility is needed on a small and on a large scale to consent the refurbishment and growth of the building. To divide the structure into small components such as modular units is here considered necessary, since it gives advantages in the case of refurbishment and change.

2.2 Identification of the Strategic Flexible Components of Design.

The building is divided into smaller parts or 'units' made up of one or more modules. These units and their strategic location in the layout of the hospital support the flexibility of design. Units and nuclei made of more units have a number of possibilities to be extended towards pre-defined directions owing to their geometrical configuration and their position in the layout of the project. A double flexibility is achieved by the configuration in smaller 'units' and by modularity which consent action on a small and on a large scale.

2.3 Use of Modular Building and Furnishing Systems.

Modularity contributes to maintaining the original idea of design and supports the use of modular building/furnishing systems. This consents rapid design solutions in the case of refurbishment and short time-frames for its realisation. Maintenance is also advantaged by the use of modular building and furnishing systems (e.g.: components which can be quickly dismantled and substituted; whose application is easier).

3. Components of the Project.

Three components of the project are finally defined as follows:

- the 'heart' of the building comprises more stable centralised functions which are unlikely to change (e.g: a series of services like reception and administration, laboratories and pharmacy, laundry and kitchen, disinfection unit, etc.);
- the 'body' of the building is made up of a number of units or nuclei which include units thought to have potential for changing (e.g.: patients rooms with annexed services; the activities of the hospital concerning diagnostics and therapy; day-hospital, ambulatory and surgery for out-patients).
- the 'spine' of the building is formed by the main corridors, which are the elements of connections between the activities and include the primary network of technological systems.

3.1 A Central Nucleus contains Centralised Functions ('heart').

This part of the building contains the main activities and services enabling hospital function. Representing the 'heart' and 'engine' of the activity of the hospital, this part assumes a 'centralised' position in the general layout and remains integrated within the original project.

3.2 Units and Nuclei for Flexible Activities

The components containing activities likely to grow are distributed in 'single modular unit' or 'nuclei of modular units', which are introduced in the layout of the hospital along the 'main lines of expansion'. Their de-centralised position and the presence of free spaces nearby consent their eventual extension.

3.3 The Elements of Connection are the 'Spine' of the Building.

The main corridors are 'spine' of the building and support the activities, since they include the primary network of technological systems, chief traffic lines and connections towards the various activities. Information and way-finding systems are also integrated within this 'spine'.

The 'spine' is designed to support refurbishment and growth of the building. It consents the simultaneous refurbishment of plural components, to be changed or extended according to

the growth of the hospital. To be flexible, the 'spine' is open-ended and allows the creation of new branches according to pre-established directions. Lay-out and dimension of the components of the 'spine' support eventual structural/technological extensions and changes.

9.6.3 IMPROVEMENT IN HOSPITAL FUNCTION

Hospitals have changed in their function and number of activities. These changes are integrated in the Hospital promoting Health and Well Being as INSTITUTIONAL CHANGES. Other specific changes are introduced in this Hospital, so called FUNCTIONAL CHANGES, which are focused on producing a less stressful approach to patients in hospitals.

A) INSTITUTIONAL CHANGES

1. Increase of Out-Patients.

The rapid development of surgery, therapies and medical equipment support the presence of an ever increasing number of out-patients, who do not need hospitalisation when undergoing many diagnostic examinations, therapeutic treatments and surgical operations.

2. Increase of Day-Hospital Activities.

Owing to the rapid development of medical knowledge and technology the number of day-hospital activities has increased and will be further increased in the future, also owing to the increasing number of elderly people.

3. Functional Flexibility.

The function of hospitals continuously evolves with the development of our society, science and technology. This typical versatility of hospital function is taken into consideration in the Hospital promoting Health and Well Being.

B) FUNCTIONAL CHANGES

1. Patients Well Being.

The approach of patients, staff and visitors to hospitals is improved by means of design to answer the expectations of various categories of people. It is also closer to the modern, more comfortable life style.

The Hospital promoting Health and Well Being supports patients' healing and well-being by taking into account, in various situations and circumstances the delicate 'condition of being a patient'.

1.2 Physical Well Being: Consideration of Human Biological Needs.

The best combination of a series of factors is achieved in design in order to respond to the individual needs (e.g.: harmonious proportions of spaces, contact with natural environments, abundance of fresh air and natural light, appropriate indoor climate, comfortable illumination, ergonomic furniture and comfortable components of design to various purposes, etc.).

1.3 Psychological Well Being: Giving of Positive Perceptions.

There are plural ways to give a positive perception of our built environments and the Hospital promoting Health and Well Being is studied to 'impress positively' the patients for therapy and healing. Perspective, light, colours, forms, building/furnishing components and decoration, forms of 'artistic expression' are real tool of design and means to communicate emotional messages. These and other 'special' components of design (e.g.: a special fountain, a small zoo, a fruit/flower garden, a decorative meridian or clock giving world/times etc.) are integrated in

the design of the Hospital promoting Health and Well Being in order to produce the positive perception of spaces and provide a de-stressful atmosphere at human dimension.

2. Supporting the Assistance.

The introduction of components supporting and increasing the assistance is promoted in the design of the Hospital promoting Health and Well Being, such as: the closer positioning of the nurse-station to the patients' rooms and means for direct verbal/visual contacts with the nurse from patient bed, the use of large glass-sheets (between nurse station and rooms), the support of the assistance given by providing accommodation for family members of the patients, increased information given to the patient by means of computerised systems, the presence of comfortable items and furniture and a patient-focused design in every circumstance, etc.

2.1 Integration of Modern Means for Information

Computerisation and quick means for communication/transportation are integrated in design for different purposes: to provide general information, to establish direct contacts between patient and nurse (for example by means of an internal-phone), to further the education of the large public in hospitals, etc. Means like these are introduced in the Hospital promoting Health and Well Being for the utility of: the patients (since these means provide information, closer contacts and assistance), the personnel (since these means help their work), the public in hospitals (since they establish quick contacts proper to modern life style; since they promote and support education), the hospital (since they give a modern image to the hospital).

2.2 Integration of Way-finding Systems.

Way-finding cues are given starting from the areas near the hospital and the main roads. Easy access to the parking area and to the entrances of the hospital are given, cues of way finding take the patients from the entrances to the various destinations. The patients' approach to hospitals becomes 'comfortable', physically and psychologically, since it helps to make clear the complex activity and configuration of the building within the perspective of establishing an immediate relationship of 'familiarity' between hospital and patients.

2.3 Integration of Systems Promoting Education.

The introduction of modern and rapid technological means for information, such as computerised systems is not only useful to increase the level of assistance but also to supply special education for the task of prevention (including treatments of diseases, procedures of diagnostic examinations etc.).

2.4 Natural Ingredients and Systems of Relaxation.

A large scale presence of natural ingredients, according to the trend of the time towards 'natural' choices, supports patients' healing and well being. 'Special' de-stressing activities are introduced in design, based on traditional therapeutic principles that support the healing of patients. These are systems for relaxation based on the use of natural ingredients, such as pleasant scents, visual-acoustic positive perception given for example by the exhibition of slides showing natural images, soft music and light, comfortable places where to lie down and so on. Initiatives like these are taken as means to enable the patient to experience hospital life and a number of related opportunities like those in every-day-life.

3. Increase of Comfort

Other 'special' activities and spaces are besides provided which increase the standardised level of 'comforts' provided for the patients, visitors and staff who also benefit. To provide some 'activity' for the patients is the aim of the Hospital promoting Health and Well Being. This is done by the introduction of a few formal initiatives focused on de-stressing the patient from the conventional routine of hospital life. For 'activity' is intended a number of initiatives which support patients' well being by keeping them away from their illnesses and influencing their attitude towards the hospital positively.

3.1 Privacy and Social Life.

There are patients who want privacy and silence. Others cannot be disturbed because of their suffering. Others, on the contrary, need to socialise, to reach another patient, to have some conversation. These opposites are taken into consideration in hospital planning. On the one hand, a quiet place is provided to have a private conversation (with a family member or a doctor, or with other patients). This place gives also the possibility for the family of the patient to rest or to find relief from sorrow. On the other hand, a number of initiatives are addressed to the second category of patients and those who prefer to move, to have the choice of reaching for example the commercial area or other 'special' places and 'special activities'.

3.2 Special Activities and Places.

Means like television, books, records and videotapes, video games and computer information represent a large range of possibilities responding to the preference of any single individual. A few 'special places' are created, nice to be to visited, which 'de-stress and activate' the patient (from this point of view it is possible to talk of 'activity' with reference for example to the presence of a winter garden or other initiatives like an exhibition of pictures and images hanging on the wall). The purpose is to ban the 'institutional impression' given by conventional design of hospitals, as well as to support patients' healing and well being.

3.3 Physical Activity.

A swimming pool or a gymnastics hall is sometimes provided in conventional hospitals for the rehabilitation of patients. But now the benefits of physical activity for the prevention and cure of diseases is always more often claimed by experts. The Hospital promoting Health and Well Being takes into consideration the recent renewed interest and use of natural therapeutic principles and means and integrate these items for various purposes. Some patients allowed by doctors to take exercise (this happens for example in the case of women after a baby's birth, in rehabilitation after disease, prevention of disease etc.). Components that allow physical activity are included in design also in view of the new prevention policies in health care. On the basis of these premises, the open spaces surrounding hospitals are also used by the patients for gymnastics or activities organised by the hospitals to make the patients move and exercise or just to take a short walk.

3.4 Implementing the Function of the Green Areas.

A number of opportunities for benefiting from the contact with abundant fresh air and sunlight, plants and green areas are integrated in the Hospital promoting Health and Well Being. The design of green areas is integrated in the Hospital promoting Health and Well Being also to promote the contacts between patients and natural environment, sunlight and fresh air. Depending on the local landscape, these areas include any natural beauty of the site (e.g.: a stream, a pond, the natural configuration of the soil and colour, the different kind of plants and flowers, etc.). According to the configuration of the site (flat, descending or sloping upwards), the plan includes the realisation of footpaths, benches and some 'special' components (e.g.: small waterfalls or fountains with the play of water, fruit gardens or scent gardens, or small zoos etc.).

9.6.4 METHODOLOGY OF DESIGN

Taking into consideration the nature of the failings recorded in hospitals, three components are integrated in design -METHODICAL APPROACH, BUILDING TECHNOLOGY and MAINTENANCE- which improve the quality of design and support its validity over time.

A) METHODICAL APPROACH

1. Improved Co-ordination and Better Combination of Plural Components.

The new policy of Sustainability suggests many remedies against many critical situations affecting hospital conditions, but the methodical approach to design consents the 'best conditions of design' to support the function of hospitals. For this reason the design of the Hospital supporting Health and Well Being promotes an improved co-ordination of several ingredients: it is the 'better puzzle', made by the best possible solution of design, to improving the quality of the environment, configuration and function of hospitals.

2. Integration of Aspects connecting Design and Function.

In view of rapid social progress, the design of the Hospital promoting Health and Well Being systematically takes into consideration a number of components also for the future validity of hospital design and function. Interference and misfits like those deriving from lack of co-ordination between design and maintenance (theory, practical needs and circumstances) can be avoided if practice and theory are examined 'face to face' and if the decisions taken in planning are integrated by technological and functional aspects. The closer co-ordination of the designers and technicians, usually working in parallel and thinking separately, supports the validity of design and function.

3. To Think in Advance

Though plural aspects of design are taken into consideration 'before' the realisation of the building, a series of misfits and inconveniences mostly depends on short-sighted decisions taken in advance. The traditional attitude of designers seems to under-estimate the practical application and perspectives deriving from the specific choices made in planning. This can be avoided:

- by thinking in advance in terms of functional and practical aspects influencing hospital development
- by integrating criteria enabling the future development and refurbishment of the hospital.

3.1 Estimation of Future Needs.

Giving a look to the future means avoiding re-doing and misfits, which also gives economical returns. For this reason, the possible expansion or reduction of specific activities and sections of the building, potential perspectives and needs concerning hospital function are taken into consideration. Various categories of people (hospital designers, hospital managers, hospital staff) formulate their opinions and forecasts about the potential future development and direction of growth, and about scientific and technological aspects influencing health care in order to create a 'competitive' hospital building.

4. Holistic Collaboration.

The holistic collaboration improves the quality of hospital design.
All target groups contributing to the hospital realisation and function are involved in hospital design:

4.1 Contribution of Doctors and Nurses.

Doctors and nurses give their contribution by identifying new needs, by providing advice and opinions for the improvement of hospital function also by means of design.

4.2 Contribution of Designers and Builders.

Designers and builders integrate the information necessary for the development of design. They provide scientific and technological opinions, and practical valid solutions. They make responsible choices concerning the structural, technological and environmental validity of the building.

4.3 Contribution of Personnel and Technicians.

Not only the nurses and the medical staff are closely involved in the activities proper to hospitals, but also those technicians using equipment and components necessary to perform hospital activity. This is the case for example of the personnel working in maintenance of the building, whose advice and opinion are taken into consideration for successful design in the present and future perspectives.

4.4 Contribution of the Patients.

The patients experience 'full time' hospital assistance and conditions. As main protagonists of hospitals, they influence choices and initiatives supporting their physical and psychological well-being. For this reason they give relevant opinions about the quality of design and the function of hospitals.

5. Specific Technical Education.

Designers, builders and technicians receive appropriate information and up-dating (general and specific) on health education and risk prevention in order to support appropriate choices in planning, building and supporting the therapeutic activities and the technological functions taking place in hospital buildings.

B) BUILDING TECHNOLOGY

1. Quality of Design and Improved Technology in Building.

The quality of the manufacture avoids re-doing and supports the prevention of the health risks (e.g.: due to the presence of biological agents, of polluting building materials, of inadequate technological systems, etc.). The use is made in the Hospital promoting Health and Well Being of building materials, building systems and technologies which do not facilitate the proliferation of biological agents responsible for health risk for the individual (for example: joints between different building components or materials are properly sealed; the openings for inspection are closed by means of hermetic doors; the realisation of voids, suspended ceilings and floating floors is avoided; etc.).

2. Designer's Skill.

The improvement in the quality of hospital design and function do not necessarily mean making expensive choices, but operating qualitative choices. In the Hospital promoting Health and Well Being, those cheap and cost-less adjustment are welcome which can ameliorate the quality of design only by means of the ability and skill of designers and the collaboration of various experts.

2.1 Choice of Easy Solutions.

To adopt 'easy solutions' is not the shortest way to reach the aim. It doesn't mean 'simplifying' methods and reality. But it represents the fundamental attitude to take into account the basic human needs and to prefer easy solutions and means in order to reach various purposes in planning and building. It means the awareness that to avoid complicated technologies is advantageous for many reasons. It is advantageous to counter to the:

- costs usually related to sophisticated mechanisms and systems,

- difficulty regarding realisation/installation of sophisticated systems,
- possible complications in function
- complication in maintenance and in the case of repairs

On the contrary, the simplest solutions often bring fast, positive results while requiring quicker and easier realisation, and low maintenance costs.

2.2 Preference for Multifunctional Components and Technologies

Specific choices sometimes allow saving on consumption, materials and money or allow the hospital to gain plural advantages at one time. In the design of the Hospital promoting Health and Well Being, preference is given to 'multifunctional' building components (e.g.: furnishing components, technological systems, materials and products, etc.) responding to plural purposes at one time, for example on the basis of their special characteristics or the introduction of specific additives, their combination with specific technology or the introduction of appropriate material, colours or other requisites, etc.

The convenience of the choice made consists in its 'return' against its 'cost' which takes into account a series of fact (such as the quality and number of the purposes achieved, the eventual economical gain, the advantages given by the final result, etc.). This estimation particularly includes the benefits gained in terms of economical profit and long-term benefits on a large scale (for the individuals in terms of health and environment).

3. Choice of Appropriate Products and Technologies in Building.

The choice of the components and technology is also focused to build a hospital able to 'grow' over time and criteria of design that will consent putting into practice refurbishment and energy saving by the use of convenient building technology and materials.

3.1 Use of Long-lasting Products and Technologies supporting Flexibility.

The building/furnishing components are preferred which support a long-lasting life of the building, resistant to the continuous presence and use of a large number of people.

3.2 Components supporting Maintenance.

The choice of building technologies, technological systems and installations takes into account the easy, rapid performance of maintenance and refurbishment of the building. Easy-to-substitute materials are preferred, which allow the quick substitution of parts (which also avoid long-lasting works delaying hospital activities) and products reducing the costs and works of 're-doing' in the maintenance and refurbishment of the building.

3.3 Use of Renewable Resources and Methodologies consenting the Energy Saving.

It is often advantageous to pay higher costs at the beginning to be paid back later on, if it is possible to avoid high consumption of energy and pollution deriving from the numerous technological systems needed in hospital function. The use of natural energy and of methodologies for energy saving is supported in design and in the life cycle of the building.

C) MAINTENANCE

1. Regular Performance of Maintenance.

The regular performance of maintenance is the aim of design. As an integral part of design, it is planned with the design of the building and supported by appropriate education provided to designers and technicians.

2. Regular Up-grading of Function and Design.

On the basis of the forecasts concerning the development of hospital function, appropriate criteria are established in design also to support structural/technological refurbishment, extension and changes of the building. Every decision taken in the plan of the Hospital promoting Health and Well Being -not only concerning the condition of the hospital at the

moment of the plan- is supported by the integral and continuous up-grading between 'function and design' which avoids many inconveniences not only at present but also later on (such as for example in the case of not foreseen 'adaptations' of the building due to changes needed in the future).

3. Revisiting of Issues in Function and Design.
A constant prevention of misfits and failings is also carried out by means of periodical check-ups in order to operate a gradual, total up grading of function and design.

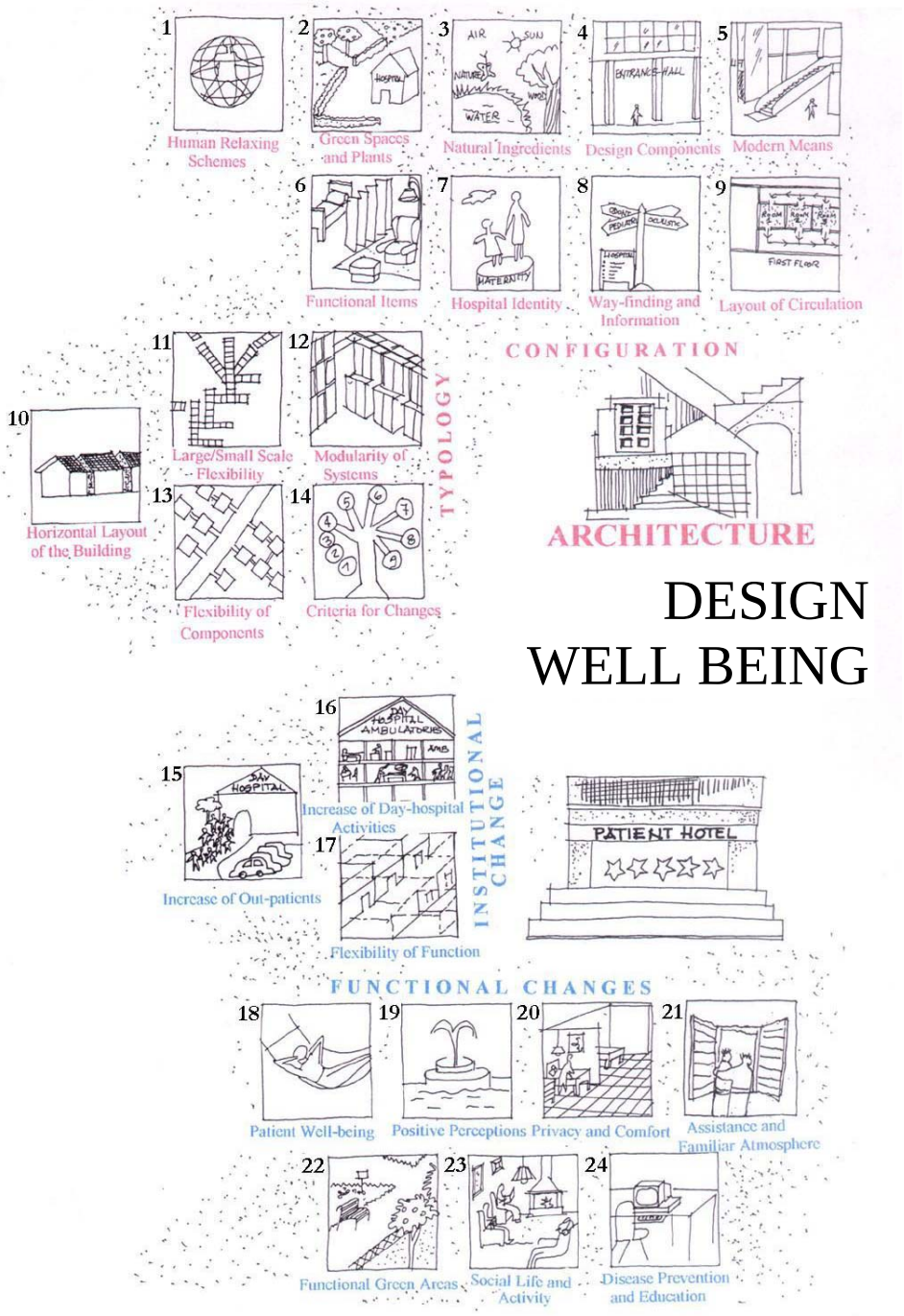
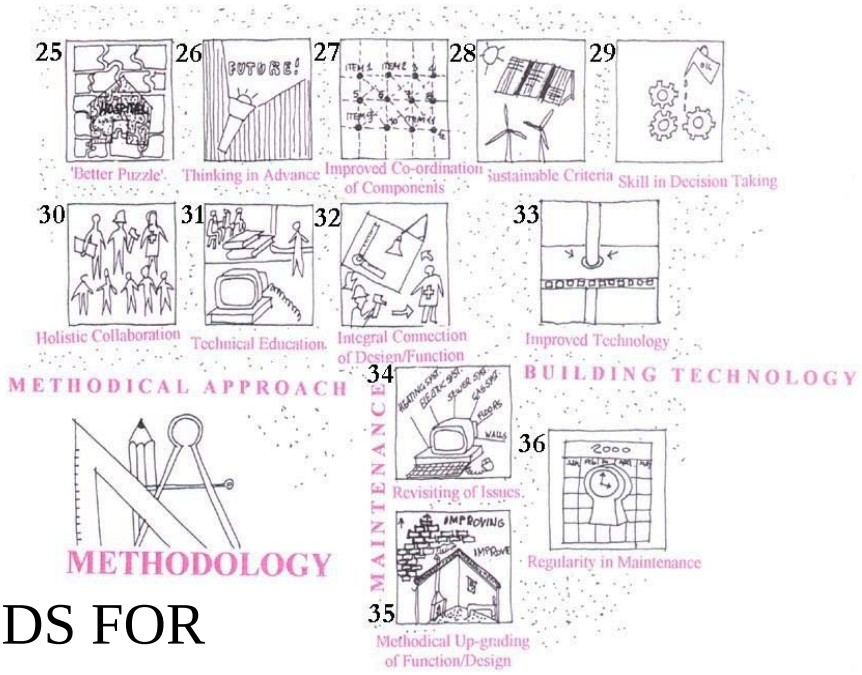
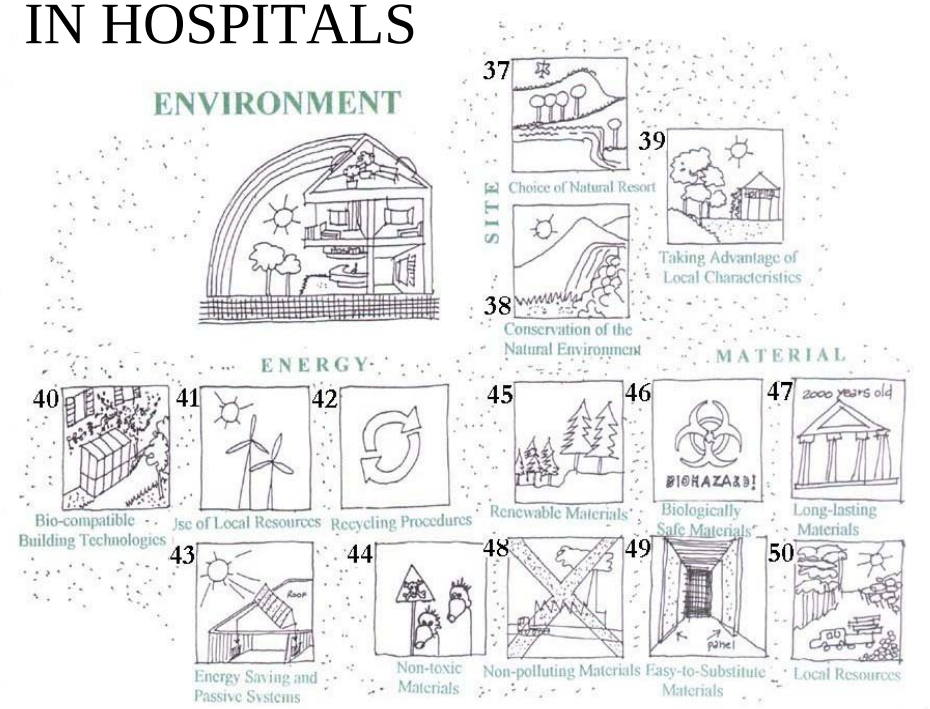


FIG. 25 - THE 50 PATTERNS OF DESIGN



AIDS FOR IN HOSPITALS



FOR WELL BEING IN HOSPITALS

Conclusion of 'Framework and Design for Hospitals supporting Well-being'
Chapter 9

Application of the Enhancements Proposed

The components integrated in the Hospital promoting Health and Well Being are reported below. They are finally listed in four categories -Environment, Architecture, Function and Methodology- which improve the Environmental Conditions, Configuration and Function of hospitals.
A final prospect shows the four categories of components with the most important components (fig.25).

