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Engineering assessment of building design option at sketch design stage.

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ENGINEERING ASSESSMENT OF BUILDING DESIGN OPTION AT SKETCH DESIGN STAGE "ENERGYSAVE[1]"

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ABSTRACT: During the early design stages of a building, different options are assessed using simple tools, that contain a large number of assumptions the very nature of which can bias choice or possibly lead to an inappropriate solution. Many designers are of the opinion that, because not all details are known, such tools are not suitable for application at early stages in the design. This paper describes the on-going development of a software tool. The prototype of the EnergySave software will be ready by the end of 2002.in which a general, text based description of the building can be used to generate sufficient data to drive a valid analysis using a detailed thermal model.

The objectives of this on-going project can be summarised as follows:

1. To provide means for linking text based descriptions to analytical tools that can be applied at the sketch design stage of a building.
2. To permit reliable energy comparisons to be made between options for a variety of building fabrics, forms and systems.
3. To provide output from the tool in a form which is readily understood by a broad range of building professionals.

Conference Topic: 3.5 Software.

1. CONTEXT AND OBJECTIVES

Whilst naturally ventilated buildings are currently one of the main solutions offered in low energy design there remains a large proportion of buildings for which air conditioning offers the only practical solution. Tools adapted to the iterative process of building design are currently lacking. The method described here is intended to provide a means to assess design options for the mechanically controlled buildings at a very early stage in their design. It is intended that the software output will useable by architects and other consultants.

1.1 what the software does

EnergySave is a whole building energy prediction method. It is a program that allows users to enter a minimum amount of data to produce an energy analysis file. The analysis of this file is performed by a third party analytical program, for testing purposes this will be Energy2. It is intended to be used to compare the performance of different building's design that the building's actors can choose the best option regarding the thermal point of view.

The originality of EnergySave is that the inputs and the outputs are generated in a building actor's understandable language and it's not necessary that they have good computer skills.

The basic features of EnergySave are as follows:

a) Simple method for evaluating energy performance of alternative plans, section, elevations of a building at the sketch design stage. It is a means to estimate relative energy performance of different options.

b) EnergySave uses energy performance data from a mathematical model, in which values have been assumed for heating, cooling, lighting energy (data that would not be available at the sketch stage). The user manipulates only a few design variables, mainly related to building form and façade design.

c) EnergySave is not a precision model for accurate estimation of performance of an actual building. EnergySave is used to evaluate relative energy performance of a number of options for comparison purposes. In fact, a tool for assessing the environmental quality of a building should be able to deal with two distinct types of reality:

[1] EnergySave is the name of the software under development.

1. The physical reality of phenomena, expressing the links between sources and environmental effects.
2. The reality of the progress of a building's operation, with its phases, actors, decisions.

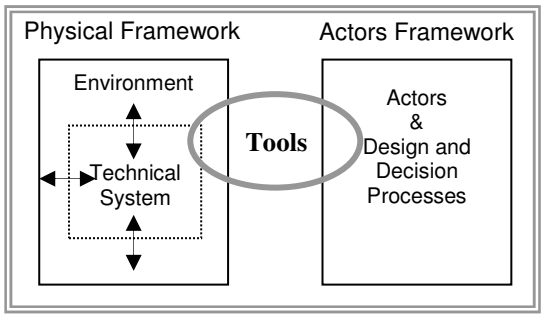

Figure 1: from Annex 31, IEA, two types of reality are incorporated

2. TECHNICAL BACKGROUND

The EnergySave software is based on a computer model, which is being used to predict annual primary energy consumption as a function of:

1. Local climatic conditions
2. Orientation of façades
3. Area and type of glazing
4. Obstructions due to adjacent buildings
5. Occupancy and vacation patterns
6. Lighting levels
7. Internal gains.

3. LIMITATION OF THE SOFTWARE

Considering the use of the software at the early stages in a design project, detailed simulations are not necessary.

a) It is not a precision energy model; use it to test and compare relative energy performance of design options.

b) EnergySave is not yet rigorously validated in quantitative terms but the general opinion is that it gives "sensible" trends.

c) The estimation analysis conducted by EnergySave in early design stage of building is not intended to be sufficient on it's own to ensure good energy design. Further relevant simulation software should be undertaken in next steps of the project.

4. DISCUSSION

The development of easy software is essentially based on the early stage of building assessments. Using this method, the building owner is able to know the project's performance level with regard to environmental criteria, decide whether some criteria improvements should be made or whether the results are satisfactory from the performance point of view.

4.1 Generic system models

These are based upon those described in the CIBSE Energy Code 'Energy demand for air conditioned buildings'. The EnergySave concept is to make detailed energy analysis available to all by means of an intelligent interface populated by data derived from a written performance specification. Intelligence is arrived from the use of extensive defaults. The development of these defaults is a major component of the research programme. The software system will operate in the following stages:

The interpreter: The written description of the building is converted into components using rules. The output at this stage is the best possible interpretation of the design specification and is in the form of a detailed thermo-physical description of the building.