I -Components that support the prevention of risks related to the ENVIRONMENT:

SITE

Choice of a Natural Setting, or:
Increase of Genuine Ingredients (sun, fresh air, plants etc.)
Close Contact with Nature (possibility of enjoying the natural surroundings)
Green Plants between Building and Traffic (filter area against roads' pollution)

Profit from the Natural Characteristics of the Land, or:
Introduction of Natural Beauty
Introduction of Living Organisms
Benefits deriving from the Characteristics of the Site (such as weather conditions, geological configuration, local material and energy, etc.)

Conservation of Natural Environment and Ecology, or:
Preponderance of Green Spaces over the Built Environment
Avoidance of Superfluous Construction
Supporting Flexibility in Design

ENERGY

Use of Local Natural Energy, or:
Wind, Solar (Thermal and Photovoltaic) Systems, Biomass, Geothermal Systems

Recycling Procedure, or:
Recover of Energy
Use of Recoverable Energy

Energy Saving and Passive System, or:
Technologies for the Energy Saving
Use of Passive Systems

Bio-compatible Building Technology, or:
Designing and Building Technologies supporting Health and Well Being
Appropriate Location/Orientation/Exposition of the Building to Weather Conditions
Optimisation of Solar Benefits (solar gain and usable light)
Design Components supporting Air Tempering and Ventilation
Glazing to Project Specific Conditions (thermal/day-lighting/view/shading)
Appropriate Quantity/Dimension/ Orientation/Position of Openings and Windows
Appropriate Use of Shading Components

MATERIAL

Local Resources, or:
Materials Produced Locally

Renewable Material, or:
Abundantly Available/Easily Renewable Materials

Recycled Material, or:
Reuse of Materials
Use of Recyclable Materials
Materials having Recycled Content

Non-polluting Material, or:
Material Production/Use which doesn't require a High Energy Input
Material Production/Use which doesn't cause Wastage and Pollution

Non-toxic Material, or:
Materials which do not Release Toxic/Hazardous Substances

Biologically Safe Material, or:
Materials/Construction Techniques providing Safety against Biological Agents

Long-Lasting Material, or:
Durable Resistant Material
Materials which can be Found Over Time

Easy to Dismantle and Substitute Material, or:
Materials which Facilitate the Performance of Maintenance
Materials which support Structural Renewals and Changes
Repairs and Replacements of Materials with Local Means

II -Components that support the improvement of the building ARCHITECTURE:

CONFIGURATION

Human Relaxing Scheme, or:
Consideration of Cultural Habits (local arts, decoration, etc.)
Local Ingredients (local materials, colours, plants and flowers, etc.)
Consideration of the Characteristics of the Site (natural landscape and beauty, local building materials, etc.)
Familiar Components (like images, pictures, colours, decoration, type of illumination etc.)

Comfortable Proportion of Spaces according to Different Design Aims (such as patients rooms at human dimension, hospitable waiting rooms, large entrance-hall etc.)

Green Spaces and Plants, or:
Natural Beauty of the Site
Design of Green Areas
Winter Gardens, Conservatories and Cloisters (which allow the view of the natural landscape from windows/glass-sheets, the presence of plants and flowers, etc.)

'Modern' Components, or:
Wide Spaces and Volumes
Large Glass-Sheets and Skylights (protected against overheating in summer and cooling down in winter)
Colours and Decoration
Special Components in Buildings and Furnishings

Modern Means, or:
Transportation (e.g.: escalators, lifts, tapis-roulant, etc.)
Information (e.g.: computer systems, way-finding, etc.)

Functional Items, or:
Useful Items (e.g.: drinking water, devices to adjust light/shade, adjustments of seats into alternative positions, mirrors in the dressing-rooms near medical cubicles, etc.)
Useful Services (e.g.: coffee shops, shops for different articles such as newspapers and gifts, computer information, baby changing room, available wheelchairs etc.)
Useful Areas (e.g.: children's areas, places for private conversation and family accommodation, resting areas, relaxation rooms, etc.)
Items that Promote Assistance (e.g.: hot water for tea, sliding trays included in furnishing components, magazines for the patients, electrical equipment like razors, radios, computers etc.)

Way-finding and Information, or:
Way-finding Systems

Building Configuration (e.g.: specific activities, can be clearly identified by means of specific components of design -such as colour, dimension, shape, material- in the hospital complex)
Colour and Images (e.g.: murals and paintings, coloured lines on the wall/floor, etc.)
Characteristics of Design (points of reference e.g.: created by special building/furnishing components such as a fountain, an exhibition, a mural, specific materials, decorations etc.)

Natural Ingredients, or:
Natural Components and Means supporting Patient's Healing
Plants and Flowers
Abundant Natural Light, Fresh Air
Sunny Terraces and Open Spaces

Layout of Circulation, or:
Coherence in Circulation (according to the convenience of the patients and visitors)
Circulation of Staff and Equipment (in order to prefer separate circuits)

Hospital Identity, or:
Building Design (including characteristics in building materials and components, configuration of design, colour and landscaping etc.)

Special Items of Design (e.g.: fountains, statues, permanent exhibitions, small zoos or scent gardens, etc.)
Possible Representation of Hospital References (e.g. by means of items representing hospital speciality, showing illustrations of particular events related to hospital activity, etc.)

TYPOLOGY

Horizontal Lay-out of the Building, or:
Horizontal Development which Avoids Gaps and Stairs
Concentration of Supporting Services (to centralise common services and to reduce mechanical transportation)

Flexibility on Large and Small Scale, or:
Modular Building Components (realisation of 'units' cutting the structure into smaller parts)
Introduction of Pre-defined Directions of Growth for the Building
Distribution of the Activities in Development on Suitable Lines which give Possibility of Expansion

Integration of Flexible Components, or:
Central Nucleus (centralised functions)
Spine of the Building (the spines for a complex of buildings are connected together)
Decentralised Units (for different categories of activities such as day-hospital, patients' rooms, etc.)

Integration of Criteria for Changes, or:
Appropriate Requisites of the Building (e.g.: concentration of technological systems into a 'spine' which facilitates maintenance, refurbishment and change; consideration of

space/dimension for a possible extension of ducts and installations; criteria for the implement/change of equipment, refurbishment of the technological systems etc.)
Use of Appropriate Components and Materials (Requiring Easy Application/Maintenance)

Modularity of Systems
which allow easier refurbishment, adaptation and change

III -Components that support the improvement of hospital FUNCTION:

INSTITUTIONAL CHANGES

Increase of Out-patients, or:
Distribution of the Activities on the Ground Level
Easy/Direct Access from Parking Areas
Systems that Promote Information and Way-finding
Special Assistance (e.g.: support for patient's family, day-hospital, patient's needs/wishes etc.)

Increase of Day-hospital Activities, or:
Criteria supporting further Expansion
Appropriate Indoor Circulation (e.g.: separated circuits for different specialities, avoiding contact with unpleasant situations, etc.)

Functional Flexibility, or:
Experts Forecasts about the development of hospital activity
Alternative Criteria of Design

FUNCTIONAL CHANGES

Supporting Patient Well Being, or:
Increase of Comfort and Support of a Patient-Focused Design
Physical Well Being of Patients (provided by factors focused on ameliorating the quality of the physical environment: comfortable microclimate, comfortable illumination and abundance of natural light where/when necessary, ergonomic furniture, etc.)
Psychological Well Being of Patients (provided by factors that favour a less stressful patient approach to hospitals, such as a home-like atmosphere, presence of colour and decoration, comfortable building/furnishing components, special components of design, such as relaxation systems etc.)

Positive Perceptions of the Building Environment, or:
Harmony in the Natural/Built Environment
Comfortable, Home-like Illumination and Furniture
Colour and Decoration in Building and Furnishing
Special Components of Design (e.g.: an exhibition of items or artistic expressions; particular objects such as fountains or clocks/meridians, gardens such as scent-gardens, fruit-gardens; small zoos etc.)

Privacy and Comfort, or:
Place to be used in Specific Circumstances requesting privacy (to be used, for example, by the family of a patient in case of death, for a private conversation with the doctor and so on)

Special Places for Activities (e.g.: libraries, rooms for listening to music, walkways and benches outside in the green spaces, etc.)
Increase of Privacy in the Patients' Rooms (possibility given by creating private and hospitable 'corners'; comfortable armchairs with coffee tables; sliding doors or panels in between beds etc.)

Assistance and Familiar Atmosphere, or:
Accommodation for Family Members
Promoting contacts between Patients and Nurses (e.g. by creating glass-sheets between patients' rooms and nurse stations, communication by internal phone and visual contact by means of video etc.)
Providing Comfortable/Useful Items (e.g.: mirrors, razors, tissues, trays, computers, radios, newspapers, crosswords, different kinds of tea etc.)

Social Life and Activity, or:
Special Components (e.g.: books, computer games, tape recorders etc.)
Spaces for Physical Activity (e.g.: small gyms and/or swimming pools, combination of initiatives including some physical activity in the open spaces etc.)
Relaxation Systems (e.g.: places for relaxation providing comfortable deck-chairs, pleasant smells, soft music and illumination, projection of slides about nature etc.)
Functional Spaces equipped for relax and 'activity' (e.g.: shopping areas, exhibitions, winter gardens, spaces for specific initiatives such as a relaxation-room, a studio for painting, listening to the music etc.)

Functional Green Areas, or:
Special Green Places (e.g.: green areas equipped with benches and pathways, terraces open to the sun and fresh air, special gardens such as a scent gardens, etc.)

Disease Prevention and Education, or:
Computerised Systems for continuing Education (e.g.: computer systems for general and special education, initiatives and courses promoting education and prevention, etc.)
Activities and Means Favouring Disease Prevention

IV -Components of a METHODOLOGY focused on improving the quality of design:

METHODICAL APPROACH

Improved Co-ordination of the Components of Design, or:
Consideration of Possible Interference between Different Components of Design
Interdependency of the Design Components is not Overlooked
Integral Co-ordination of the Components of Design

'Better Puzzle', or:
Best Combination of Plural Components
Choice for Best Possible Solution (best possible compromise which answers the needs of Design, Function and Maintenance)

Integral Connection between Design and Function, or:
Connection of Design Components to Hospital Function and Maintenance (taking into consideration conveniences/inconveniences, practical aspects and needs)
Designer's Decisions Support Function and Maintenance

Thinking in Advance, or:
Consideration of the present and future Needs of Function and Maintenance
Consideration of the trends influencing Hospital Design (scientific, technological, social aspects susceptible of influencing the development of the hospital)

Holistic Collaboration, or:
Collaboration of Designers, Builders and Technicians
Contribution of Doctors and Nurses
Contribution of the Patients and the Public

Specific Technical Education, or:
Technical Information of Designers and Builders (knowledge of the existence of specific risks affecting Hospital Activity)
Responsibility of Designers, Builders and Technicians for the Prevention of these Risks (knowledge of the possible interference of Design on the Presence/Avoidance of Risks)
Technical Education (knowledge of the preferable means, technologies and procedures capable of preventing these risks)
Up-grading of Information about Risks and Methods of Prevention

BUILDING TECHNOLOGY

Improved Technology in Building, or:
Appropriate Building Manufacture (proper material/building technologies, correct application, experienced technicians)

Designer's Skill in Decision Taking, or:
Sustainable Choices (consideration of long-term benefits)
Application of 'Easy' Solutions
Preference of Multifunctional Components
Choices of Components advantaging Maintenance and Refurbishment

Application of Sustainable Criteria, or:
Application of Criteria supporting Health (e.g.: use of non-toxic materials, components etc.)
Future application of Sustainable Criteria also in the Function and Maintenance of the Building (use of renewable resources, methodologies and technologies consenting energy saving in the maintenance performance and in case of refurbishment)
Choice of Products and Technologies facilitating Function and Maintenance
Saving on Energy and Materials through the Life-cycle of the Building

MAINTENANCE

Regular Performance of the Maintenance, or:
Technologies and Products requesting Easy Maintenance
Input of Expert Technicians
Methodical Approach to the Maintenance

Regular Up-grading of Function and Design, or:
Regular Check-ups on the Components of Design
Well-timed Consideration of Emergent Needs
Methodical Integration of Every Aspect Influencing/Connecting Function and Design
Gradual Up-grading of Design

Revisiting of the Issues of Function and Design, or:
Periodical Re-Consideration of the Various Components of Design
To Support a Long-Lasting Life-Cycle

Overall Conclusion

Chapter 10

The hospital Model resulting from this study represents the 'indispensable basis' upon which it is possible 'to start to build' a hospital supporting the 'Health and Well Being' of its patients. It may be compared to the starting brief and the general lay-out of a project. On its basis, however, it is possible to formulate precise details. For this reason it will be called the SHAWB (Supporting Health And Well Being) Model.
The goal of the SHAWB Model is to promote life-enhancing environments on the basis of specific misfits recorded in hospitals (2- Health, Environment and Hospital Design). To this end criteria and components are integrated in design improving the quality of health care against the background of recent social changes. In this Model, the quality of hospital production is focused on 'globally', regarding Hospital Environment (Environmental Condition and Architecture) and Function (Hospital Function and Design Methodology).

10.1 Quality of Hospital Environment and Assistance

Hospital design is strongly influenced by the recent quick development of our society and in particular of science and technology. Environmental conditions, typology and configuration of conventional hospitals do not correspond to the needs and living standards of patients and staff. A number of misfits (e.g. Sick Hospital Syndrome, risks relating to health and environment etc.) relating to environment and building design are recorded in hospitals (2- Health, Environment and Hospital Design).
Environment, Architecture and Function of hospitals are mainly improved by the integration of components promoting psychological well-being (e.g. increased privacy, special activities and components of design, etc.) and physical comfort (e.g. increased air quality, appropriate illumination, natural light, temperature etc.). The adaptation to new living standards (e.g. modern design components, means of information and transportation, way-finding, etc.) is integrated in the building Architecture. Hospital Function is supported by a number of components, which respond to the traditional requests of the patients (e.g. home-like assistance, computerised information, supply of disease prevention, etc.).
The Methodical approach to design contribute to improving Environment and Function of hospitals (e.g. holistic collaboration, improved design manufacture, introduction of criteria which validate the durability of design over time, etc.).

10.1.1 Environmental Conditions

As a consequence of rapid social progress and urbanisation -which had already begun in the last century- there has been a loss of natural green spaces. The deterioration in the quality of the environment still continues today and even more affects the health and well being of the population: traffic pollution coming from the road, radon radiation, pollutants released by building material etc.

Beside this situation, it has been ascertained in this study that the risks recorded in hospitals – in relation to indoor environments, health and well being- are mostly due to the inappropriate performance of hospital activity, maintenance and building design. There are risks, affecting health and well being of patients and staff, due to poor maintenance and design misfits (e.g. diseases depending on pest infestation, biotic agents living in technological installations, inadequacy of microclimatic conditions and illumination, etc.), and to the peculiarity of hospital activities (e.g. presence of plural sophisticated technological systems and equipment, constant use of chemicals and radioactive products, different types of waste disposal, etc.).

10.1.1.1 Physical Well Being

The SHAWB Model wants to re-create sustainable conditions in the realisation of hospitals in order to support and promote the healing and well-being of patients. This is done by the re-introduction of hospital buildings into a natural context, the integration of specific components and criteria (e.g. choice of a natural setting, conservation of the natural environment, profit from the local resources etc.).
The physical well being of the patients is supported in design by the use of passive systems, recycling procedures and bio-compatible technologies in building, the choice of natural renewable materials and energy, the use of non-polluting biologically safe materials. The SHAWB Model finally promotes physical comfort by means of the improved quality of design (e.g. increased air quality, appropriate illumination, abundant natural light, etc.).

10.1.2 Built Environment

The Architecture of the SHAWB Model introduces appropriate changes (10.1.2.4 Building Architecture) to overcome the misfits recorded in hospitals (2-Health, Environment and Hospital Design). This is done on the basis of the changes influencing the social background of hospitals and the study of the development of hospital design over time (10.1.2.1 Social background, 10.1.2.2 Psychological Well Being, 10.1.2.3 Past, present and future).

10.1.2.1 Social Background

Social background has always influenced hospital design and function. What at present influences our society and building design should also affect hospital design.
At present the policy of the W.H.O. promotes the physical and psychological well-being of the population by introducing specific components in the building design. Many recently built public buildings have often integrated analogous and specific design components. They basically answer to improved living standards (e.g. computerised information, green plants and decoration, etc.) and often respond to the policy promoted by the W.H.O. in building and design (e.g. by the introduction of special activities, building technologies etc.).
Sporadic proposals for alternative models of hospital are recorded (e.g. Hospitality, Residential and Mall Models, etc.). They highlight the needs and requirements of the new social background. From the study of these examples, the typologies of changes introduced in design are pointed out.

10.1.2.2 Psychological Well Being

The presence of green areas and a window overlooking green spaces were considered by Florence Nightingale an integral part of hospital design. The room with a view continued to be a patients' wish and an interesting subject for designers, researchers and experts of hospital design. Contact with the natural environment, and increase in the amount of fresh air available indoors, have constantly been an objective interest of designers and affected the development of hospital design.

Luxury and degree of comfort have affected social life and building design. Though they sometimes had to be restrained owing to primary needs or financial limits, 'suggestive' components have often been introduced in design. In the architecture of ancient Greece, the indoor environments and the site were indispensable requisites for hospitals. Decoration, furniture and architecture were taken into high consideration in the *Asklepieion* as well as the component of 'suggestion' produced in the patients by means of various expedients. From then on, the environments of hospitals continued to be the object of studies -which mostly concerned their configuration and specific components (physical or psychological). For example, the hospitals built in the Middle Ages assumed a mystical impression by means of the position of the windows and natural light, the presence of coloured glasses and religious components. Later on, in the renaissance, a special floor was built in hospitals for the paying patients with special alcoves. Today, specific environments and different special configurations of design are given in the recently built American hospital (8.2 Present/Past Analogies in Buildings). The designer's intention still seems coincident with the purpose of affecting the patients positively. As if producing the paradoxically similar suggestion typical of the *Asklepieion*, designers still 'build' the healing environment of hospitals, on the basis of what is considered likely to influence the patient's psychological attitude positively.
To positively impress the 'user' is now also the aim of the policy promoted by the W.H.O. in building design. In fact, physical and psychological Well -Being is promoted in the production of Healthy Office, the Healthy University etc.

10.1.2.3 Past, Present and Future

The study of hospital history, carried out in this research, confirms the opinion that hospitals are constantly subject to change. The peculiarity of their activity and their strict connection to social development make it possible to consider hospitals as dynamic buildings, functionally and structurally.
The components of design aim at improving the overall level of comfort and assistance and the performance of the activities.
They are selected through an accurate study of hospital design, including Past and Present trends, where it becomes evident that specific components have always been considered the object of interest for patients, staff and designers. Besides, they became more evident with time. Finally, it seems that analogous components still attract patients, staff and hospital designers. Therefore, the SHAWB Model re-launches almost the identical basic components of design. Though, these are re-integrated on the basis of new needs and new living standards, to respond to the new social background.
On the basis of the renewed interest in natural therapeutic means and natural products, the re-introduction of 'natural' ingredients is an integral part of the SHAWB Model in order to support well being and healing of patients. Spaces for relaxation are for example created making use of natural ingredients, social life and functional activities take place indoors and in the open. General computerised information and computerised education are supplied in order to support well being, cure and prevention of diseases.
In this way, the SHAWB Model enables hospitals to attain new living standards and the hospital building becomes competitive with other categories of public buildings.

10.1.2.4 Building Architecture

On the basis of the previous considerations, two groups of components, relating to Configuration and Typology, are introduced in the SHAWB Model.
The first group regards building Configuration (fig.25). In this case, the gap produced by progress is filled in the SHAWB Model by assuming a new identity of design by means of

specific building/furnishing/finishing components (e.g. colour and decoration, ergonomic seats, comfortable illumination, comfortable home-like furniture, specific items in different situations typical of hospital activities, etc.). This is also done by assuming human relaxing schemes of design (e.g. integral green areas, functional lay-out of design and circulation, way-finding and information systems, quick means of transportation and information, etc.).
The second group relates to building Typology (fig.25). It includes criteria for change. Due to this traditional need, flexibility is given on a small and a large scale. Criteria for change are integrated (e.g. building lay-out and lay-out of the activities, lay-out of technological systems and dimension of ducts etc.) and appropriate components (e.g. modular blocks, modularity of building systems and furniture etc.).
A standardised level of assistance and comfort are consequently improved in the SHAWB Model. This is done practically by integrating the main perspectives recorded in the development of hospital design and the analogous level of comfort recently assumed in other public buildings. The SHAWB Model promotes the physical and psychological well being of the patients and staff.

10.1.3 Assistance and Cure

Institutional changes influence health care. There has been an increase in the number of elderly people in our population, an increase of day-hospital activities and in the number of outpatients attending hospital. Other changes influence the traditional model of hospitals, owing to improved living standards and a growing awareness in the patients about health care and disease prevention. There are besides alternative models of hospitals, recently built in the United States, which receive the consent of patients and doctors (4.3.1 New Developing Categories of Hospitals: case-studies). These trends and proposals for alternative typologies of hospitals express the emergent need for renewal and the direction of the changes.
The SHAWB Model takes into consideration this need and integrates criteria and components supporting the change of hospitals as institutional and functional buildings (10.1.2.1 Social Background, 10.1.2.2 Psychological Well Being, 10.1.2.3 Past, Present and Future). Therefore it integrates criteria for flexibility in hospital activities (e.g. flexible spaces, plan of hospital activity also in the perspective of future previsions, etc.). The quality of assistance is improved by introducing criteria which also support the psychological well being of the patients (e.g. increased privacy and comfort, familiar assistance and atmosphere, social life and special activities, functional spaces indoor and outdoor, etc.).

10.1.4 Design Function

In the SHAWB Model, design is intended as a 'global' procedure, not only including plan and realisation, but also maintenance and management (function and use of the building). This improves the quality of design. Besides, appropriate criteria contribute to keeping design valid over time (10.1.4.1 Maintenance and Management, 10.1.4.2 Improved Design Quality, 10.1.4.3 Durability of Design).

10.1.4.1 Maintenance and Management

Function and Use of the building, Maintenance and Management keep the outcome of design valid *after* the building realisation, during its life cycle. On the basis of this consideration, the SHAWB Model considers their role indispensable to the achievement of better design. An integral part of the SHAWB Model is to supply an appropriate education regarding the risks relating to the environment, which enables hospital activities to be performed properly.

Management and Maintenance have an influence on design profits and are considered as a whole in the SHAWB Model. In fact, managers and technicians 'experiment' the project and carry out its function, only *after* its realisation, when the product of design is 'ready to be used'. They are the ones who find out positive aspects and faults of design. Their impact can improve the quality of hospital design. Therefore they become an integral part of design.
In the SHAWB Model, all target groups participate in the formulation of design, including staff and patients of hospitals, which express their needs and wishes as 'users' of the building. In practice, different contributions 'validate' the design product *before* its realisation.

10.1.4.2 Improved Design Quality

The experience offered by various categories of people, owing to the contribution of different expertise and points of view, improve the design quality. The contribution of these experts also support increased co-ordination of various activities and components influencing design and function of the building. This allows the contemporary comparison of different aspects affecting the quality of identical environments. In this way, advantages/disadvantages of specific choices can emerge.
Other components improve the quality of design, such as: the choice of easy solutions, which means preferring easy technologies instead of 'sophisticated' and complicated systems; the choice of multifunctional components, which allows to fulfil different purposes at the same time, etc.

10.1.4.3 Durability of Design

In the SHAWB Model the product of design has been considered as valid both in the present and the future, but only for a relatively 'short' period of time (4.2.1 Lack of Flexibility). In fact hospitals are 'dynamic in function and structure'. It is hence designer's interest to support the validity of the objectives achieved in design. Therefore the necessity of promoting the design 'durability' over time is evident.
The up-grading of design is considered in the SHAWB Model, which includes criteria to keep the design valid over time, such as: the continuous 'revisiting' of the issues of design in order to face/introduce/fulfil new needs and issues; the periodical up-grading of design in order to realise and put into practice functional /technological innovations, etc.
The SHAWB Model in practice is thought of as a dynamic solution, where the objectives achieved in design are not considered as 'design limits'. Its proposal is not based on restrictions, but on the 'further advancement' of hospital design, which might be integrated. The SHAWB Model therefore represents a 'flexible proposal' since it is not a 'final' product.

10.2 General Discussions and Analogies

Use and possibility of improving the SHAWB Model are illustrated below. Analogous Design Models are also discussed.

10.2.1 Application

The SHAWB Model is studied on the basis of specific situations affecting the conventional typology of large hospitals (2- Health, Environment and Hospital Design). But its framework of design and innovative approach are considered suitable for any typology of hospitals.
The SHAWB Model improves almost 'globally' the quality of hospital design. This is done by the introduction of appropriate criteria based on the policy of the W.H.O. in order: to abolish or reduce specific risks regarding health and environment in buildings; to support the health and well-being of patients and people. These criteria, as well as improving the quality of design and supporting the user's well being in other public buildings (4.3.3 Prevention Policy and Sustainability in Building), are considered analogous with those influencing any category of hospital as a public buildings.
Other purposes of the SHAWB Model are considered generally valid for hospital design. In the SHAWB Model the formulation of design is intended as a 'global procedure' addressed to improve and validate *production, function and durability* of hospital design. The SHAWB Model also represents a 'flexible proposal' integrating criteria for future up-grading. Therefore the components integrated to improve quality and durability of design are also considered suitable for hospitals of different size and specialisation (10.1.4.1 Maintenance and Management, 10.1.4.2 Improved Design Quality, 10.1.4.3 Durability of Design).

10.2.2 Future Necessary Research

The SHAWB Model is compared to the starting brief of a project, as asserted in the introduction of this chapter and, for this reason, further studies are needed to define the Model in detail. Aimed at individuating appropriate solutions and conditions in order to produce well being in hospitals, these studies may for example concern:

1- development of the Model in relation to different typologies of hospitals and social context;
a) identification of best solutions for specific categories of hospital (e.g. children's hospitals which require different parameters for well being; psychiatric hospitals where environmental factors/local references are relevant, etc.).
b) variations and characteristics of design for different social contexts and economic/cultural situations (e.g. different countries, religion, economical possibility, resources, etc.)

2- targeted investigations regarding the use of sustainable building technologies and technological systems for energy saving in hospitals (e.g.: passive systems, combination/renewal of energy, use of specific building technologies and materials, etc.);

3- study of the impact (functionality, comfort, impression, etc.) performed by specific components (e.g. settings, furniture, building materials, colour, etc.); for example the

study of the characteristics (e.g. settings, colours, building components, building material, etc.) which better support health and well being in hospitals; and characteristics and items which do not have a positive impact on the patients and staff of hospitals.

4- Studies should be aimed at individuating any risk relating to health and design, such as:
a) effect and capability of specific categories of building/furnishing/finishing components (e.g. carpets, curtains, suspended ceilings etc.) in maintaining hygienic conditions in hospitals; their use in relation to health disturbances and diseases.
b) accidents occurring in the performance of the activities which relate to building design.

This includes for example: colour and material of floors and surfaces (e.g. which look to be slippery, produce the effect of dampness, etc.); lay-out of spaces/furniture which doesn't facilitate the correct performance of activities; inappropriate position of lights or inadequacy of illumination in relation to specific activities and spaces, etc.

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10.2.3 Analogy found in Design

Analogies to the SHAWB Model have been found, which mostly regard the methodology within the framework of design. These analogies and the concepts introduced into the Model will be discussed in the following paragraphs.

10.2.3.1 Design Process and Patterns

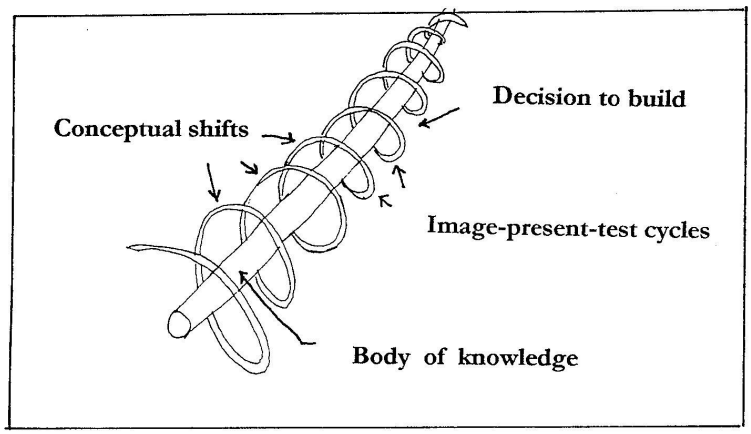
This study introduces a methodical approach to the 'design process', which integrates hospital function, building up-grading and maintenance. Besides the participation of all target groups and the changes of paradigms in health care and social behaviour are taken into account. It finally integrates design-aids which address the improvement of the quality of design and act as 'patterns' of design.
Architects recently share the use of patterns addressed to improve the quality of design and the definition of design as a 'process'. These patterns often aim at creating 'order in space'. They are based on specific inquiries carried out by the architects, which take into account the psychological influence of the environment (built and physical) on man.

Christopher Alexander, professor of the Graduate School and Emeritus Professor of Architecture at the University of Berkeley (U.S.A.), has defined several hundreds of patterns in the book 'A Pattern Language'. He analyses and creates proposals-patterns for new environments based on logical systematic analysis, both spatially and psychologically. His patterns are not to be seen as restrictions and limitations of design, but as 'seeds', which *"give the power to create an infinite variety of new and unique buildings"* [1]. They are mostly addressed to producing better design.
In 'A Pattern Language', each pattern is given in the form of a small icon, very similar to the icons reported in fig.25 of this book. They prescribe some feature which is required to solve a problem occurring in a multi-service centre. These are practically intended as 'hints' suggesting solutions to definite problems. Their utility as design-aids is therefore analogous to the utility of the icons used in the SHAWB Model. Here in fact they propose answers to definite misfits occurring in hospital design.

Jon Lang supports the opinion that the environment affects the individual and intends the design as a 'learning process' based on theoretical patterns relating to environment and human behaviour [2]. Design *"brings problems to light"* [2] says Lang. Inquiry and learning support the

final decisions of designers in planning. This attitude implies the participation of the client in design in order to achieve its consent and satisfaction. Jon Lang says *"an architect is responsible only for the overall framework and the inhabitants should be responsible for the infill"* [2]. This 'client-focused' design takes into consideration preferences and decisions of the users.
Jon Lang asserts: *"as a basis for making predictions about the future, we need to be able to look at past trends and to understand the reasons for change"* [3]. This makes the basis of a *"systematic body of architectural knowledge"* [3].
In the study carried out for the realisation of the SHAWB Model, the historical approach to design takes into consideration the body of knowledge and the traditional aims of hospital design. The design process is studied in its continuity over time, by taking into consideration past, present and future perspectives of hospital design. This study is considered to put into evidence the 'red thread', connecting origin and goals of hospital development. By looking at the different stages of hospital history, we can find out which have been the factors influencing hospital design and its fundamental components.

John Zeisel, PhD in sociology from Columbia University, is president of a company that manages assisted living treatment residences, the Hearthstone Alzheimer Care in Massachusetts. He was honoured with the Environment Design Research Association's Career Award for his contribution to design research.. He asserts that researchers work together with designers in order *"to identify problems that designers may not see themselves but will see immediately when made apparent through research"* [4]. He highlights the relevance of the patient-focused design in managing the assisted living treatment residences for people with Alzheimer's disease.

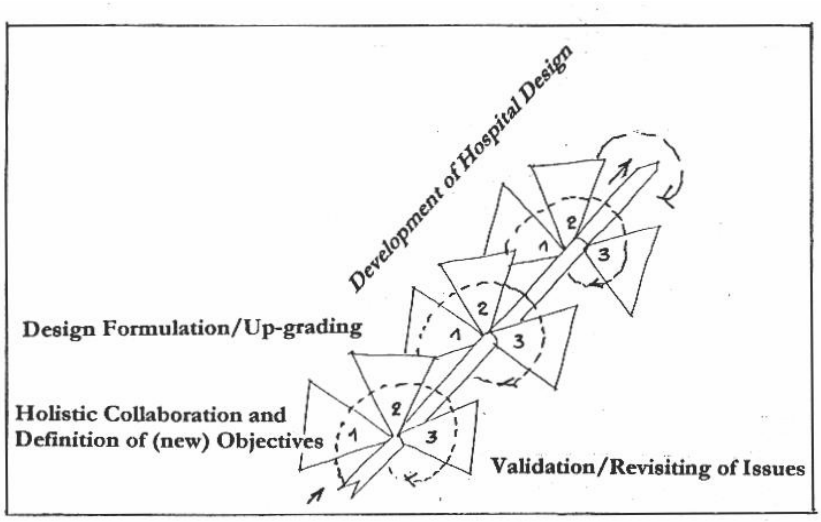


Design development spiral (John Zeisel)

Fig.39 Design Development Spiral (J. Zeisel)

The client, he says, usually has no choice and no control on design decision, though he is the user and his well-being is aim of design.
Zeisel promotes the participation of different categories of people to solve or "at least to improve" the user-needs problem and "flexible building framework". He mostly sustains that

"solving the user-needs problem offers both researchers and designers opportunities to learn from users and from each other" [4].
Design is seen as a procedure, which connects three activities *"imaging, presenting and testing"* [4]: imaging is the ability to go beyond the information given. It is the ability of the designer to identify the problems, aims and solution to achieve better quality. Images are developed during design activity, just as *"working hypotheses are refined during scientific exploration"*, Zeisel asserts.
The designer should represent "*transparent solutions"* to specific problems and after presentation he should go back *"with critical eye"* to examine the product of design. From the examination of this product, the designer improves and refines its goals, in order to achieve better results. The consolidated awareness achieved from this activity, in practice, creates the roots of the next activity of design.



Design development spiral (Hospital supporting Health and Well Being)

Fig.40 Design Development Spiral (SHAWB Model)

1. Holistic Collaboration and Definition of Objectives
2. Design Formulation and Up-grading
3. Validation or Revisiting of Issues

→ The Development of Hospital Design is according to the Spiral development of 1,2,3

The continuity of this process is necessary to improve. Zeisel asserts: *"testing is a feed-back and feed-forwards process, adjusting the relation between a design product as it develops and the many criteria and qualities the product is intended to meet"* [4]. Designers basically readjust their position to gain new perspectives, through continuous improvement towards the goal, which keeps this process going on. This design cycle allows the information gained from an existing project to be applied immediately to the next. This is taken into account for the planning phase of still another project. Therefore, the development of design is seen as a *'spiral metaphor'* through linked cycles. This *'spiral metaphor'* reminds us of the procedure of 'creating new knowledge' supported by Nonaka and Takeuchi. It also has analogy with the concepts introduced in the

SHAWB Model, where the product of design is not considered as definitive. Here the building is considered in fact, as a 'dynamic structure', whose components should be 'revisited and up-graded' to keep the design valid over time (see the following picture).
In the development spiral of the SHAWB Model, the development of design is promoted by: the Holistic Collaboration in planning which define the objectives of design (1), the practical Formulation of design (2), its final Validation and discussion of the results achieved (3). This cycle is then repeated, starting with the definition of new objectives of design (1), formulation of design up-grading (2) and revisiting of the issues (3).

10.2.3.2 The Experience of Marigold Lai

Marigold Lai's experience, which is reported below, has several analogies with the Model of Hospital supporting Health and Well Being. The situation occurring not only in the hospitals of Hong Kong, but according to her all over the world, is produced by similar factors described in this work.
Marigold Lai, who is a member of the Royal Institute of British Architects, Royal Australian Institute of Architects, and the Public Health Group of the Institutional Union of Architects, is Project Director of the Architectural Services Department of the Hong Kong Special Administrative Region Government. Involved in health care facility projects since 1988, she is the author of a paper presented at the 32nd International Hospital Federation Congress in Hong Kong, 17th May 2001. In this paper she explains the *'heuristic'* experience of Hong Kong in matter of Architecture and Health Care development. She asserts, *"health care delivery systems have undergone significant transformation on an international scale"* [5].
A metamorphosis of large proportion is occurring in health care and hospital design. The on-going process of *'metamorphosis'*, as she asserts, is the response to the social, economical and technological development.
The transformations occurring in Hong Kong include:

- Obsolescence
- Growth and expansion
- Demand for quality health care services
- Advances in science and technology
- Statutory requirements and standards

The Hong Kong Government made a review of the health care system on the basis of the deficiencies identified by the School of Public Health of Harvard University. The Health Care Reform which followed was addressed to promote 'health and lifelong holistic care', enhancing 'quality of life' and 'enabling human development'. A multi-disciplinary network of community-based integrated health care services is promoted, which comprises '*Home, Workplace, Community-based Health Care Centre, Hospital, and Virtual Healthscape* (individual access to health-related information)'. This system is focused on supplying 'closer assistance' to the individual, by providing a 'multi-sectorial' network of services and information. On this basis of course, it is also possible to support disease prevention.

The changes proposed by Marigold Lai in order to overcome this situation and the components introduced in hospital design are also very close to the changes/components proposed in the model of Hospital supporting Health and Well Being.
"Hospital is on the verge of redefinition," says Marigold Lai, underlining that those hospitals built 30 years ago are characterised by *"sterile and institutional appearances, with uninviting environments"*. The concept of 'patient-centred' and the use of the 'built environment to achieve healing and therapeutic outcome' have been introduced in design.

M. Lai also illustrates some examples concerning built hospitals and the new directions of health care design in Hong Kong, which are:

- *Flexibility and Adaptability* (spatial organisation, site configuration, space interchangeability; functional space, service, organisation, circulation, amenity/wellness module; modular system supporting speed and quality, environmental control, maintenance, building elements assembly, etc.)

- *Sustainability* (green health care facilities including re-use, retrofit, use of 'green' building materials, assembly processes, natural environment for daylight and ventilation, landscape design, appropriate construction technologies, conservation methodologies, minimising energy consumption etc.)
- *Serviceability* (access to service areas to ease maintenance work, preventive maintenance, material selection for durability, quality control and supervision, post-occupation evaluation etc.)
- *Humanity* (meet physical/psychological needs, promote life quality, non-institutional image, homely environment, integrated interior design, positive outdoor spaces, access to nature, bring nature indoor, surrogate views, clear circulation patterns, privacy etc.)

The request of quality, the nature of the components introduced in hospital design, the factors considered responsible for hospital conditions and the changes occurring in hospitals are analogous to what is illustrated and discussed in the 'Hospital supporting Health and Well Being'.

10.2.3.3 The Methodology of I. Nonaka and H. Takeuchi

The book 'The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation', written by the Japanese I. Nonaka and H. Takeuchi [6] illustrates the 'dynamics of innovation' which has been a dominant characteristic of successful Japanese Companies, in businesses and industry.
Continuous innovation, improvement and up grading, are the factors which produced the success of the Japanese companies all over the world. The theory, which is put into practice by these companies, can be applied in different life activities. But to understand how this is possible, a few basic concepts of Nonaka and Takeuchi are illustrated in the following:

1. The 'knowledge society'

In the era in which we live, a new society, so called *'knowledge society'* [6], is opposed to the '*industrial society'*. Knowledge perishes quickly in our society. Therefore, *'acquiring, applying and creating'* new knowledge [6] promotes and produces advantages in the future competition.

2. The 'holistic collaboration' contributes to 'producing innovation'

Newly developed and existing technologies are combined to build a prototype. The knowledge turns into operational knowledge. Experience-based operational knowledge often produces a new cycle of knowledge creation. This knowledge is often socialised, initiating improvement and development of an innovation. In fact creating a product concept involves a community of interacting individuals with different backgrounds and mental models. The process of sharing knowledge also produces innovation on a larger scale.

3. The ‘knowledge spiral’

Therefore 'innovation' and 'knowledge creation' is also *'extended on a global scale'* [6]. The continuous ongoing of this process represents the never ending *'knowledge spiral'* [6]. This is analogous to what happens in the case of the Zeisel and in the SHAWB Model (fig.39 e fig.40).

The SHAWB Model is a 'product' resulting from the ‘design process’, made of plural technological components. Therefore, as happens with an industrial product (technological installations and industrial products such as cars for example) the designer supplies ‘instruction’ for use, management and maintenance.

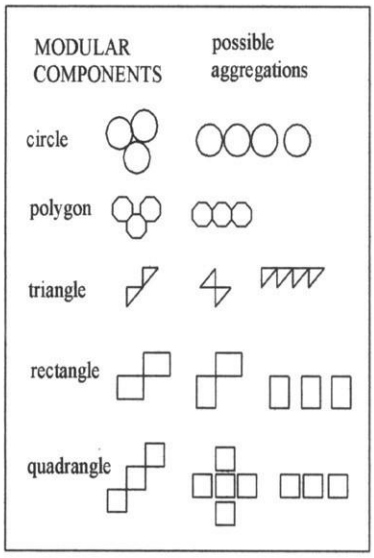
1) The product of design is competitive with other public buildings and, in order to be competitive, project and up-grading are supported by the holistic collaboration of different categories of people, the revisiting and up-grading of the issues of design.
2) In the SHAWB Model, the 'new knowledge' (Present Experience and Future Trends) and the ‘body of knowledge’ (the Past) are examined in order to introduce new criteria in hospital design. The ‘body of knowledge’ is further nourished by ‘new knowledge’ (Methodology) and the continuous ongoing of this process represents the never ending *'knowledge spiral'* (fig.40).
3) Due to social development, hospitals are ‘*dynamic structures’* and the product of design is never considered ‘definitive’. For this reason the design of the SHAWB Model is subject to *'continuous revision and up-grading'*. The collaboration and feedback of information given by different categories of people influence the design up-grading. In this way the concept of ‘creating new knowledge' is integrated in the SHAWB Model with the end result of keeping the requisites of design ‘fresh’.