The converter: This is based around a simple interface; it writes a general building and plant description as required by any other application program. The data structure produced by this particular converter will be specified in sufficient detail to allow any developer to use their model in conjunction with this system.

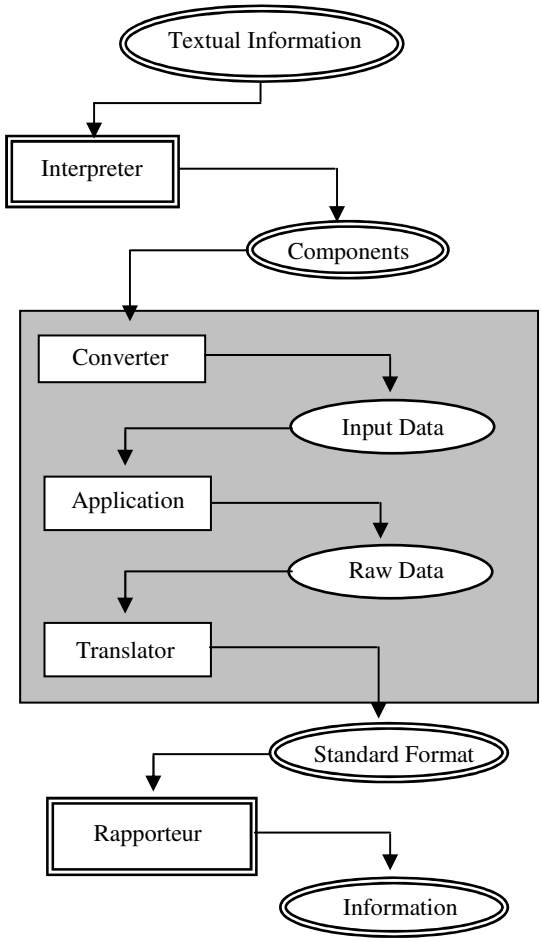

Figure 2: Information flow

The Application: In this case the Arup ENERGY2 program will be used. It could however be any appropriate model.
The translator: This is specific to the program used in the analysis and is used to convert the predictions (raw data) into a standard format. This format is specified in detail to allow the system to be used by other software developers.
The rapporteur: The rapporteur provides a facility to compare and interpret design options. An example might be comparing the energy saved by increasing the level of thermal insulation to that saved by a more efficient light fitting. Figure 2 illustrates the software structure.

4.2 How to use the EnergySave method

EnergySave shows that a general, text based description of the building can be used to generate sufficient data to drive a valid analysis using a detailed thermal model. This will be done using simple textual input via key words, comprehensive default data and the application of rules to interpret the linguistic description. The resulting data file will be a building that is the best possible interpretation of the design intent.

4.3 advantage of the method

a) The input does not require the user to provide a detailed set of physical parameters and dimensions.
b) The same numerical model can be used throughout all stages of the design.
c) The effects of the different theoretical assumptions required by models of varying complexity are no longer of any concern.
d) The building model will be built up over the life of the project resulting in a more efficient design process.
e) Simulation experts will not be required at the early stages of the project.

5. ERGONOMIC INTERFACE

The software will be used by a broad panel of building professionals, thus the necessity to present information in an accessible way will be essential.
Each of the large buttons in figure 3 could be presented to allow the user to examine and modify the converted data.

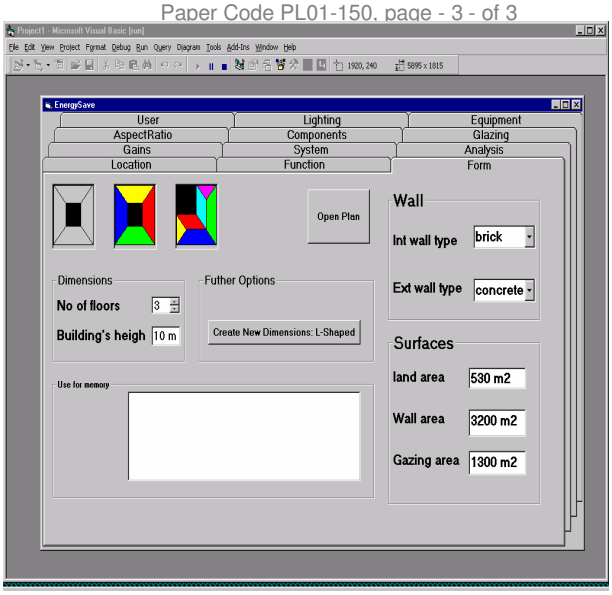

Figure 3: Interface

6. CONCLUSION

The method EnergySave is being designed to suit the following aspects of building design:

a) the iterative nature of the 'real-world' design process,
b) the language of actors involved,
c) to supply results which can be interpreted by a multi-professional team.

The assessment criteria of the method, which consider the actors' point of views, are related to the thermal performance of the building. The development of a method for assessing the thermal performance of a building is a difficult task because of the complex requirements to be met. The final output profile, which represents the building's performance according to different criteria can then be useable by architects and other consultants.

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