SHAWB MODEL

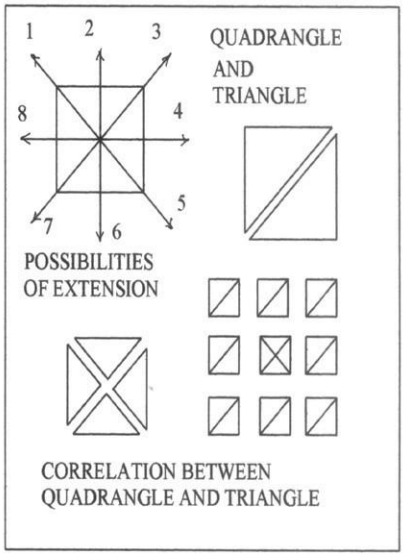
EXAMPLE OF A HOSPITAL SUPPORTING HEALTH AND WELL BEING

FIG. 26 - VIEW OF THE HOSPITAL AND ACTIVITIES IN THE OPEN SPACE

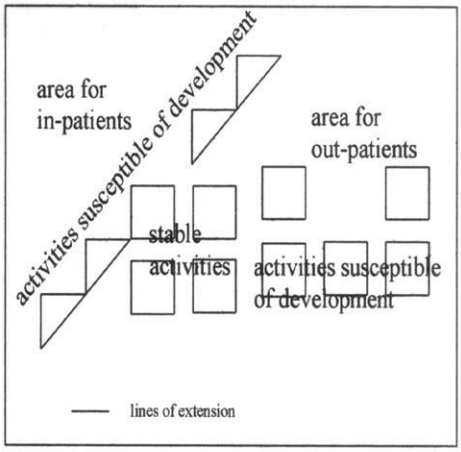
**: for 1, 2, etc. see Fig.25*



1. Characteristic morphological elements for groups of rooms or building parts suitable for a 'flexible' lay-out

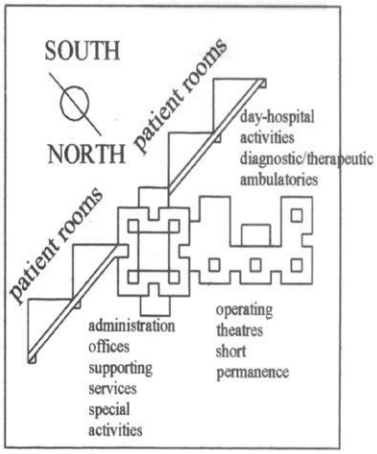


2. The quadrangle is cut into smaller parts on the basis of geometrical criteria, which gives a number of advantages



3. Possible configuration offering flexibility of design in specific directions and creating different blocks of activities

The privacy of the patients'rooms is improved by means of the physical separation from the activities



4. Plan of the hospital in relation to its functional activities

11 12 13 14 15 16 *

FIG. 27 - CHOICE OF THE MODULE AND LINES OF EXPANSION

**: for 11, 12, etc. see Fig.25*

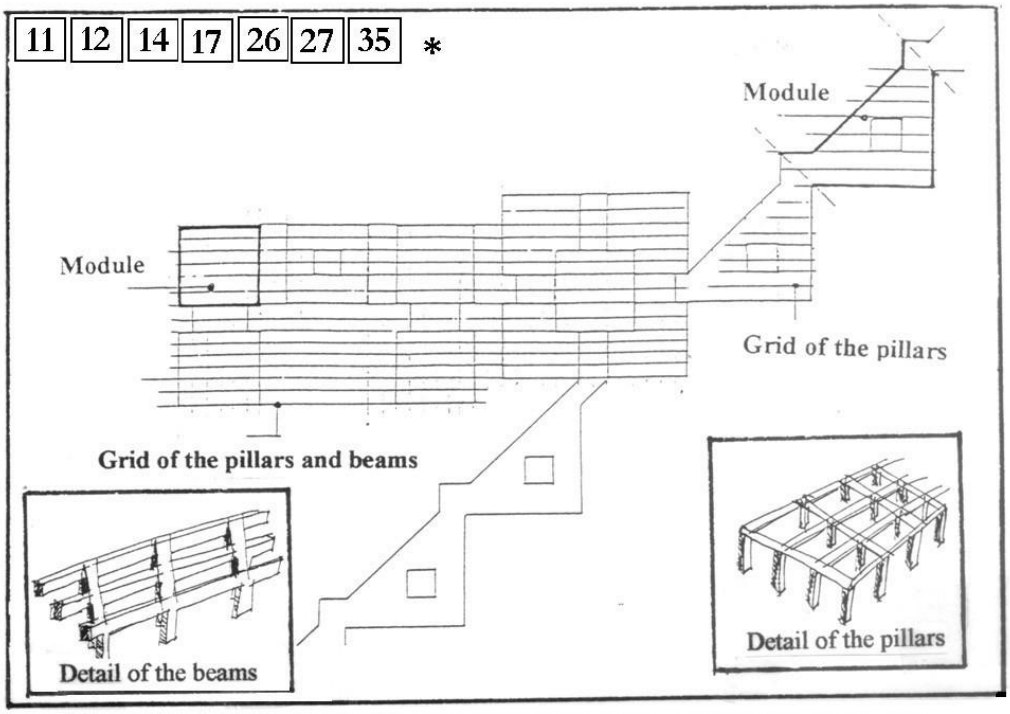


FIG. 28 - MODULES AND THE MODULARITY OF THE PILLARS

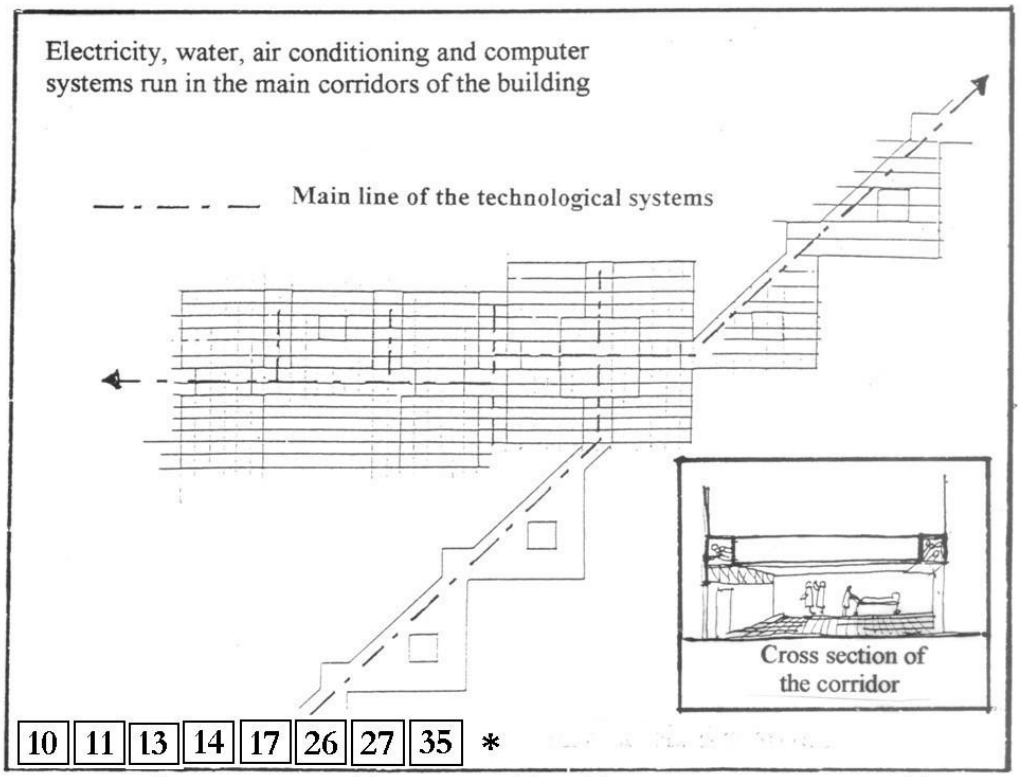


FIG. 29 - THE MAIN NETWORK OF THE TECHNOLOGICAL SYSTEMS AS THE "SPINE OF THE BUILDING"

**: for 10, 11, etc. see Fig.25*

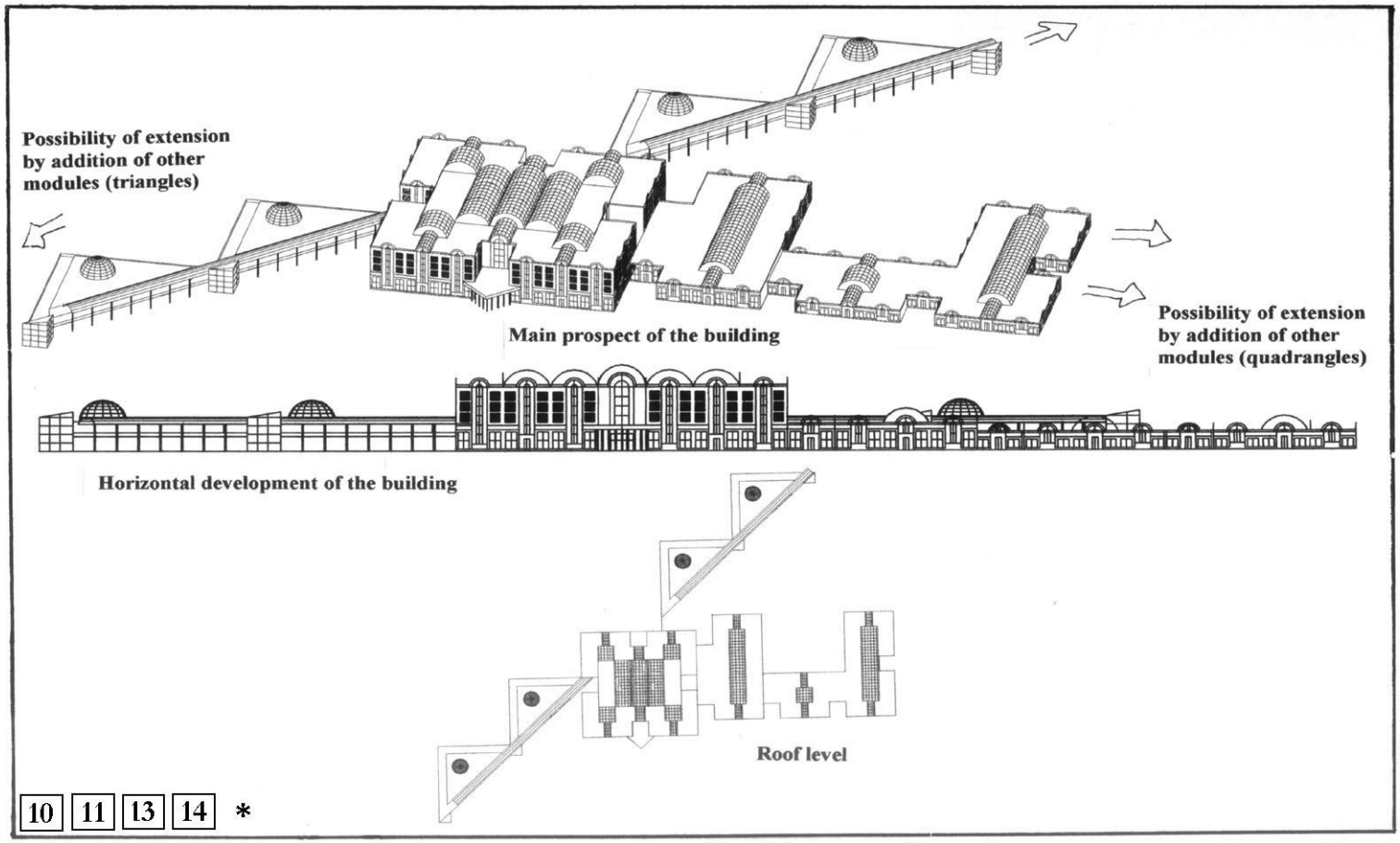


FIG. 30 - LAY-OUT OF THE HOSPITAL

*: *for 10, 11, etc. see Fig.25*

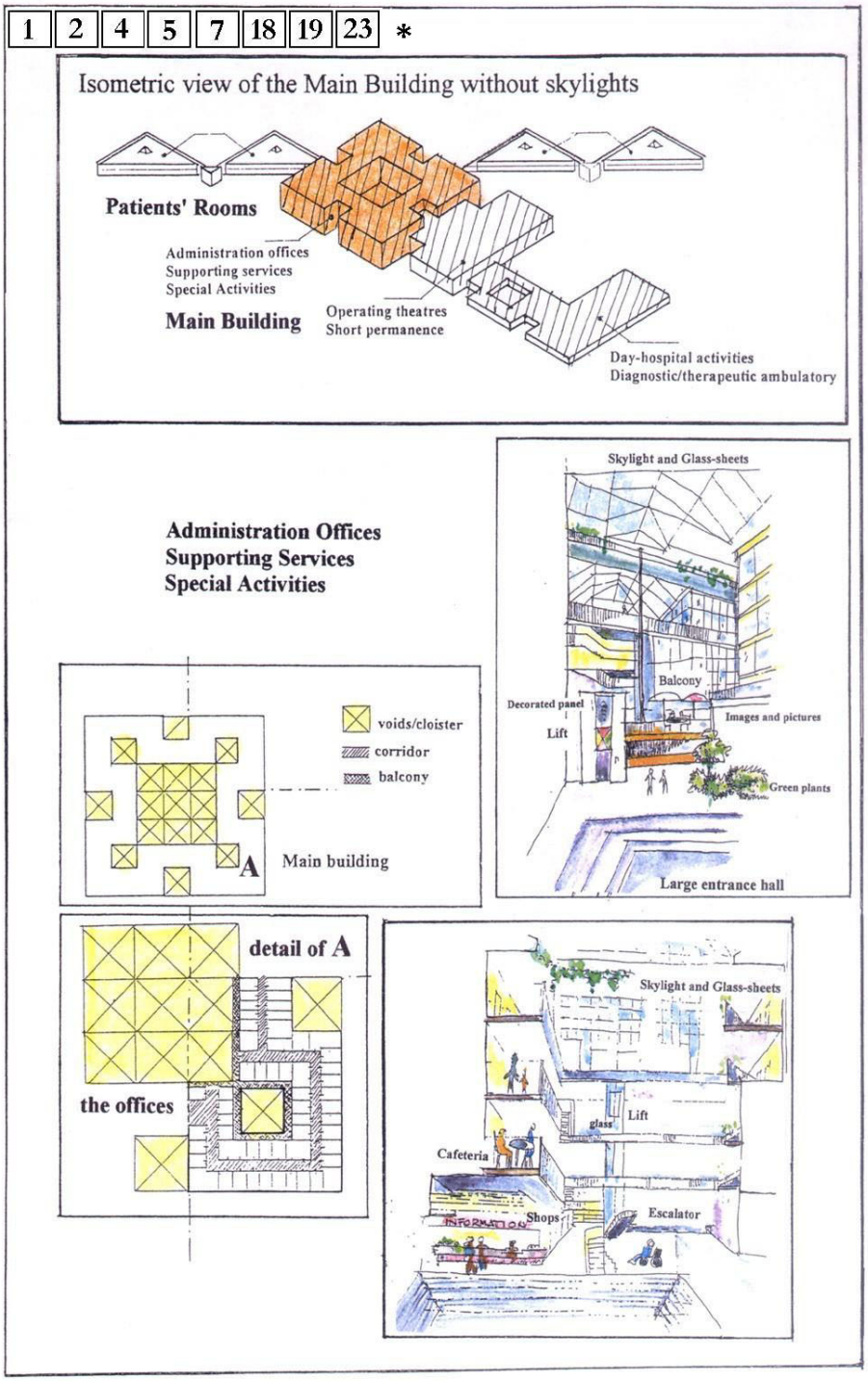


FIG. 31 - MAIN BUILDING

**: for 1, 2, etc. see Fig.25*

1
2
3
7
18
19
20
21
22
23
37
38
39
*

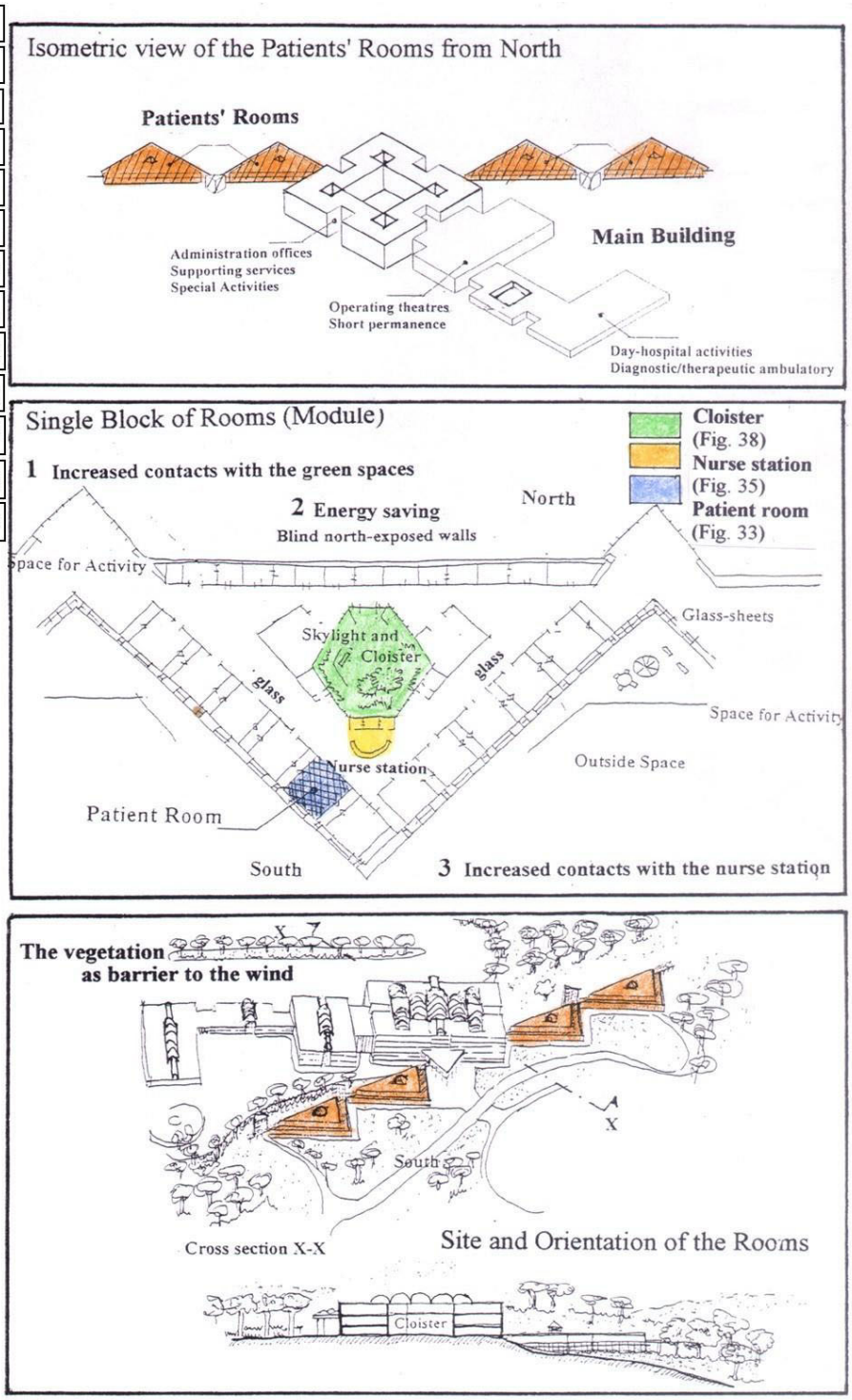
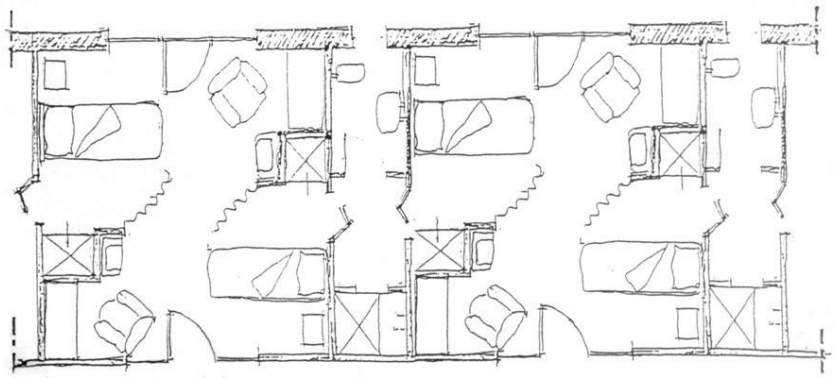


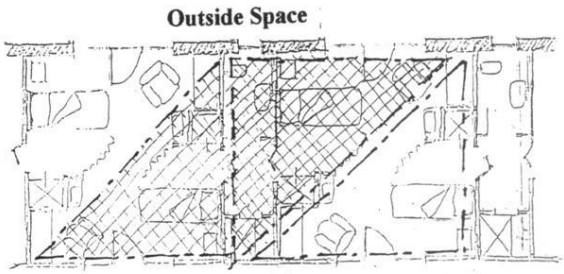
FIG. 32 - PATIENTS' ROOMS

**: for 1, 2, etc. see Fig.25*

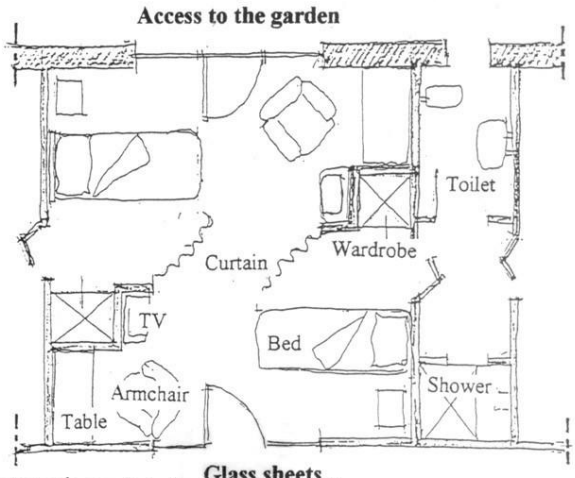
1
6
18
20
21
*



A. Combination of the modules



B. Privacy of the patient



C. Setting of the room: each module houses two patients

FIG. 33 - LAY-OUT OF THE PATIENT'S ROOM - GROUND PLAN

**: for 1, 6, etc. see Fig.25*

1
4
6
7
8
18
23
24
*

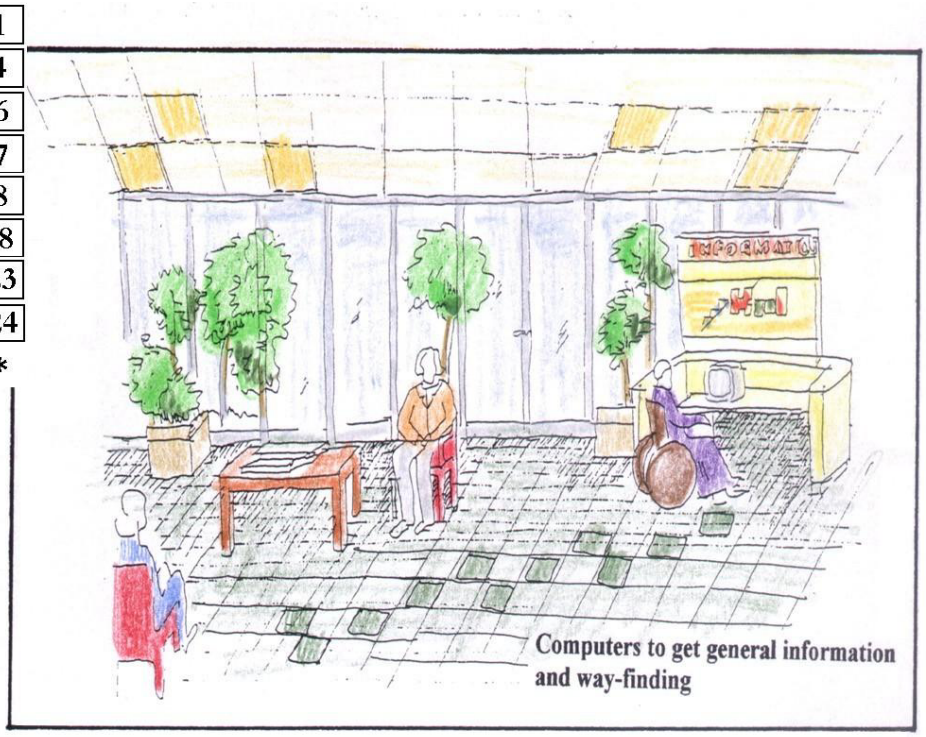


FIG. 34 - WAITING ROOM AND COMPUTERISED INFORMATION

The closer presence of the nurse is given by:

a) desk in the corridor
b) glass-sheets between corridor and patient room
c) equipped nurse station

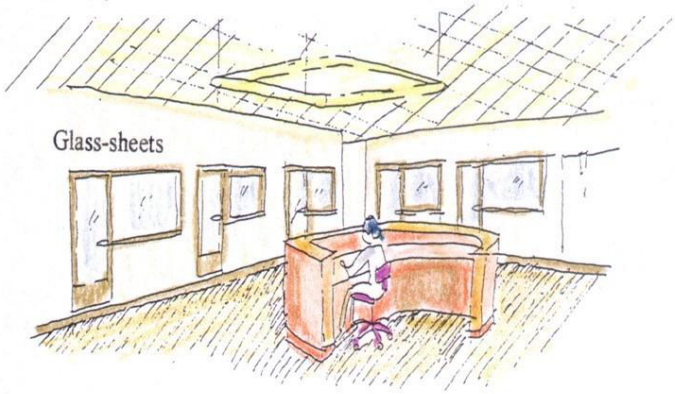


FIG. 35 - NURSE STATION IN THE CORRIDOR

**: for 1, 4, etc. see Fig.25*

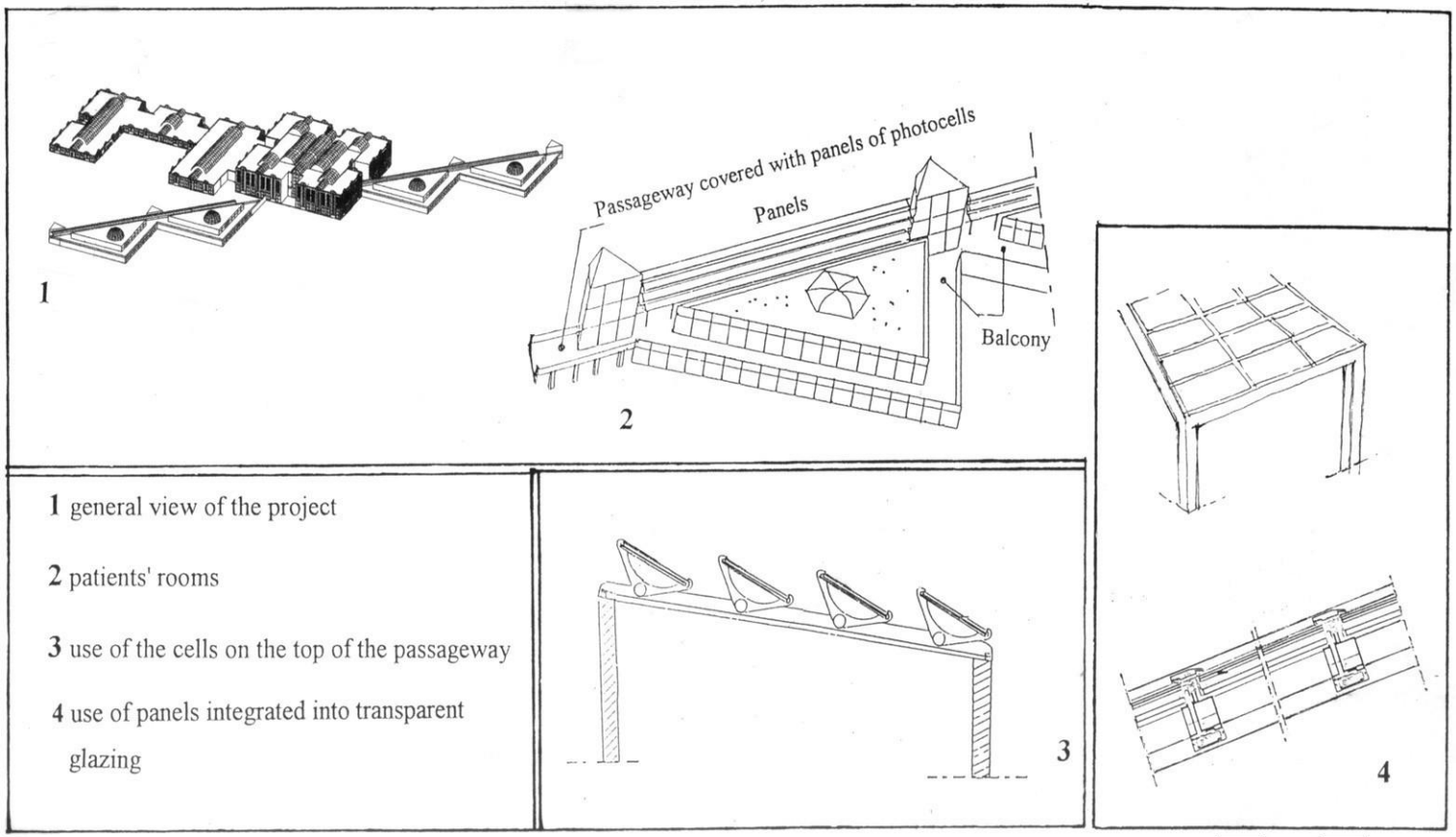


FIG. 36 - USE OF PHOTOCELLS AND SOLAR PANELS IN THE PATIENTS' ROOMS

40 | 41 | 43 | 50 *

**: for 40, 41, etc. see Fig.25*

2
3
4
7
18
19
22
40
43
*

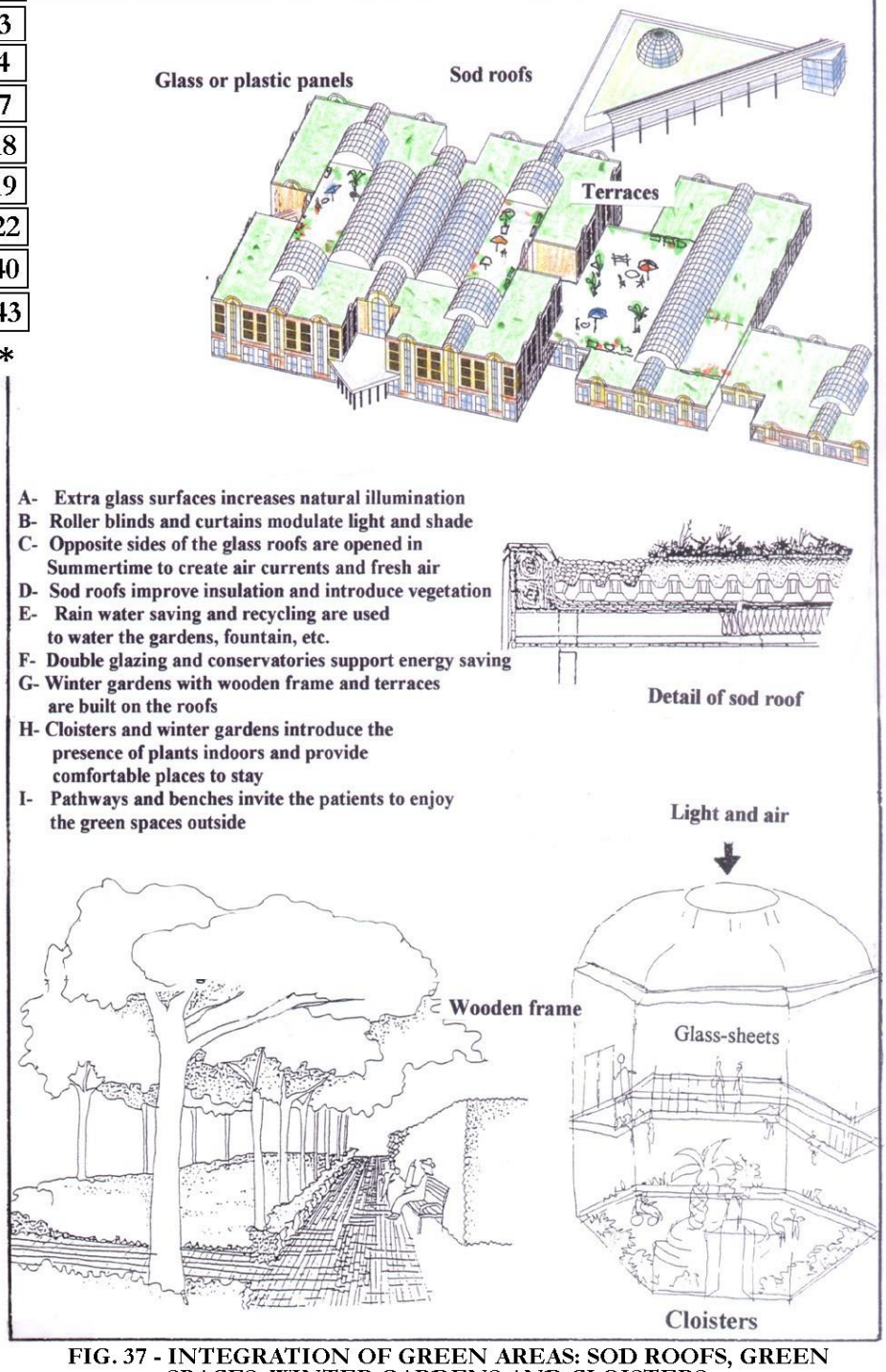
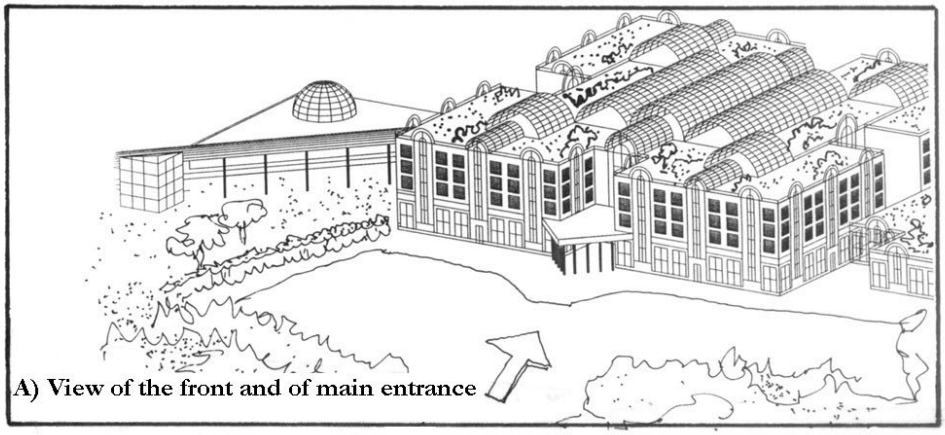
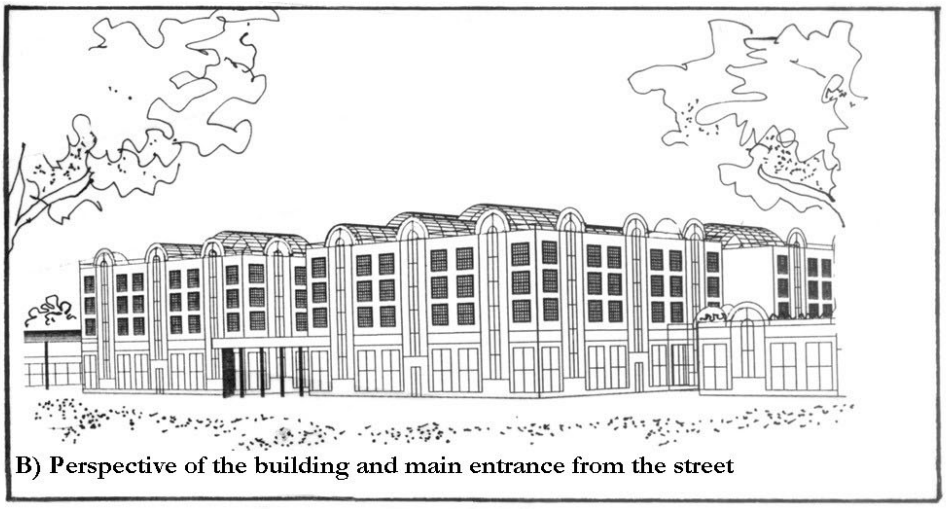


FIG. 37 - INTEGRATION OF GREEN AREAS: SOD ROOFS, GREEN SPACES, WINTER GARDENS AND CLOISTERS

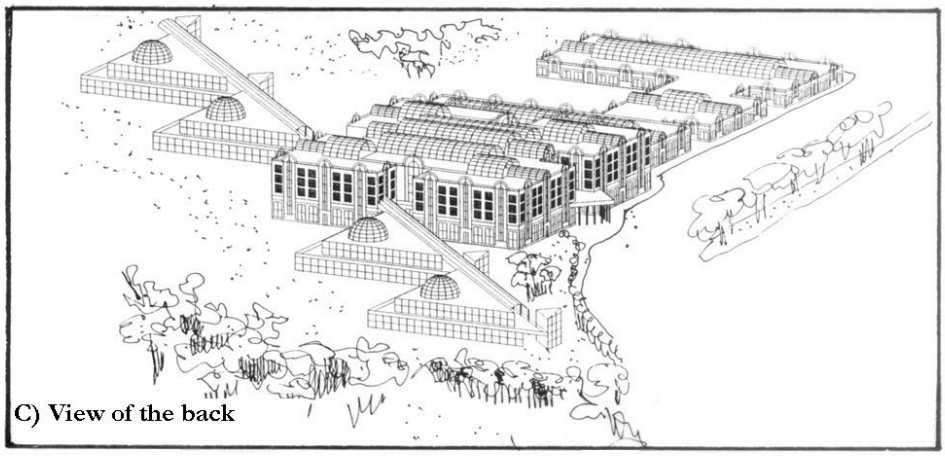
**: for 2, 3, etc. see Fig.25*



A) View of the front and of main entrance



B) Perspective of the building and main entrance from the street



C) View of the back

FIG. 38 - HOW THE HOSPITAL LOOKS LIKE

Illustration of the SHAWB Model
(Hospital Supporting Health and Well Being)

Premise

The number and level of hospital activities to be built in a specific place are usually examined in planning. This is done on the basis of social needs and financial possibilities, the policy promoted by local government, and by a consideration of factors such as the demand for the number of beds, the identification of the activities in expansion and policy in health care, etc.).
The size and site for a hospital are identified on the basis of other considerations such as the size of the population in the city, towns and villages included in a specific territory; the distribution of this and other hospitals/health care structures on the same territory; the distances from the various conurbation and the means of access; the density of traffic and time needed to reach the hospital from the above places, etc.). There are then, local building regulations, financial considerations and so on influencing the plan and realisation of a hospital. In fact, the specific context and social background (including scientific and technological), which vary from case to case, influence the realisation of a hospital.
Although every hospital is designed on the basis of specific situations and background, nevertheless, specific objectives of design remain identical as well as the objectives of the Hospital promoting Health and Well Being (Part IV -Strategies for the Accomplishment of the Model), which promotes the health of the population and supports the well being of the patients. Since the background of design changes from place to place, the example which is here reported, is thought in relation to the physical/social conditions existing in central Italy.

Preliminary study

For the above reasons, the design solution in this example of Hospital promoting Health and Well Being is studied on the basis of specific considerations. The characteristics of the place, social background, social culture, education and habits, religion of the people, the possible advantages/disadvantages related to the site (such as weather and climatic conditions, the presence and direction of the winds, humidity and temperature, thermal excursion etc.), the possible use of local material and energy, introduction of natural beauty and so on are taken into account in design.
The criteria and technology finally integrated in design (e.g.: configuration of the building, choice of building technologies, etc.) are taken from this specific context, other more specific components (e.g.: concerning location, orientation, etc.), are supposed as responding to specific physical situations.

Example of the Model

An example of the SHAWB Model (Supporting Health And Well Being) is illustrated below, where sketches and drawings show some of the possibilities for the practical application and feasibility of a hospital responding to the social and physical background of Italy. The most important environmental/structural/technological/functional components of this model and the criteria adopted in design are illustrated in the following paragraphs.

Site

1. Healthy Peaceful Conditions

The Hospital supporting Health and Well Being is built on a comfortable, sunny green area, near to conurbation but far enough to avoid the effects of congestion of traffic and people. This is a healthy place, far from cities and industries, from the noise of the roads, electricity ducts and source of radiation, polluting activities of the population. It is connected to the urban context by quick means of transportation, clear way-finding and easy access from the roads.

2. Advantages taken from the Site

The climatic conditions and the geography of the land influence the choices made in design. Site and position of the building are decided in relation to the morphology of the land sloping downwards and the presence of vegetation, the (presumed) orientation of the land to the sun.

3. Proportion in Relation to the Site

The site is chosen on the basis of a number of facts such as: the quantity, dimension and specialisation of other hospitals/health care structures in the region/district; the size of the population living in the cities nearby, towns and villages included in this area; the quick connections with this urban context; the easy access to the hospital by roads; degree of congestion for traffic influencing the time needed to reach the hospital etc.

4. Infrastructure

Ultimate is to create a healthy place suitable for building a hospital without risk to health and capable of offering comfortable environmental conditions. For this reason, this area provides a sufficient water supply and sewer system. The building is situated at distance from cemeteries and waste disposal sites.

5. Orientation

The hospital provides comfortable physical conditions and supports energy saving by assuming appropriate location and orientation.
The main building of the hospital is oriented to the East and to the West. A large part of the activities of day-hospital are oriented to the East.
The sloping surface of the land towards South permits building the North exposed walls of the patients' rooms partly underground, in order to save on energy consumption for heating (fig.32). This part of the building is sheltered from the wind by natural barriers created by the lay out of the land and vegetation.

6. Energy and Atmosphere

The patients' rooms face the South according to the aim of producing/gaining comfortable physical conditions indoors and supporting energy saving. They overlook the gardens.
The functional areas (sanitary direction, administration offices, supporting services, day-hospital, diagnostics and therapies) face East or West and have the nice view of the green spaces outside or the cloisters.

7. Natural Environment

The beauty of the site is an integral part of the design. A wood, a pond and other characteristics of the local natural environment (e.g.: trees, plants and flowers, stones and colour of the earth, animals, etc.) are integrated in the design of the surrounding areas of the hospital (fig.26).

8. Extension and Flexibility

The open spaces surrounding the building provides for future extensions of the activities and, for this reason, the construction of superfluous cubic meters is avoided.
Changing the design of the hospital or creating future extensions of the building is possible, owing to the realisation of a flexible design (according to specific criteria which are illustrated in the following paragraph).

Typology and Configuration

1. Size of the Hospital

The example here reported is a hospital for about 100 patients (which can be extended up to 150/200 patients) having common function and infrastructures which are the following:
Departments: General Surgery, General Medicine, Cardiology, Orthopaedics, Gynaecology, Paediatrics, Urology, Birth delivery and Nursery, Intensive Cure.
Services: Day Hospital, Day Surgery, Diagnostic examinations, Analysis Laboratory, Registration, Administration and Management Offices, Church, Morgue.

2. Structural Flexibility

The structural flexibility of the building, on large and small scale, is based on the presence of modules and the regularity of the distance between the pillars (fig.27-30). These two characteristics make possible to extend or reduce both the functional spaces and the building itself.
The addition of one or more modules supports the increase in the activities and the number of patients. The regular grid of the pillars allows easier refurbishment of the indoor spaces.

2.1 Geometry of the Modules

The quadrangle and the triangle are used as modules of the hospital (fig.27-28).
The module of the main structure is a quadrangle, whose shape allows the extension of the building in 8 linear directions (fig.27.2). Its square format allows easier adaptation of the indoor spaces and furniture. The quadrangle also offers the possibility of being divided into triangles, by a diagonal cut. This allows the designer to assume alternative shapes and dimensions which respond to analogous criteria of design.
The triangle is used as a module for the patients' rooms. Its format usually offer a number of advantages. For example it makes possible to have a different exposure to the sun. In this example (fig.32), two sides of this triangle face to the gardens and increase the surface of the building exposed to the South. The front of the building which corresponds to the hypotenuse offers a wider surface, which more generally can be used for different purpose (e.g: realisation of the most important facade, adaptation of the building to the configuration of the land, extension of spaces, increase of glass-sheets, increase/reduction of the exposure to specific weather conditions such as sun, wind, snow and so on). In our case, the prominent configuration of the triangle fits to the configuration of the land, sloping downwards; the facade correspondent to the longer side is partly built underground in order to support the energy saving policy.

2.2 Possible Use of Modular Building Systems

The use of modular building/furnishing components is possible owing to the modularity of design. This gives the possibility of producing easy functional changes in short times.

2.3 Bearing Structure

The bearing structure of the building is made of concrete, since this part of the building remain unaltered through the whole life-cycle of the building.

3. Technological Flexibility

The flexibility of the technological systems is promoted by specific criteria, which are:

- design of open-ended corridors as integral part of every section of the building (fig.30)
- network of technological systems runs in apposite voids along the main corridors ('spine of the building') (30)
- technological systems are dimensioned for possible extensions

3.1 Corridors

The main corridors of the hospital contain the main network of the technological systems. For this reason these corridor are intended as 'spine' of the building and support the technological flexibility of design.

3.2 Network of the Technological Systems

The main lines of the technological systems are contained in voids having openings which allow works and inspection. They also facilitate the regular performance of the maintenance. The refurbishment of the technological systems becomes easier since the work is concentrated in this space.

3.3 Open-ending corridors

Open-ending corridors include the main network of the technological systems. This supports the structural/technological flexibility of design..
Structure and technological systems can be extended in length according to specific criteria.

3.4 Dimension of the Network and Systems

Reductions or extensions of the network are possible, since installations, lines and voids are over-dimensioned (up to a certain extent) for the possible addition of wires or ducts.

4. Functional Lay-out

The functional activities of the hospital are separated into two distinct groups: the *activities in expansion* and the more *stable functions* (administration offices, sanitary direction, shopping area and restaurant, centralised services supporting the activity of the hospital such as kitchens, laundry, sterilisation, operating theatres, chemical deposit etc.). The activities which are considered capable of growing are positioned on the sides of the building bordering open land. These sides are developed in the horizontal, on one floor, since this avoids gaps and stairs. This also gives the further possibility of building another floor, if needed.

4.1 Stable Functions and Activities in Expansion

The main building contains the *centralised functions* of the hospital (such as administrative offices, sanitary direction, chemical deposit, operating theatres, sterilisation, laundry, kitchens, etc.) *and spaces for social activities* (such as shopping area, restaurant, waiting rooms etc.).
The *activities in expansion* are positioned on the sides of the building which border the open land.

5. Design of the Main Building

The structural module of the main building is a quadrangle having a side of approximately 30 meters. Its format is used for the functional areas of the hospital, except that for the patients' rooms which appear as below illustrated.

5.1 Typology of the 'Cube' with Cloister

Building blocks rise from these quadrangles. Each block has the configuration of a 'cube' having a cloister in the middle covered by a skylight. This configuration increases the natural illumination indoors and the area of the cloister offers comfortable spaces for social contacts.

6. Configuration of the Offices

Four modules give rise to four 'cubes' for offices. These are built over the entrance hall and the ground floor of the main building. The central open space of each cube for offices has a courtyard on the first floor of the main building (which is the first level of the office buildings). This courtyard, arrayed with benches and green plants, is considered as the entrance hall of each office building. This central area includes a waiting room and a space for exhibitions. From here, it is possible to get direction and information in relation to the activities of the building. Colour and arts make up part of the design, furniture and setting of the building.

The lay-out of the offices has a square format which includes two rows of rooms with a large corridor in the middle. The external row of rooms has some external windows and others which offer a view of the central open space and entrance hall of the main building (fig.31). The balconies of the internal row of rooms offer the attractive view of the entrance to the offices and the courtyard below where living spaces, special components (for example an exhibition of illustrations, other objects or material) and green plants are found.

6.1 Entrance Hall

On the ground floor, in the middle of the four cubes, the central area of the building is a large open space covered by the skylight on the roof. This space contains the entrance hall, the reception and a special place for computerised information. Here a large waiting room is open to wide passageways. The display of shops, restaurant and cafeteria have tables in the large open space covered by skylights.

6.2 Terraces and Open Passageways

The quadrangles containing the activities of the hospital are separated by regular spaces of about 10 meters which create the connection between different parts of the building. Beside to connect the quadrangles of the module, they also create open passageways between two blocks of buildings and terraces on the top of the building.

7. Distribution of the Activities

A further five modules contain the operating theatres, laboratories for analysis, diagnostics and treatment, preventive medicine, out-patients consultation and day-hospital.

These modules give rise to lower buildings shaped into single or double cubes with or without cloister (in the case of the operating theatres, sterilisation and laundry, laboratories for analysis, etc.).

7.1 Out-patients Activities

The modules containing activities for the out-patients (e.g.: day-hospital, ambulatories for diagnostics, cubicles for specialists, examinations and therapies etc.) are built nearby the

parking areas. Positioned in the last part of the building, they have open land nearby, which allows an eventual extension to contain new activities, if needed.

7.2 Facilities for the Out-patients

A large entrance hall and waiting room are created in the section of the out-patients activities. This area has skylights in the ceiling and large panels of glass with the view of the green spaces outside.
Special components and activities are provided in this central area (such as machine/disposal for coffee and drinks, newspapers and magazines, computerised information, children area etc.).
A quiet open space is at the back of the building, where the out-patients can take a walk while waiting. This is furnished with benches and green plants, a 'special fountain', exhibitions, etc.

8. Patients' Rooms

Separate from the main building, the patients' rooms are designed by adopting modular triangles with one square angle and two identical sides which are approximately 44 meters long (the third is about 62). This increases the exposure of the rooms to the South and gives the views of the green areas from all the windows.
The diagonal side of these triangles is exposed to the North. This wall is partly built underground and this side of the building has small windows.

8.1 Supporting Services

The rooms located along the North side are used for: occasional conversation of the family with the doctors, quick check ups (e.g.: electrocardiogram, blood pressure, weight, etc.), systems for patient's relaxation (room with soft illumination, pleasant fragrances, slides of images of nature etc.), a place for the nurse to relax and a small kitchen, storage for medical equipment and so on.

8.2 Design of the Patient Room

The room is designed for two patients. The general lay out of the patient's room facilitates the surveillance of the nurse and the comfort of the patients.
A panel of glass separates the room from the corridor where the nurse station is found. The patients can be seen by the nurse (fig.35) and can talk with her by phone. But to gain privacy, they can keep the curtain closed. Curtains also allows the separation of beds and patients if necessary.
The position of the bed, television, the surface of the table, the curtains of the windows can assume different adjustments.

8.3 Privacy

Each room is for two patients and its space is virtually divided into two triangles which give the possibility of creating two separate environments for the two patients (fig.33). Every patient has an armchair and a table in front of the bed, television and wardrobe. The toilet and shower are located between two bedrooms. In this way the patient shares the toilet and shower with the patient of the next bedroom. This gives the impression that this area is private and exclusive to each patient.

8.4 Nature and Green Spaces

The patients' rooms, with windows allowing a view just sixty centimetres from the floor, make it possible that the patients enjoy the natural landscape from their beds.
A cloister is created in the central area of each triangle with a winter garden covered with skylight. This place is arrayed with benches and plants for the patients who want to sit, read and relax or have a conversation (fig.32-38).
A terrace, located in between two triangles, is arrayed with chairs, tables and sunshields (fig.32).

8.5 Facilities for the In-patients

Spaces for activities (such as a library, a place for listening to music, videocassettes, a room for computers to be used for games and information, etc.) are created in between two consecutive triangles and adjacent to the cloister so they can have the view of green spaces.
The green areas outside are arrayed with benches and pathways, special gardens and activities for the patients (wood, small zoo, flower and fruit gardens, pond with fishes, etc.).

8.6 Surveillance and Assistance

The nurse station is situated in the middle of the two rows of rooms for the patients (the wall between patients' rooms and the corridor has panels of glass). The nurses sit at their station (seats and desk with computers), in an open space of the corridor to be in direct visual contact with the patients. But they also have a special room at the back of the station (with a table and chair, chemicals, papers and every other medical equipment necessary), which borders the cloister. This room has a nice view of the cloister, which is a winter garden arrayed with green plants and flowers, cage of birds and benches. From this window the nurse can watch the patients sitting here. This makes possible that the patients are continuously 'at short distance' from the nurse.

Energy, Materials and Technologies

1. Building Design

The design of the building reflects the typical 'colour' and 'configuration' of the landscape which keep unaltered the characteristics of the local culture and architecture, also integrating the local products, energy and materials.

2. Comfortable Physical Conditions

A comfortable microclimate is provided in the various departments of the hospital by the integration of systems based on the use of natural energy, according to the resources of the site, its specific climatic conditions and configuration.

3. Natural Products

Natural energy, renewable materials, local building technologies are used both in design and in the maintenance of the building in order to avoid pollution (deriving from manufacture and use of industrial products) and to align the production and function of hospitals with sustainable design.
The use of natural components and local materials mostly avoids costs and pollution produced by the transportation of alternative building products. The use of local products also facilitates refurbishments and maintenance, thus reducing the transportation of materials.

3.1 Building Materials

Local products and means are used in design and maintenance: earth, straw, stones and other renewable materials are taken as valid for the construction and life-cycle of the hospital.

4. Sustainable Technologies

Solar technologies are for example integrated here in combination with an efficient use of resources which includes heat pumps and better insulated windows, walls and roofs.

4.1 Solar Technologies

Photocells are integrated to provide energy for the illumination and use of medical equipment. Solar panels are integrated in the design of the building to provide hot sanitary water and to contribute to the heating.

4.2 Natural Illumination and Ventilation

The electricity system includes low-energy lighting. Large panels of glass are integrated in design for the increase of the natural illumination and skylights are used in many parts of the building, (e.g.: corridors and spaces under roofs) allowing the presence of light and air also in dark areas of the building.

The cloisters integrated in different sections of the hospital (fig.31-32) act as conservatories in winter.

They also have the function of creating ventilation in summer through their openings.

5 Technologies Integrated in Design (by Means of Multipurpose Components)

The technologies used in design also have the aim of improving the architecture of the building (e.g.: solar technologies are integrated into facades and roofs; skylights and large glass-sheets improve the natural illumination, ventilation and the design of the building etc.).

EXAMPLE CONCERNING SOME METHODOLOGIES FOR ENERGY SAVING

The case is taken of the patients' rooms (fig.32-37) where:

- the northern facade is partly built underground to increase the energy saving in wintertime (fig.)
- the openings in the northern facades are small and insulated by double glazing but they provide ventilation in summertime
- ventilation is promoted by means of counterpoised openings to avoid overheating in summer
  - the openings of the cloister face the windows of the facades of the building.
  - the two rows of windows situated in the common spaces for activities face each other in order to create air droughts
- solar panels are used in the patients' rooms to integrate the production of heat and hot water
- photocells are integrated into the electricity system to supply illumination and power for the medical equipment

A) USE OF SOLAR ENERGY

1) CALCULATION OF NUMBER AND DIMENSION OF PHOTOCELLS

The consumption of one module (fig.) is supposed to be of about 50 Kw. The calculation takes into account the total illumination (the emergency system is provided by means of a separate electricity generator) and the use of medical equipment (such as ultrasound, electrocardiograph, etc.), computers and others (videorecorder, projector, etc.),
Every room has a television, telephone and video.
The power output of a photovoltaic module relies on the amount of sunlight that falls onto the modules, therefore the physical orientation is of significant importance. The criteria which have been considered when selecting the proper position of the modules are:

- their orientation towards South
- no interference from shadows
- availability of suitable space and good life expectancy
- feasibility and easy access for maintenance and cleaning

The installation of photovoltaic panels depends on:
Mean consumption per year per person = 900 KW/h
Number of persons = 20
Amount of energy needed per year = 18000 Kwh/year
Mean presence of sun-hours per day per year at the latitude of Rome: Kwh/day = 4,7
Rendering = O,75%- 0,80%
Power necessary: $p \frac{18000}{4,7 \times 365} \frac{1}{0,77} = 13,40$ Kw p
The modules are in crystalline silicon producing 55w/p
Number of the modules = $\frac{13,40}{55} = \frac{13400}{55} = 244$
The dimension of the module = 0,70 x 0,70
The modules are integrated in the building design, positioned in three rows on the top of the passageway (fig.36)

2) CALCULATION OF NUMBER AND DIMENSION OF THE SOLAR PANELS NEEDED FOR SANITARY HOT WATER SUPPLY

It is supposed that the consumption of sanitary hot water per day is 400 liters at a temperature of 60°
If the water is normally at a temperature of 10°, the calories to be added are:

400 (60°-10°) = 20.000 Kcal/day = 24 Kwh/day
we suppose that this contribution of heat is constant through the year

We take into consideration that the rendering of a collector is of 45%, owing to the loss in the installation

If the maximum supply of sun radiation per year is = 6.75 Kwh/mq./day
The rendering is of 50% = 3,4 Kwh/mq./day

Factor of radiation for the area of Rome = 56%

Energy caught = 3,4 x 0,56 = 1,9 Kwh/mq./day

A collector which is positioned at an angle of 50° will produce about 2 Kwh/mq./day in a year
This means that 12mq of solar collectors will be necessary to provide 400 lt. of water at 60°

Function

1. Positive Perception of the Environment

The components of design give a first immediate impression of the hospital as a 'pleasant place'. Colour and decoration, building and furnishing details contribute to the positive perception of the environment.

1.1 Comforts Proper to Other Modern Public Buildings

A waiting room and a shopping area (including coffee shop, toilets, area for children, newspaper kiosk etc.) are close to the hall, where way-finding and computerised information systems support the assistance given to the patients. The same comforts and requisites of design which are proper of the 'modern' large public buildings are integrated in the design of this central area, which is also a meeting place and reference point for patients and visitors.

1.2 Large Volumes and Spaces

The entrance-hall and reception are destined to the passage of a varied large public. Colour and natural light, large spaces and volumes, comfortable furniture and a relaxed atmosphere make the hospital alike other large public structures where the technique of 'neighbour-hooding' [5] creates the reality of every-day-life. Natural light is achieved by large glass-sheets and skylights.

1.3 Design Identity

Some building/furnishing components defined as 'special' (such as for example a fountain, a mural, a sculpture, etc.) are introduced in the setting of the building. They 'add' richness to its configuration and give identity to the lay out of the hospital, while improving assistance and comfort (helping for way-finding/providing 'activity').

1.4 Corridors

In contrast to the anonymous, white corridors of traditional hospitals, they are designed as real and functional components of design. They are the 'connection' between various sections and contain the main network of the technological systems and components of way-finding (e.g.: signs and cues, appropriate building material or colour, images etc.). Day-light is present in these spaces owing to the use of glass-sheets or skylights. Plants, pictures and colour or other decoration make part of the array.

2 Modern Means of Transportation and Information

Modern means for information and clear way-finding improve the assistance of the patients and their positive approach to the hospital. The design, colour and material of escalators and lifts, apposite areas for computerised information, images and building components supporting way-finding, make part of the array and decoration of the building.

2.1 Way-finding

Way finding is evident from the roads approaching the hospital and leading to parking areas, to first aid, to the main entrance of the building and the day-hospital. Sign and the variety of colour indicate the activities and departments of the hospital, the patients' rooms.

2.2 Computerised Information

Apposite spaces for the supply of computerised information offer the opportunity of enjoying 'special activities' included within the project as 'entertainment' for the patients (fig.34). Two large entrance-halls are created for the patients: the first for the in-patients and the second for the out-patients. Desks for computerised information are mostly concentrated in these two entrance-halls, nearby the reception and a large sitting room.

2.3 Obliged Circuits

In the sections of diagnostics and therapy, sign posting and obliged circuits direct the patients in the passage from place to place (e.g.. from the entrance, registration and payment desks, waiting rooms and any other consecutive passage according to the treatment, including the dressing-room and the way back to the exit).

The administration offices for registration, payments, appointments, delivery of special information include way-finding, computerised systems for information and appropriate obliged circuits for the patients and staff.

3. Design of the Waiting Rooms

Waiting rooms are in different paces of the building. There are waiting rooms annexed to specific medical specialities of the hospital and wider spaces for the utility of the patients who spend a long time waiting. The design of these areas mainly creates comfortable physical conditions: ergonomic seats, warm illumination and comfortable temperature, plants and natural light, colour and pictures on the wall, furniture and decoration, the comfortable view of the landscape from the window offer a relaxing atmosphere. Various utilities for different categories of people are offered nearby (e.g.: playing-areas for children, facilities for wheel-chairs, drinkable water, toilets and baby-changing, etc.) and 'activities' which means something to see or to do (see also 3.1 Special Activities).

3.1 Special Activities

A few ‘entertainments’ are given in these areas such as magazines, pictures or slides which offer small exhibitions (e.g.: medical treatments in history, natural ingredients used for therapy, relevant facts occurring in the same hospital, or other). An area with computerised systems is provided for information and games which also promote education (e.g.: giving information about cures and diseases, prevention of diseases, proposal for a healthy life-style including diet and physical activity, etc.). Here it is given general information (e.g. about hospital specialities, the timetable of visits, the services and activities offered etc.) and special information (e.g.: illustration of specific therapies/treatments, etc.).

3.2 Waiting in the Entrance-Hall

A large sitting room, close to the cafeteria and the shopping area, offers signs and cues of way-finding which are mostly positioned near the areas where many people sit and pass by. Here it is possible to get immediate information (e.g.: information about the therapies or how to reach various destinations as cafeteria, entrance/exit, reception, medical cabinets etc.) and the answer to various needs (e.g.: drinking water, toilets, baby changing, telephone, children's area, corner for entertainment such as computerised information, etc.) provide a ‘comfortable and easy’ approach to therapies and examinations.

3.3 Specific Waiting Rooms

The waiting rooms annexed to the medical specialities offer slides and recordings illustrating the specific treatment the patients undergo and the relative computerised information. General information is also provided concerning specialities and characteristics of the hospital, cures and disease prevention.

3.4 Apposite Spaces Outside

Special areas with benches and other components of design (such as special fountain, exhibition, small zoo, special gardens, etc.) are also found in the green spaces surrounding the hospital. These spaces also promote the physical/psychological well being of the patients.

4. Diagnostic and Treatment Areas

Diagnostic and treatment areas are planned to make the patient feel relaxed and assisted. The patients are not exclusively helped with their malady, but also emotionally by means of design. Solidarity and comfort are expressed by the familiar building/furnishing components, the comfortable/warm illumination and suitable solutions of design (e.g.: lay-out and dimension of spaces, way-finding and obliged circuits, etc.) which are studied case by case to make the patients feel at ease in relation to different situations, activities and environments.

4.1 Supply of Information

To counter the usual apprehension which is caused by the 'un-known', the patients are allowed to get computerised explanations and illustrations of the examination or treatment. Images show what will happen. Suitable spaces (e.g.: space to move in the dressing rooms, adequate space/places for hanging clothes, armchairs and small tables, serviettes and mirrors, etc.) and atmospheres (e.g.: comfortable temperature and illumination, variety of colour and images on the walls, useful items at hand, etc.) are provided for the possible needs of the patients in order to give them support and assistance.

4.2 Comfortable Atmosphere and Assistance

The design of these sections takes into consideration the needs of the patients in waiting, preparing, undergoing the visit or examination.

Obliged passages help the patient to reach consecutive destinations (from the offices for payment through the waiting room, dressing room and cubicle for the examination and any consecutive treatment of diagnosis and therapy).

Cues for way-finding help the patient to find the way back to the exit.

4. 3 Doctors' Cubicles and Ambulatory

The dressing rooms are within a short distance from the cubicles and examination rooms. Their dimension and design takes into consideration that every patient, including disabled individuals on a wheel-chair, can move conveniently and that the patient might be accompanied by a second person. It is the aim of design that the patient 'feels assisted and comforted '. This aim is achieved also by providing a seat and a small table, comfortable items like hooks for clothes and a mirror, etc.

Adequate spaces are given within the cubicles and examination rooms or annexed facilities, where the presence of a familiar environment, warm illumination and colour create a less-stressful atmosphere for the patient.

Comforting items and furnishing material are provided in the various cubicles where the patient undergoes the examination. Before and after the examination (or treatment), the patient is helped by obliged circuits following appropriate way-finding.

5. Patients' Rooms

The patient's room is the place where the patients spend the largest part of the day and the night. Special comforts and facilities are concentrated in this place to support the healing and well being of the patients. Comfortable arrays and home-like components (e.g.: plants and flowers, home-like furniture and decoration, illumination and colour, etc.) and useful items (such as radios or tape recorders, clocks, choice of personalised decorations etc.) produce a comfortable home-like atmosphere. The flexibility of building/furnishing components satisfies different needs of the individuals: the possibility is given of making different adjustments to the furniture (e.g.: to change the position of the bed and the inclination of the mattress, armchair and small table; it is possible to modulate the natural illumination by means of curtains and screens; other devices allow the modulation of the artificial illumination; the curtains between the two beds make shield to the air-currents and increase the privacy of the patient, etc.).

Array and configuration of these spaces allow to increase the privacy of the patient. The room is divided into tow single areas which are for two patients. Each area can be separated by means of curtains and comprehends a bed, an armchair and table, television and a wardrobe (Fig. 33). A warm illumination is provided at night, which the patient can adjust to satisfy individual preferences.

Fresh air and sunlight are allowed to come in and the contact with a natural surrounding support the physical and psychological well-being of the patients. The room has a large window with a view over the natural landscape so that the patient lying in bed can see outside.

5.1 Increase of the Assistance

Privacy and familiar assistance are given by means of useful items at hand according to individual preferences (e.g.: tapes and cassettes, television, newspaper, tea and coffee etc.), quick contact with the nurse by means of the array and inter-phone, etc. The accommodation for a family member assisting the patient is provided and a special room, which can be used for a private conversation between patient and family, family and doctors. Here the family of the patient can find a quiet place to stay in case of his death.

5.2 Comforts and Well Being

The section of patient's room provides a private place for activity (e.g.: small library, place where listening to the music, playing computer etc.) and a cloister, which is a comfortable place arrayed with benches and plants. Here the patients can stay and enjoy the sunlight also in winter.

Natural ingredients as natural ventilation, sun light and radiation, are provided abundantly since the patients can walk outside and enjoy the park which offers special places to visit. There are places with benches where to sit in the sun and umbrellas allowing to sit in the shade.

6. Green Areas

The physical and psychological benefits given by the presence of plants and green spaces, and the 'therapeutic' relaxing effect created by a natural landscape on the patients is taken into consideration in design.

6.1 Contact with Nature

A winter garden is created indoors, in the corridor of the patients' rooms, as a relaxing 'oasis', made of sunlight and plants, where patients and visitors can sit and relax, have a conversation or read a book.
Gardens and green areas provide fresh and shaded spaces in summertime and produce psychological benefits by encouraging relaxation. They are part of the setting of the building, annexed to part of the building where the patients live.

6.2 Special Components

The contact with the natural environment is supported and promoted. Special places are created outside for the use of patients, visitors and staff of the hospital. The patients can benefit from the presence of special activities (fig.26). Special components of design are integrated within the configuration and design of the green spaces. These are intended as special places and points of interest to be visited by patients and visitors (such as for example: flower gardens, particular plants and fruit trees, small zoos, etc.). These areas include special components or special objects (e.g.: special fountains, clocks, sculptures, exhibition of images/pictures, etc.).

7. Special Places

'Hospitality and welcome' are given to the public of the hospital -in and out patients, staff, visitors, occasional clients- by providing nice comfortable places and components (6.2 Special components) inside and outside the building. These places give 'identity' to the design of the hospital and help in way-finding (since they create points of reference).
Close to the waiting rooms, for example, the presence of 'special places' (such as computerised systems for information, shopping area, restaurant and so on) becomes 'entertainment' (as paradoxically happens in the special 'areas for children' within public buildings).

8. De-stressing Activities

Special places and 'activities' are supplied within the building (e.g.: quiet places are provided near the patients' rooms for music-listening, reading, using computers for information and games, etc.). These and other initiatives (e.g.: permanent exhibitions, collections of items, illustration/information about hospital activity, etc.) give the patients opportunities to be mentally and physically 'active'.
The patients might also combine the benefits of natural remedies and cures with allopathic therapies in suitable space, created for relaxation, which offers natural ingredients such as pleasant fragrances, plants and slides with images of the nature, comfortable lighting and atmosphere encouraging well being and relaxation.

8.1 Physical Activity

Natural therapeutic principles support the healing and prevention of diseases. As promoted in health care, they are also integrated in design. Physical activity is for example encouraged by including special components in design (e.g.: the traditional swimming pool a suitable gym of adequate dimensions, special areas outside the building, small gym) which are used for therapy, prevention and rehabilitation.

9. Assistance

The supply of 'closer assistance' and the closer 'presence' of the nurses by the patient's room are supported by enhancements introduced in design. They are, for example: the 'centralised' position of the nurse-station; the presence of glass-sheets to have the patients within sight; the reduced number of beds to be attended more closely; means of communication including

visual connection and so on. Assistance is also provided in other ways, such as by supplying accommodation for family members assisting the patient (suitable room is available in every ward).

10. Privacy

Special components supplying 'greater privacy' are introduced in design. For example, the patients' rooms contains two beds and the possibility of dividing this space into two separate parts by means of design and curtains. Each patient has a private space with an armchair, seat and small table, wardrobe and television. A private area is provided in this way and separate toilets increase the privacy of the patients (the patient shares the toilet with the patient of another room).

A quiet space is also annexed to the corridor, where the patients find a quiet place and a comfortable environment for reading or listening to music and relaxing. A room is created for private conversations, which can be used by the family also in the case of death of the patient.

Methodology of Design

1. Best Solution of Design

The solutions are chosen in design which make it possible to save money, materials and energy, and give a return in terms of comfort (e.g.: improving various aspects of building design and/or function, providing comfortable environmental requisites -concerning light, temperature etc.).

1.1 Choice of Easy (Rapid) Solutions

The availability of rapid solutions in building/furnishing makes possible to execute refurbishments in convenient times while responding sooner to the needs emerging day by day in the performance of hospital activities. To design spaces capable of growing (or of being reduced) owing to the use of multiple elements is a further benefit for a hospital (not only in case of structural changes but mostly in the furnishing of laboratories, medical cabinets, patient rooms and any other space where may be convenient to apply modular furniture).

1.2 Multipurpose Choices

Those choices are preferred which achieve various ends at a time like for example specific elements of design when their shapes, components and materials, improve function, design and array of the building (such as use of different colours/materials on walls/floors to distinguish different sections of the hospital, introduction of skylights in corridors to increase natural illumination, etc). Specific components of design improve the lay out of the indoor environments and give identity to the design of the building (e.g.: arts and special manufactures as fountain, pond, zoo, etc.). Staircases and lifts are for example integrated in the array (e.g.: covered with coloured panels, arts or special pictures, otherwise made of specific material such as glass, stainless steel, etc.) as building/furnishing components beside to be means for transportation.

Specific technologies for the energy saving are also integrated in the architecture of the building (e.g. solar panels, photocells and panels, skylights, etc. which improve the function and configuration of the building).

2. Building Technologies

Local building technologies are chosen for the construction of the building, which offer a better quality in the building manufacture. The correct use of well-known building technologies also corresponds to the choice for 'easy solutions', which give advantages in terms of money and time in the construction and maintenance of the building.

3. Holistic Collaboration

The different categories of people involved in hospital design, realisation and function (designers, technicians, hospital staff, patients etc.) collaborate in the plan of the hospital.
Patients and people give their contribution to grant the co-ordination between the therapeutic activity of the hospital and the technological function of the building. Various opinions are taken into account to this end as well as any logical consideration concerning function and design of the building. The technicians working in the maintenance for example, make possible to discuss facts related to the use of the many technological systems present in hospitals. Their opinion about specific facts (as excessive consumption related to specific technological systems, air conditioning which doesn't work properly, too frequent maintenance of specific technological installations, building materials/components which need to be too often substituted, possible failings in the design of specific technological system or structural component, etc.) can influence the building design in order to improve the performance of hospital function.
Doctors and nurses also express their opinion. They illustrate the needs emerging from the performance and development of their activity. On the basis of these and other considerations, the best possible solution of design is formulated which gives positive answers to the needs of design, function and maintenance.

4. Durable Results

The design of the Hospital promoting Health and Well Being includes a methodology of design focused to support and to give positive answer to the needs occurring in the future development of hospital activity. The results obtained in design and construction of the Hospital promoting Health and Well Being are maintained valid in the future by means of: the performance of regular maintenance and regular 'check-ups' on the technological systems of the hospital, the periodical up-grading of design which takes into consideration new needs and issues, up-grading about more recent information of the people working in specific activities (mostly the staff of the hospital working in the functional activities and in the maintenance of the building).

4.1 Methodical Up-grading of Design

Various aspects of design are usually the object of consecutive changes owing to the development of new needs (e.g.: in the function and activities, dimension and configuration of spaces, structural/functional renewals, adjustments concerning technological systems, etc.). For this reason, the components of design of the Hospital promoting Health and Well Being are object of regular maintenance and up-grading.

4.2 Revisiting of Issues

The continuous improvement of design is supported on the basis of periodical 'revisions' of these components and owing to the consideration of various opinions. Periodical discussions are carried out by the staff and managers of the hospital, who formulate and collect relative considerations and proposals focused to improve the condition of design. They are discussed by all the people involved in the activities of the hospital and the managers of the hospital take consequently decisions concerning eventual functional changes, adaptations or refurbishment of the building supposed to improve the activity of the hospital (such as the performance of the assistance, the well being of patients' and staff, etc.) and the function of the building (such as the performance of technological systems, the maintenance, the life-cycle of the building, etc.).

All the people involved in hospital function periodically discuss the factors which influence the development of hospital activity (e.g.: changes in function such as new technological means used in hospitals or new therapies/methodologies adopted in health care, emergency and requests of the patients, needs of hospital staff in the performance of their activity, etc.). The conclusions derived from this discussion allow to take measures in advance and, methodically, to plan gradual changes in function and design.

4.3 Gradual Structural/Technological Improvement

Designed according to criteria for structural/technological flexibility (as illustrated above in 'Typology and Configuration of Design'), the design of the Hospital promoting Health and Well Being makes finally possible to refurbish the building according to the needs deriving from the development of hospital activity and function.

5. Maintenance

The regularity of the maintenance supports the durability of the results achieved in design. To this end, the network of the technological systems runs in apposite voids of the corridors. Covered with prefabricated panels and provided with openings for inspections, these can be easily removed to facilitate the building's refurbishment and maintenance. This makes it possible to do easy check-ups and to concentrate the work for the maintenance in this area.

6. Flexibility and Coherence of Design

Systems and installations are designed as flexible in the perspective of the possible increase or change of needs, extension of the activities and so on. Basic criteria for structural and technological flexibility are defined in the starting project. Common terms of reference are therefore created to regulate technically the details of the concept supporting the structural/technological development of the building coherently to the original idea of design.

6.1 Modularity supports Flexibility

The assemblage of building parts on the basis of modular systems offers plural advantages. It produces a gain in terms of time (in the construction and maintenance of the building) and provides functional spaces on the basis of serial models (e.g.: laboratories, cabinets, patient rooms, etc.). The application of prefabricated modular elements or the assemblage of single building parts, as it happens in case of partition panels, facilitates the quicker refurbishment and easier maintenance of the building. This kind of systems supports the coherence of design and the realisation of ‘clean’ structural changes, even after plural consecutive adaptations. The use of modular systems finally reduces the period of time necessary for the manufacture and consequently for the refurbishment otherwise produced by means of traditional systems.

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List of definitions

Building Activity: every activity related to building design, construction, refurbishment and maintenance

Hospital Building Design: plan and construction, including possibilities for maintenance of a hospital building

Configuration: characteristics and components of the building structure and its geometry

Design Function: support given to hospital activity and hospital use by means of design

Environment: building surroundings in relation to its physical characteristics and components

Environmental Conditions: physical conditions of the indoor and outdoor spaces

Environmental Dysfunction: factors present in our environment which create health disturbances or diseases

Environmental Risk: every risk for health in relation to environment and building

Healthy Building: building that is not affected by the S.B.S. (**Sick Building Syndrome**)

Hospital promoting Health and Well Being: hospital which is not affected by the S.H.S. responding to the characteristics of a Healthy and Sustainable Building suitable for hospitals

Hospital Function: assistance and therapeutic impact of a hospital as institution and every activity which consent to perform the function of a hospital as building

Sick Building Syndrome (S.B.S.): health disturbances or diseases due to factors dealing with the building and its environment

Sick Hospital Syndrome (S.H.S.): similar to the S.B.S. but manifest in hospitals includes factors deriving from hospital activity and hospital building

Sustainable Building: building having the requisites of the Healthy Building which promotes the well being of its occupants and every other criteria supported by the W.H.O. towards Sustainability in building

Well Being: physical and psychological well being of patients and staff

List of Illustrations

WELL BEING IN HOSPITALS

Design-aids for Functionally Environmentally-sound Therapeutic Buildings

Summary

The rapid development of society, technology and science have inevitably produced various changes in hospital activities. An analysis of the current situation reveals a number of failings and inadequacies, many of which depend on design. For example, it is often impossible to upgrade old hospitals structurally or technologically, because such buildings were planned and constructed according to now obsolete criteria. In addition, both patients and experts complain of poor levels of comfort and privacy (even easy way-finding is often left unconsidered). Most hospitals today are really unable to meet the challenges posed by such rapid development in expectations. In addition, there is a close relationship between Design, Well Being and Environment, which old buildings cannot take into consideration. A number of factors tied to Design and the Environment are considered responsible for damaging public Health, and these produce a number of disturbances, some of them quite serious and widespread as for example allergies. Similar illnesses as well as those produced by Sick Building Syndrome (SBS) have also been found in hospitals, which instead should be structures that guarantee health and well being. Researchers have shown that Sick Hospital Syndrome (SHS) is caused by failings and short-comings of different nature and, in particular, hospital Design has been faulted (planning, realisation and maintenance). At the same time, a new policy has emerged, dictated by the World Health Organisation (W.H.O.), that aims at protecting and improving public health and well being. This new policy is influencing design and the realisation of Sustainable Buildings.

The purpose of this study is to identify components for the production of the Hospital promoting Health and Well Being which are:

1) 'healthy' in response to the failings mentioned above (and analysed in detail in this study) with regard to Environmental Conditions, Configuration and Function of hospitals
2) capable of responding to recent social changes, keeping the purposes of the W.H.O. in mind and also the factors that intertwine Design, Well Being and the Environment

To achieve this aim, environmental factors that generally influence/impact on well being and design have been analysed. More precisely, the hospital building was analysed in terms of Health (Function), Environment (Environmental Conditions) and Design (Configuration).

This investigation was conducted regarding the past history of hospitals and future perspectives, in order to: 1) identify the components that always interested design; 2) examine the relationship between design and therapy in hospital evolution. From the study of hospital history it was found that: 1) specific components have always been appreciated in design; 2) the social, scientific and technological progress have always influenced hospital construction. From the consideration of future perspectives it was found that there are: 1) new concepts of Hospital, Patient, Well Being and Health; 2) alternative models to conventional hospitals; 3) new tendencies indicative of a gradual process of hospital development in Function and Configuration; 4) the new W.H.O. policy regarding public Health, Environment and Design, promoted Health and Well Being in the production of Sustainable Buildings.

At last four categories of components -Environment, Architecture, Function and Methodology- were identified. These were integrated in the design of this Hospital on the basis of: 1) traditionally recognised requisites as valid and new tendencies seen in hospital design; 2) the W.H.O. policy in relation to Well Being, Environment and Design; 3) correlation of specific factors with inadequacies found in hospitals in the area of Environmental Conditions, Configuration, Function.

These components were validated at the end, on the basis of: 1) an interview conducted with patients in three Hospitals in different countries; 2) evaluation of data regarding recent public buildings and hospitals; 3) consideration of the means used in other buildings to prevent similar risks involving Health, Environment and Design.

Finally, a practical example is given of a hospital that shows certain possibilities of applying these components in design.

The realisation of Hospitals supporting Health and Well Being promotes: a policy of prevention against the lacks present in hospitals and the factors relating to Health, Well Being, Environment, Design; a social growth in health care supporting the issues of the W.H.O.; a higher life quality within the new social, technological and scientific context by corresponding the social development.

WELL BEING IN HOSPITALS

Supporto per la Realizzazione di Edifici Funzionali in Armonia con l'Ambiente e la Salute

Riassunto

Il rapido sviluppo del livello sociale, della scienza e tecnologia, hanno prodotto vari cambiamenti nelle attività dell'ospedale. L'analisi dello stato di fatto rivela che le Condizioni Ambientali, Configurazione e Funzione dell'ospedale sono carenti. Molte di queste carenze dipendono dal disegno. Per esempio, è spesso impossibile effettuare adeguamenti tecnologici/strutturali dei vecchi ospedali perché costruiti in base a criteri di progettazione che risultano obsoleti. Le lamentele dei pazienti ed i commenti degli esperti reclamano poi uno scarso livello di comfort (ad esempio, la quasi totale mancanza di way-finding). Gli ospedali risultano praticamente inadeguati a dare positivo riscontro al rapido evolvere del progresso sociale, della scienza e tecnologia. Più generalmente poi, esistono relazioni ravvicinate tra il Disegno, la Salute e l'Ambiente di cui i vecchi edifici non tengono conto. Diversi fattori legati all'Ambiente e al Disegno sono considerati responsabili di danneggiare la Salute pubblica producendo disturbi di varia entità. Allergie e malattie analoghe a quelle prodotte dalla Sick Building Syndrome (SBS) sono state riscontrate anche negli ospedali dove invece dovrebbero essere garantite le migliori condizioni di salute e benessere. I ricercatori rilevano che la cosiddetta Sick Hospital Syndrome (SHS) dipende da carenze di diversa natura ed in modo particolare dal Disegno (progettazione, realizzazione e manutenzione) degli ospedali. Intanto una nuova politica è emersa dettata dalla Organizzazione Mondiale della Sanità (W.H.O.), inerente alla salute pubblica, le cui finalità influenzano il disegno e la realizzazione di Edifici Sostenibili.

Lo scopo di questo studio è individuare valide componenti per la produzione di 'Ospedali del Benessere', cioè ospedali che risultano: 1) 'salutari' a riscontro delle carenze sopra accennate (analizzate dettagliatamente in questo studio), relative alle Condizioni Ambientali, Configurazione e Funzione dell'Ospedale; 2) capaci di rispondere positivamente ai recenti cambiamenti sociali, tenendo in considerazione le finalità dalla W.H.O ed i fattori che mettono in relazione il Disegno con la Salute e l' Ambiente. Per raggiungere tale scopo sono stati analizzati quei fattori ambientali che genericamente mettono in relazione la Salute ed il Disegno. Più direttamente è stato analizzato l'Edificio-Ospedale circa la Salute (cioè la sua Funzione), l' Ambiente (cioè le sue Condizioni Ambientali), ed il Disegno (cioè la sua Configurazione). L'indagine è stata condotta sia nel passato che riguardo alle prospettive future in modo da: 1) identificare componenti costanti nel disegno; 2) esaminare la corrispondenza tra disegno e terapia nell'evoluzione dell'ospedale. Dall'esame del 'passato' risultava che: 1) determinate componenti sono state fino ad oggi costantemente apprezzata nel Disegno; 2) il progresso Sociale, Scientifico e Tecnologico ha costantemente influenzato la produzione degli ospedali. Dall'esame delle future prospettive emergevano: 1) nuovi 'concetti' in merito al significato di Ospedale, Paziente e Salute; 2) nuovi modelli alternativi all'ospedale convenzionale; 3) conseguenti nuove tendenze indicative di un graduale progresso di sviluppo dell'ospedale. Un'indagine veniva compiuta circa la politica della W.H.O. riguardo alla Salute Pubblica, il Disegno e la produzione di Edifici cosiddetti Sostenibili, che risultavano promotori della positiva relazione tra Salute, Ambiente e Benessere.

Quattro categorie di componenti erano individuate alla fine, da integrare nel disegno dell' 'Ospedale del Benessere', sulla base di: 1) requisiti tradizionalmente considerati validi e nuove tendenze registrate del disegno dell'ospedale; 2) politica della W.H.O. in relazione a Salute, Ambiente e Disegno ; 3) corrispondenza di precisi criteri con le carenze registrate negli ospedali circa le Condizioni Ambientali, Configurazione e Funzione. La validità di queste componenti veniva poi confermata sulla base di: 1) un' intervista effettuata con pazienti di tre ospedali in Paesi diversi (circa la Configurazione e Funzione dell'ospedale); 2) documentazione relativa al disegno/funzione di recenti edifici pubblici e di ospedali; 3) confronto con i mezzi utilizzati in altri edifici per prevenire identici rischi inerenti alla Salute, l'Ambiente e il Disegno. Un capitolo conclusivo propone un prospetto con le quattro categorie di componenti da integrare nel disegno dell' 'Ospedale del Benessere' (Ambiente, Architettura, Funzione dell'Ospedale e Metodologia di Disegno) ed un esempio pratico di ospedale che mostra alcune possibilità di applicazione di queste componenti nel disegno. Tale Ospedale promuove una politica di prevenzione contro le carenze riscontrate negli ospedali ed altri fattori che legano Salute, Ambiente e Disegno; una crescita sociale che tiene in considerazione le finalità della Organizzazione Sociale della Sanità; una migliore qualità di vita nel contesto sociale dando riscontro al lo sviluppo sociale.

WELL BEING IN HOSPITALS

(WELBEVINDEN IN ZIEKENHUIZEN)

Ontwerphulpmiddelen voor gebruikersvriendelijke milieusparende ziekenhuizen
en gebouwen voor de gezondheidszorg.

Samenvatting

Snelle ontwikkelingen in maatschappij, technologie en wetenschap hebben tot verschillende veranderingen in de wereld van ziekenhuizen en gebouwen voor de gezondheidszorg geleid. Een analyse van de huidige situatie in dit veld openbaart een reeks van tekortkomingen en fouten, waarvan vele op het bouwkundige ontwerp berusten.

Bijvoorbeeld is het vaak onmogelijk een verouderd ziekenhuis technisch of structureel te verbeteren want dit soort gebouwen waren aan de hand van zulke criteria ontworpen en uitgevoerd, die vandaag ontoereikend zijn. Bovendien klagen zowel patiënten als ook experts vaak over het lage comfortniveau en het gebrek aan individuele privé-ruimte en het is zelfs vaak moeilijk zich binnen het gebouw te kunnen oriënteren, omdat daar geen aandacht aan besteed werd. Het ligt in de verwachting, dat de meeste ziekenhuizen tegenwoordig niet geschikt zijn de uitdagingen en eisen die de snelle ontwikkelingen opwerpen, te beantwoorden.

Daarnaast speelt een rol dat met de nauwe relatie tussen ontwerp, gezondheid (well being) en milieu in het geval van de meeste bestaande gebouwen geen rekening werd gehouden.

Een reeks van factoren met betrekking tot ontwerp en milieu zijn bekend als verantwoordelijk voor de aantasting van gezondheid van de bevolking, en deze factoren veroorzaken wederom een reeks van storingen en aandoeningen, waarvan een aantal tamelijk serieus en wijd verspreid zijn, zoals bijvoorbeeld allergieën.

Soortgelijke ziekteverschijnselen en het ondergraven van de vitaliteit ten gevolge van het Sick Building Syndrome (SBS) werden ook in ziekenhuizen aangetroffen, alhoewel deze gebouwen juist een garantie voor gezondheid en welbevinden zouden moeten zijn.

Onderzoekers hebben uitgewezen dat het Sick Hospital Syndrome (SHS) veroorzaakt wordt door tekortkomingen en fouten van de meest uiteenlopende aard, maar in het bijzonder is het ook het ontwerp voor ziekenhuizen en gebouwen voor de gezondheidszorg, die tekort schiet (ontwerp, realisatie, onderhoud).

Tegelijkertijd verscheen echter ook een nieuw beleid, geleid door de W.H.O. (Wereld Gezondheids Organisatie) dat tot doel heeft algemene gezondheid en welbevinden te beschermen en te verbeteren. Dit nieuwe beleid heeft duidelijk invloed op het ontwerp en de realisatie van duurzame gebouwen.

Het doel van deze studie ligt in de identificatie van de factoren en componenten, mede verantwoordelijk voor het gebouw dat welbevinden en gezondheid bevordert:

1e 'gezond' in relatie tot de boven genoemde tekortkomingen – en in deze studie meer in detail geanalyseerd – rekening houdende met milieu condities, configuraties en functies van het gebouw;

2e rekening houdend met de recente maatschappelijke veranderingen, tegen de achtergrond van de doelstelling van de W.H.O. en met het oog op multilaterale samenhangen tussen ontwerp, welbevinden en milieu.

Om dit complexe doel te bereiken werden de milieufactoren, die impact op het welbevinden en ontwerp hebben, onderzocht. Dit toegespitst op de onderwerpen van welbevinden, functie, milieucondities en ontwerp, onder meer de configuratie betreffende.

Dit onderzoek was gericht voor een kleiner deel op het verleden van ziekenhuisgebouwen en voor een groter op toekomstperspectieven met de vragen naar

1e identificatie van die componenten die altijd van interesse zijn voor een ontwerp;

2e vaststelling van de relatie tussen ontwerp en therapie in de ontwikkeling van ziekenhuizen.

Uit de studie over de ziekenhuisgeschiedenis bleek:

1e vanuit het ontwerp werden altijd al specifieke componenten geapprecieerd;

2e de sociale, wetenschappelijke en technologische vooruitgangen hebben steeds het ziekenhuisgebouw beïnvloed.

In het perspectief van een wenselijke toekomstige ontwikkeling is de uitkomst het volgende:

1e nieuwe concepten aangaande gebouw, welbevinden en patiënt zijn nodig;

2e alternatieve modellen zijn naast of in plaats van de conventionele wenselijk;
3e de algemene nieuwe tendensen geven indicaties voor een successievelijk proces van ziekenhuisontwikkeling zowel voor het gebruik als voor de fysieke omhulling.

De nieuwe W.H.O. beleidslijnen met betrekking tot welbevinden of gezondheid, ontwerp en duurzaam bouwen werden doorgelicht en het bleek duidelijk dat het beleid de relatie tussen milieu en gezondheid oftewel welbevinden promoot.

Tenslotte zijn vier categorieën van componenten geïdentificeerd, om geïntegreerd te worden in het ziekenhuisontwerp, stoelend op:

1e de als waardevol erkende traditionele rekwisieten dienen ook in de nieuwe ziekenhuisontwerpen opgenomen te worden;
2e het WHO beleid is een leidend principe in relatie tot welbevinden, milieu en ontwerp;
3e er zijn correlaties gevonden tussen specifieke factoren van tekortkomingen in ziekenhuizen en het gebied van welbevinden, milieu en ontwerp

De vier categorieën Milieu, Bouwkunde, Functie en Methodologie werden geëvalueerd met behulp van:

1e interviews met patiënten in drie ziekenhuizen in drie verschillende landen
2e evaluatie van data met betrekking tot recentelijk gerealiseerde openbare gebouwen en ziekenhuizen
3e vergelijking met middelen die in geval van andere gebouwtypen toegepast worden, om risico's te vermijden aangaande welbevinden, milieu en ontwerp.

Afsluitend wordt een voorbeeld van een ziekenhuisontwerp gepresenteerd dat de mogelijkheden illustreert, hoe de gevonden inzichten geïmplementeerd kunnen worden.

De realisatie van gebouwen voor de gezondheidszorg en ziekenhuizen, die gezondheid en welbevinden ondersteunen, berust op een beleid van preventie en leidt tot voorkomen van de huidige tekortkomingen. Een bewuste integratie van gezondheids- en milieuaspecten in het ontwerp behoort hierbij. Verdere voordelen zijn de sociale groei in de gezondheidszorg, hand in hand met de W.H.O. recommandaties en een hogere kwaliteit van het bestaan binnen de nieuwe sociale, technologische en wetenschappelijke context overeenkomstig de algemene sociale ontwikkeling.

WELL BEING IN HOSPITALS

Eine Unterstuetzung bei der Realisierung von Krankenhaeusern als therapeutische Gebaeude

Zusammenfassung

Gesellschaftliche Entwicklungen, Foertschritte in Wissenschaft und Technik haben auch in Bereich des Krankenhauswesens Veraenderungen herforgerufen. Das Verhaeltnis zur Umwelt, Bedingungen der Umwelt, Konfiguration und Funktion der Krankenhaeuser oft mangelhaft ist. Viele von diesen Maengeln sind eine Folge des architektonischen Konzepts (z. B. ist es oft unmoeglich technologische/strukturelle Anpassungen der bestehenden Krankenhaeuser, die aufgrund einer veralterten Projektierung erbaut wurden, durchzufuehren). Die Beschwerden der Pazienten und die Kommentare der Experten reklamieren einen geringen Komfort (z.B. das voellige Fehlen einer leichten Orientirung- „way finding"). Grundsaetzlich existieren Beziehungen zwischen Design, Gesundheit und Umgebung, die allerdings bei den ublichen Gebaeudekonzepten nicht in Betracht gezogen werden. Verschiedene Faktoren, die aus der Umwelt Design beeinflussen, werden neuerding fuer die allgemeine Schaedigung der Gesundheit verantwortlich gehalten. Erkrankungen, allergien und das "Sick Building Syndrom" (SBS) werden in der gebauten Umwelt hervorgerufen. Diese sind aber auch in den Krankenhaeusern festgestellt worden. Forscher finden heraus, dass das sogenannte "Sick Hospital Syndrom" (SHS) von unterschiedlichen Maengeln abhaengig ist, vor allem aber auch vom Entwurf (Projektierung, Verwirklichung, Instanhaltung) der Krankenhaeuser. Inzwischen sind neue Regelungen aufgetaucht, die von der Weltgesundheitsorganisation (WHO) vorgeschrieben werden, um die Gesundheit der Offentlichkeit zu schuetzen -Design und Verwirklichung von "nachhaltigen Gebaueden" positiv zu beeinflussen. Das Ziel vorliegenden Studie ist, relevante Faktoren fuer das Entstehen von sogenannten "Well Being"- gesunden Krankenhaeusern zu erkennen. Diese sind: 1) "heilsame" im Gegensatz zu den oben aufgefuehrten Maengeln (detalliert analysiert) und zwar bezueglich der Umweltbedingungen, der Konfiguration und der Funktion des Krankenhauses; 2) positive Einbeziehung der juengsten sozialen Aenderungen entsprechend der Ziele der WHO, und der Faktoren, die Design mit der Gesundheit und Umwelt verbinden, zu bereucksichtigen. Um diese Ziele zu erreichen, wurden die Umweltfaktoren analysiert -die allgemein Gesundheit und Design miteinander verbinden. Genauer wurde das Krankenhausgebaeude aus die folgende Aspekte untersucht: Gesundheit (Funktion), Umgebung (Umweltbedingung), Design (Konfiguration). Diese Untersuchung wurde sowohl bezueglich Vergangenheit als auch zukuenftiger Perspektiven des Krankenhausbaues durchgefuehrt, um: 1) gleichbleibende Bestandteile im Design zu identifizieren; 2) die Uebereinstimmung zwischen Design und Therapie in der Entwicklung des Krankenhauses festzustellen.

Aus der Studie der Krankenhaeuser in teils freuher Vergangenheit ergab sich dass: 1) entscheidende Bestandteile bis heute im Design gleichbleibend beliebt geblieben sind; 2) der soziale, wissenschaftliche und technologische Fortschritt die Produktion von Krankenhaeusern immer schon beeinflusst hat. Aus der Untersuchung der Zukunftsprospektiven ergab sich: 1) neue Konzepte feur Krankenhaeusern, die feur den Pazienten von Bedeutung sind; 2) interessante Alternativen zum konventionellen Krankenhausbau; 3) neue indikative Tendenzen zu einem stufenweisen Fortschritt in der Entwicklung des Krankenhausbaues. Es wurde untersucht welchen Einfluss die Politik der WHO zu der Produktion sogenannter "nachhaltiger Gebaeude" auseubt. Positive Beziehung zwischen Gesundheit, Umwelt und Wohlbefinden foerdern. Vier Kategorien sind schliesslich zur Integration in das Design des ‚Hospital supporting Health and Well Being' beschrieben: 1) traditionelle, wirksame Eigenschaften und neue Tendenzen im Krankenhausdesign; 2) Politik der WHO bezueglich Gesundheit, Umwelt und Design; 3) Uebereinstimmung von bestimmten Kriterien mit den gefundenen Maengeln in den Krankenhaeusern (Umweltbedingungen, Konfiguration und Funktion); 4) Methodik des Design. Die Gueltigkeit dieser Elemente wurde aufgrund von: 1) durchgefuehrten Interviews mit Experten und Pazienten in drei Krankenhaeusern in verschiedenen Laendern (bezueglich Konfiguration und Funktion der Krankenhaeuser); 2) Dokumentationen ueber Design/Funktion von neueren oeffentlichen Gebaeuden und Krankenhaeusern; 3) Vergleichen mit anderen Gebaeuden mit aehnlichen Risiken fuer die Gesundheit. Integration des Design (Umwelt, Architektur, Funktion des Krankenhauses und Methodik des Designs) und ein praktisches Entwurfbeispiel fuer ein prototypisches eines "Hospital supporting Health and Well Being" wird schlisslich forgestellt.

WELL BEING IN HOSPITALS

Suport pour la Realisation d'Hopitaux dans Etablissements Therapeutiques et Salutaires

Resumé

Le rapide développement social des sciences et technologies a produit de nombreux changements dans les activités des hopitaux. L'analyse rivele que les conditions de l'environnement, la configuration et les fonctions de l'hòpital sont défectueux. Nombreux de ces manques sont dus au dessin. Par exemple, il est souvent impossible d'effectuer des ajustements technologiques/structuraux des anciens hopitaux car ils sont construits d'après des critères de projets jugés obsolètes. Les plaintes des patients et les commentaires des experts démontrent un manque de confort (par exemple, le manque presque total de 'way-finding'). Les hopitaux paraissent inaptes a donner un contròle serieux à l'evolution du progrès social, des sciences et des technologies. Plus généralement, il existe une relation très proche entre dessin, la santé et l'environment auxquels les anciens bàtiments ne tiennent pas compte. Divers facteurs liés à l'environment et au dessin sont accusés de nuire à la Santé Publique produisant ennuis de diverses importances. Allergies et maladies similaires à celles produites par la Sick Building Syndrome (SBS) ont également étés rencontrées dans les hòpitaux où les conditions de santé devraient ètre les meilleures. Les chercheurs ont noté que la Sick Hospital Syndrome (SHS) est du à plusieurs motifs et en particulier au Dessin (plans, réalisationn et manutention des hòpitaux. Une noiuvelle politique est apparue dictée par l'Organisation Mondiale de Santé (W.H.O.) inhérent à la santé publique, dont les finalités influencent le dessin et la réalisation des bàtiments soutenables.

Le but de cette étude est d' individualiser de solides composants pour la rèalisation d'hopitaux qualifiés "healthy", c'est à dire: 1) 'salutaires' en comparaison des manques cités peu avant (analysés en détails dans cette étude), relatives aux conditions d'environment, configuration et fonction de l'hòpital; 2) capables de répondre positivement aux récents changements sociaux, tenant compte de la finalité de la W.H.O. et des facteurs qui mettent en relation le dessin avec la Santé e l'environment.

Pour atteindre ce but ont étés analysés les facteurs environnants qui mettent en relation la santé et le dessin. Plus directement a ète analysé le batiment-hopital en ce qui concerne la santé (c'est à dire sa fonction), l'environment (les conditions de l'environment) et le dessin (c'est à dire la configuration). Dans le passé l'enquète a été effectuée tenant compte du futur de façon à: 1) Identifier les composants constants du dessin; 2) Examiner le rapport entre le dessin et la thérapie dans l'évolution de l'hopital. D'après les examens sur les prospectives futures il apparait: 1) nouvelles conceptions dues à la dèfinition de l'hopital, patience et santé; 2) nouveaux modèles d'hopitaux alternatif aux hopitaux conventionnels; 3) nouvelles consequènces indiquent un progrès d'évolution à l'intérieur de l'hòpital. Une enquète a été faite d'après la politique de la W.H.O.; elle a été faite au sijet de la Santé Publique, du dessin et la construction de bàtiments définis soutenables qui résultent promoteurs d'une relation positive entre la santé, l'environnement et le bien etre.

En conclusion quatre catègories de composants a insérer dans le dessin de l' 'Hospital supporting Well Being' ont été individuyalisées sur la base de: 1) conditions depuis toujours considérees valides et nouvelles tendences enregistrées du dessin de l'hopital; 2) la politique de la W.H.O. en relation a la Santé, l'environment et le dessin; 3) correspondence des critères précis avec les manques enregistrés dans les hopitaux au sujet des conditions de l'environnement, de la configuration et de la fonction.

La validité de ces composants a été confirmée sur la base de: 1) une interview effectuée sur des patients dans trois hòpitaux dans différents pays (concernant la Configuration et la Fonction de l'hòpital); 2) documentation relative au dessin et à la fonction de récents bàtiments publics et d'hòpitaux; 3) comparaison avec les méthodes utilisées dans autres batiments pour prévenir les risques inhérents pour la santé, l'environnement et le dessin.

Pour conclure, un chapitre propose un tableau avec les quatre composants a intègrés dans le plan du "Hospital supporting Well Being" (Environment, Architecture, Fonction de l'Hòpital et Méthodologie du Dessin) et un exemple pratique d'un hòpital qui montre quelques unes des possibilités d'application de ces composants dans le dessin.

L' Hospital supporting Well Being encourage une politique de prévention contre les manques rencontrées dans les hòpitaux et les autres facteurs qui lient entre eux la Santé, L'Environnement et le Dessin; une croissance sociale qui tient en considération la finalité de l'Organisation Sociale de la Santé; une meiulleure qualité de vie dans le contexte social représentant le developpement social.

WELL BEING IN HOSPITALS
Design-aids for Functionally Environmentally-sound Therapeutic Buildings

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Abstract

Complaints from patients, staff and experts reveal that hospital condition and design are at a critical stage. A series of mismatches have been registered in relation to Environment, Configuration and Function of hospitals. These three design domains need to be improved in order to be adequate to the new life-style and to create 'better' conditions in hospitals. This study is aimed at identifying appropriate components to improve the quality of hospital designs related to these domains, which can then be integrated into a new hospital model called the Hospital Supporting Health and Well Being (SHAWB). The new model will also take the current background of hospital design and function into consideration (i.e. the Policy of Prevention in Health Care and Sustainability in Building). To fulfil this aim, the nature of the mismatches mentioned above is closely investigated, both in hospitals and in the literature. This is done in relation to the past, present and future of Hospital Design and Health Care. A number of components are identified which improve the quality of design in relation to the three domains. They are integrated in the SHAWB Model.

Statement

The aim of the hospital design is to support Health and Well Being

Key-words

Sustainability in Hospitals, Environment, Architecture, Function, Design Methodology, Health Care, Disease Prevention , SHAWB Model

Current Conditions in Hospitals

Patients and medical staff complain about physical discomfort and other general problems within hospitals. A series of building and environmental components have been identified as contributing to the 'Sick Hospital Syndrome' which is analogous to the 'Sick Building Syndrome'. It seems that many of the situations at risk are directly linked to the hospital environment and its functioning (e.g. poor maintenance, design mismatches, activities being performed inappropriately, etc.). Complaints also relate to the configuration of hospitals (e.g. lack of signposts, obsolete facility, unattractive decorations, insufficient space and inadequate technological systems, etc.). Here emergent needs frequently require structural and functional changes. But Designers and technicians assert that, owing to structural limits, it is sometimes impossible to renew old hospitals. A series of mismatches affect the following three domains of design: the Environment, Configuration and Function.

Aim of this Study

This study aims to improve the quality of Hospital Design by using appropriate components to compensate for the mismatches identified in hospitals, with regard to the Environment, Configuration and Function. It is based on the W.H.O. (World Health Organisation) policy that is the current major influence on Health Care and Building Design. The components are integrated into a new model called the Hospital supporting Health and Well Being (SHAWB Model).

Health Care and Hospitals

Outpatient clinics and day surgeries are increasing, as are the numbers of new diagnostic methods and therapeutic treatments. A recent round-table-conference stated that hospitals are actually "dedicated to 60 percent outpatient care instead of 10 percent" [1]. The population is

growing in quality and quantity. The typology of patients is changing, due to an increased awareness in matter of disease. Nowadays patients are discharged immediately after treatments and are considered to be "taking responsibility" [2] for their own health condition. Advanced technologies and computerisation are being introduced everywhere, requiring appropriate functional areas to integrate the increased activities and equipment. The difficulties arising due to growth or changes in structure/technological systems, the obsolete configurations, the lack of signposts and the increased risks related to health and design, all testify that hospitals are currently unable to cope with the new reality. This is in contrast to other types of public buildings, where new living standards are already catered for.

The experts and others involved are inclined to increase the application of homeopathic cures and natural therapies. As in other walks of life, natural products are often thought of as being unsophisticated. The use of chemicals is generally reduced. There is an emerging interest in the use of natural products and ingredients, even in private clinics and hospitals. For example, there are some newly built American clinics which specialise in natural cures and include physical activity, relaxation systems and natural ingredients. Alternative, new types of hospitals are also being built, where the patient is considered to be a 'client' of the facility. Some newly built hospitals perform both the functions of prevention and cure. These changes in hospitals are greeted with enthusiasm by the staff, patients, doctors and researchers. They also receive financial support from the local administrations.

Well Being and Building Design

The W.H.O. publishes guidelines aimed at promoting energy saving and the use of renewable products to halt the depletion of resources. They promote the reduction of industrial pollution and polluting materials in order to re-establish healthier environmental conditions. The W.H.O. policy supports disease prevention in health care and the production of Sustainable Buildings that promote the Health and Well Being of their users. This policy is already influencing the design of public buildings (e.g. healthy universities, offices, etc.). Designers introduce special components in their designs (such as determinate furniture, decoration, colour etc.) to create pleasant environments resulting in activities that support the well being of the users.

The Need for a Hospital Supporting Health and Well Being

In the past, designers have always responded to the issues dictated to them by the social, scientific and technological context, which have influenced the development of hospitals. Nowadays, the numerous mismatches reveal that hospitals are unable to adequately respond to the new needs emerging from the recent advances in social development. These mismatches are a result of design failures in the areas of Configuration, Environment and Function.

Health Care and Building Design are more generally influenced by the policy of the W.H.O., supporting Health and Well Being. The quality of Building Design has been improved by the Sustainability policy. Specific design components have been introduced in other categories of public buildings to respond to our new living standards and needs. The SHAWB Model compensates for the failings resulting from the quick social development and meets the needs recorded in hospitals based on the W.H.O. policy.

The Model of this Hospital

The design framework for the new Hospital is given in the form of a conceptual model which offers criteria for a methodical approach to design. This model will act as a guideline for the realisation and function of hospitals. The quality of 'Hospital Design' is increased by including components which respond to specific needs found in hospitals in relation to the Configuration, Environment and Function. The SHAWB Model therefore introduces the following four categories of components: Architecture, Environment, Function and Methodology. They are illustrated in a final prospect, working as 'design-aids' for designers and

builders. An example of a 'Hospital supporting Health and Well Being' is also given in order to show that the Model is feasible and to illustrate how these components would be used.
To prevent various risks related to the Environment, the Model promotes contact with natural ingredients, a natural resort, the use of natural renewable building materials and products with specific requirements which are integrated into the design and the furniture. The quality of the environment is improved by the use of natural energies, energy recovery and bio-compatible building technologies.
To improve the quality of the Architecture, suitable criteria for the refurbishment of hospitals are identified in a flexible building typology and modularity of spaces, supporting structural and technological changes. The building configuration is mainly developed on one level to facilitate the movement of persons and means according to a specific circulation from place to place. Clear mapping and the application of a way-finding system fulfil the needs of various categories of people and the increased numbers of out-patients. Quick means of communication and transportation are integrated in the design. The finishing touches and furnishing also play a role in the building design, providing colour and decoration. The building configuration assumes its own identity as opposed to the conventional 'anonymity', making hospitals more like other public buildings with their familiar and more comfortable environments.
The hospital Function is improved by implementing the assistance and supporting the well being of the patients, by responding to the new needs due to institutional changes (integral solutions support flexibility of space and function). The individual well being is promoted by functional changes through the introduction of specific activities. Comfortable living spaces, common areas for socialising and activities, increased privacy in the patient's room and homely environments all add to the comfort and assistance of patients. Green areas are integral functional spaces and form the green frame of the building.
The design Methodology supports the fulfilment of positive results. This is done by improving the quality of the design itself, the performance of the activity, the building technology and the maintenance of the building. In practice, a methodical approach to the design and its function makes possible to control the conditions of the design also in the future.
The responsibility for the project rests not only with the designers and builders themselves, but also on a wider range of collaborators. The design procedure is a product of the co-operation of all the parties involved in its planning and functioning. Designers, builders, patients, doctors and nurses all participate in the hospital production and functioning. This means that, in addition to the project, the function, maintenance and management of the building are also integral parts of the design proceedure. The continual 'revisiting of issues' and the consequent up-grading of the design allow these buildings to avoid unwanted mismatches and to solve the new design issues.

Method and Means of Research

The current condition of hospitals reveals that the function, the building and the physical environment of hospitals are affected by specific failures. The three domains of design which need to be improved, the Environment, Configuration and Function, are the object of this study. The Environment, Configuration and Function of hospitals were analysed in relation to the history of hospitals and health care, the current and future perspectives of design.
The research about the history of hospitals and health care has highlighted the fact that Scientific, Technological and Social Progress have always dictated hospital development and design. Hospital buildings have therefore been subject to continual change and are considered to have a 'dynamic' structure. However a number of components have always been valid for patients and designers. These components are considered to be indispensable to improve the quality of the Environment, Configuration and Function in hospitals.

The analysis of current hospital design in regards to the Environment, Configuration and Function of the building design has highlighted that analogous risks influence the quality of the building environment. The physical well-being of the people is affected by similar factors related to the environment in hospitals and buildings. Besides, the particular activities carried out in hospital buildings, the use of chemicals and radioactive products, the presence of sophisticated technological systems and equipment, mean that they are subjects to specific risks.

The W.H.O. policy is aimed at generally improving the conditions of design by promoting a policy of sustainability in building and prevention in health care. The W.H.O. policy states that specific criteria should be introduced in designs for the production of Sustainable Buildings.

Our higher living standards are not only reflected in the building design but also in our everyday life. Physical and psychological aspects of well being are promoted in the designs of other modern public buildings. The new roles of patients, hospitals and health care are emerging which should presume a correspondent change in hospital design.

The newly built hospitals have been analysed in relation to Environment, Configuration and Functional aspects. In the study of the future perspectives of hospital design, the new trends have highlighted that hospitals are considered as 'Residential buildings' or 'Mall models' or 'Hospitality models'; these models are welcomed by the patients and doctors. Newly built hospitals with similar aims are being realised all over the world as well as various initiatives taken by doctors and others to improve the quality of the hospital environment and its functioning. Researchers and designers, staff and patients of hospitals all express very similar needs and views.

The correlation of specific components to the components from other categories of public buildings was noted. The analogy is based on some components and trends which could all improve the quality of the Environment, Configuration and Function of hospitals. Analogous components can also help to overcome specific mismatches currently present in hospitals, to promote the well being of patients. Finally, they can respond positively to the new attitude and role of patients, to the new function of hospitals and health care. The data resulting from this research have been verified through investigations carried out in hospitals, which focused on finding out the opinion of the patients and staff.

The global study of the past, present and future perspectives of hospital design produced specific components suitable to improve the quality of hospital designs with regards to the Environment, Configuration and Function. These are introduced in the SHAWB Model and belong to the specific categories of the Environment, Architecture and Function.

The research carried out in hospitals also revealed that hospitals have a 'dynamic' function and structure and it is difficult to keep the results of a design 'fresh' over time. Besides, specific mismatches can be attributed to poor maintenance and to wrong considerations made in planning. This is why another category of components is introduced into the SHAWB Model, that is Methodology. This promotes a methodical approach to the production of hospitals, which is necessary to improve the quality of hospital designs and their function. The design procedures include all the components necessary to the production and function of hospitals (i.e. collection of objectives and needs, plan, realisation, maintenance, management, monitoring of the activities etc.).

Conclusion

This study achieved the goal of 'globally' improving the quality of hospital designs, based on a series of mismatches recorded in hospitals and on the policy currently influencing building designs. However, the results of this study only represents the first stage and the indispensable basis from the total indispensable criteria, on which we can 'start to build' a Sustainable Hospital supporting Health and Well Being. We could think of the results as being like the initial brief and the general lay-out of a project. Just as the essential basic information is contained in the initial brief of a project, so the concept of a Hospital Supporting Health and Well Being is contained in the SHAWB Model. Therefore, the components of the SHAWB will enable the designer to formulate a specific design solution and the executive drawings for the production of a Hospital.

The SHAWB Model highlights two relevant aspects for an innovative approach to hospital design:

- the design is intended as a general procedure for the production and functional design of hospitals Drawings and calculations, realisation of the building, its function, maintenance and management all represent different phases of the same procedure. To improve the quality of this product, all target' groups take part in the formulation of the project. This improves the quality as the various contributions by validating the design before its realisation. The increased quality is also achieved by increasing the co-ordination of the various activities and components, the contemporary confrontation and co-ordination of the various aspects, by considering the advantages/disadvantages given by specific choices, and by the collaboration of various categories of experts with different competences.
- the maintenance and management of the building play a relevant role in achieving design objectives

Maintenance and management 'test the project' in real life and 'use the final product' of the design. The positive aspects and faults of a design are therefore discovered after the building realisation, during maintenance and management. Therefore, they can play a relevant role in conditioning the planning of a hospital and in keeping the outcome of a design valid after the building realisation. This is taken into consideration in the SHAWB Model. The quality of designs is also improved by performing various activities punctually and regularly in order to avoid and prevent the failures; by continually 'revisiting' the design issues in order to keep the product 'fresh'; and by continually up-grading the design in order to solve new issues.

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Curriculum vitae
SIMONA DI CICCO

Born in Toffia, Italy, on the 20th of April 1951. Married with Pierlorenzo Galli. One daughter (born on the 25th September 1994). After finishing the primary and secondary school in Rome in Italy, she studied Architecture at the University of Rome where she graduated to Architect in April 1975. The final project, published on the journal of architecture 'Finalità dell'Architettura' in the same year, was about 'A winter sports Village'.
She studied English at the 'English School' in Rome and passed the final examination for the 'Lower Certificate of Cambridge' and 'TOEFL'. She studied German at the Oesterreichisches Kulturinstitut in Rome, getting two final diplomas. She studied Arab for two years by the 'Istitut Pontifical des Etudes Arabes' in Rome and passed the final examinations obtaining the 'Certificat de scolarité'.
In November 1975 she passed the examination requested to be on the List of Professional Architects for the area of Rome.
She was a teacher for Drawing and Technology in a secondary school during 1975-76.
From September 1976 until June 1985 she worked as an architect in the Engineering Office of the Flavia ltd, Building and Planning Company in Rome. Most important realisations were:
-Interior spaces of the hospital for elderly people 'Merry House' in Acilia (Rome);
-Urban planning and projects related to the area of Rome, denominated Serpentara II- Piano di Zona n.°5, comprehending apartments (about 200.000 m^3) office and commercial spaces (about 1.400 m^3), public green areas, parking and traffic lines. Total development of drawings and details.
-Plan, design and development of two residential buildings, comprehending offices and commercial spaces (about 80.000 m^3), including parking and children playground located in the area of Rome Torre Maura,-Piano di Zona n.°28 bis.
-Primitive project of an hospital for elderly people with day-hospital (about 36.000 m^3) in the area of Torre Maura in Rome (the realisation of the hospital was delayed and its final project was done later, according to a different plan and the new regulation).
-Plan for apartments, office and commercial spaces (about 100.000 m^3) situated in Rome, Castel Giubileo. Piano di Zona n.°1. Total development of drawings and details.
-Renewal of the Primary and Secondary School in Tor Bella Monaca, Rome depending on the 'Programma Straordinario Edilizia Pubblica del Comune di Roma'.
From July 1985 until December 1986 she worked freelance in Rome, mostly realising renewal of residential houses and apartments, projects and acts requested by the Government Regulation. Since January 1987 up to date she has been working in the Engineering Office of the Istituto Superiore di Sanità in Rome (Italian National Institute of Health) which undertakes as an organ of the Italian National Health Service research, experimental, control and training functions in relation to public health in Italy. She is responsible for the realisation of constructions mostly concerning new laboratories (for medical, biologic or physical applications), maintenance and renewal of the complex of buildings, technical furniture and installations. In summer 1991 she acted as a technical expert of the Istituto Superiore di Sanità, participating in the Commission of Ministero degli Esteri and Crocerossa Italiana. She was sent to Iran to examine the possible realisation of a hospital in the area of Korrhamshar.
She has been studying and working-as guest researcher sent by the Istituto Superiore di Sanità- in the Eindhoven University of Technology (NL) for three years (1993-96), in order to deepen her work about 'Biological building and planning' and ' Well Being in Hospitals'. Since December 1996 she's been working on the project of the 'Well Being in Hospitals', subject of the thesis proposed for her Ph.D. by the Eindhoven University of Technology (NL). In 1999 she participated to the Mediterranean Conference 'Sharing Knowledge on Sustainable Building' (Bari, dec. 16-17), presenting her work 'Enhancements against Environmental Risk'. In 2000 she illustrated her research 'Quality of Hospital Design' at the International Symposium 'Beyond Sustainability' (Eindhoven University, sept. 28-29).
From February 2000 up to date, she is the responsible for the renewal of the Istituto Superiore di Sanità in Rome. The works, for an amount of 20 millions Euro, will be finished at the end of the year 2003. She is one of the responsible for the maintenance of the complex of buildings belonging to the Istituto Superiore di Sanità.

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DE STELLINGEN

In relation to the thesis

Well Being in Hospitals

by

Simona Di Cicco

8th April 2004

1.
Social attitudes and trends have always had the most influence on us, sometimes even when negatively.

2.
The SHAWB Model discredits the well known aphorism 'the surgery was a success but the patient died' (Well Being in Hospitals, 9.3.2 Patient-focused Design).

3.
There are alternative methods, materials and means which have been over time developed in design producing relatively small changes. Ever open to criticism, these changes have however the merit of enlivening our otherwise dull existence.

4.
As the old saying goes 'all roads lead to Rome', old needs and wishes of the patients are only *renewed* in order to correspond their social context (Well Being in Hospitals, Chapter 3 Hospital Building and Health Care in History).

5.
Something which doesn't hurt is hard to find in nature, mostly if this is pleasant or attractive: when you drink, you should know how much wine you can afford.

6.
What is *preferable* is always relative, *what is needed* is certain and it is the latter to create our limits.

7.
The product of design can never be considered *definitive*.
As *dynamic* structures, hospitals grow and change parallel to the social context (Well Being in Hospitals, 3.1.2 Building Typology).

8.
On the background of the recent scientific and technological challenges, *prevention* is a magic word working to the welfare of our society.

9.
The hospital building is the *theatre* of health care. Science and technology are the *actors*. As *director* and *producer* of the scenery, designers are responsible of its performing (Well Being in Hospitals, 9.4 Methodology and Approach to the Quality of Design).

10.
There is no innovation and growth without a loss.
In this game some prefer to stay and others to risk.
Social progress is produced by the criticism of these two attitudes.