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Kinetic performance : a study in portable architecture

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KINETIC PERFORMANCE:

A STUDY IN PORTABLE ARCHITECTURE

A thesis submitted in partial fulfillment of the

requirements for the degree of

MASTER OF ARCHITECTURE

by

Ernest Brian Abuin

2004

To: Dean Juan Antonio Bueno
School of Architecture

This thesis, written by Ernest Brian Abuin, and entitled Kinetic Performance: A Study in Portable Architecture, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this thesis and recommend that it be approved.

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Camilo Rosales, Major Professor

Date of Defense: November 27, 2003

The thesis of Ernest Brian Abuin is approved.

Dean Juan Antonio Bueno
School of Architecture

Dean Douglas Wartzok
University Graduate School

Florida International University, 2004

DEDICATION

To my mom and family who have been a source of support throughout my life. They have nurtured my determination to realize my potential as a student. To Dean William McMinn for his guidance and mentoring. Also, to my advisors Mery and Eileen for their time and guidance; friends Gianpaolo, Melina and Caterina whose love, inspiration, affection, encouragement, understanding and patience through the years enabled me to complete this work. Last but not least, to Lourdes and Claudia, love you always.

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ABSTRACT OF THE THESIS

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Professor Camilo Rosales, Major Professor

The purpose of this research was to explore a new way of experiencing a performance space using the portability and flexibility of a cargo container. Since the 17th century there has been a split between theater, as a written work, and architecture. Theater has lost its founding essence becoming more about the structure and less about the performance.

Contemporary theater designs came through the development of street performances, which developed into theater types such as the Black Box and lately video and projection screening. With the exploration of kinetic uses in architecture and defragmentation of a cargo container there is a new step on the development of theater design. Using a cargo container gave me a familiar object with specific dimensions to start my exploration as well as the possibility of having the theater transported to many sites.

The findings demonstrate that there are many unexplored possibilities to create a performance space outside the conventional theater that can promote new types of performances as well as the use of new technologies of video and projection.

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"If a building could mediate our needs and the environments:

Its demand on physical resources could be slashed

If it could transform to facilitate multi-uses:

Its function would be optimized

If a building could adapts to our desires;

It would shape our experience." (Mafox, Kinetic Design Group)

Transformation in architecture does not depend on shifting use or reconfiguration. It is the need to create new architectural methods in response to a changing environment. This is a concern of the entire construction industry.

"In a built environment that is now affected more and more by rapid and dramatic change, ecological considerations and social and cultural impact, a form of architecture that is flexible, light weight in construction, has minimal impact on sensitive sites, and is responsive to new technological and aesthetic opportunities has great value" (Kroneneburg, 1997).

This describes the essence of portable architecture.

The relationship between technology and architecture has always been complex. It has been discovered that the role of architecture is strongly connected with human beings sense of identity. This leads to the question, what part of human creativity is concerned with the creation of architecture? Is it problem solving when creating architecture? Or is there a need of expressing an aesthetic sense? Early buildings throughout the world and history were created by people who made and used them. All buildings served a purpose,

addressing an invaluable need usually of shelter or safety as well as fulfilling an artistic one. Giving it a unique sense of identity representative of a culture and a smaller scale. As cultures developed the need of more complex, larger structures were required. In these cases, more than one person took on the task of creating these buildings. They became community buildings and shared dwellings. Building construction became more complex. This is perhaps due to more difficult environmental conditions. In essence, this is the basis of a vernacular form.

History

A great misconception of the vernacular form is one of that it being crude and unsophisticated. This is, in fact, a response to a people's needs, environmental conditions and available materials. These structures make use of all technologies and materials available in order to maximize their potential as buildings. One example seen in Kronenburg's book *Portable Architecture* is the yurt in Central Asia. This traditional structure can be seen as an archetypal dwelling in which its standard design maximizes its operational potential and design so efficiently it has changed little for millennia (See example 1, yurt in the appendix).

The yurt can serve as a symbol for early portable houses. It can be seen as a living dwelling with contraptions enabling inhabitants to open and close hatches and be easily transported. This mechanized movement is in response to localized weather and lifestyle. By manipulation, it is

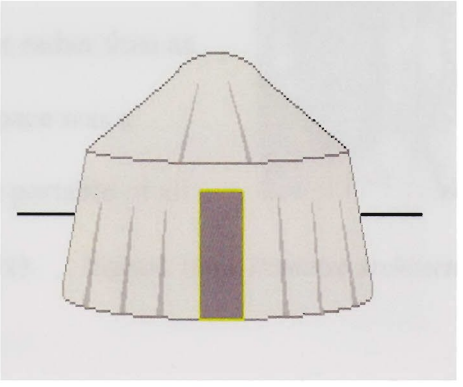


Figure 1. (from *Portable Architecture*)

moved and shifted into a series of shapes and disassembled depending on the need of space. The use of portability in terms of dwellings is not a new idea. It is commonly found in nature in the form of shells.

Since the dawn of civilization, humanity has created structures that are mobile. What drives the need for movement? Long before there were built structures there was the noble tent that kept nomads safe and secure for thousands of years. Apparently, we still have the need for that caravan of nomads. Although, now they are in the form of weekend campers. It became necessary for survival as early tribes migrated from place to place. There is a similar condition in today's society where the search for employment opportunities often results in people moving from place to place. For tribal societies, the need for mobility and security was found in the family group and portable dwelling. Such dwellings consisted of a basic space frame adapted to use skin membranes without inherent strength, a twin skin system and natural air movement patterns for environmental modification. As seen in the case study of the Australian aboriginals in *Primitive Architecture,* (1987), the use of space was highly abstract. In this case, abstract space rather than an actual building was architecture. The center of this space was a decorated staff rooted in the ground. This is the most portable of all structures (See example 2, Aborigines in the appendix).

Figure2. (from *Primitive Architecture*)

Types of Portable Structures

The demand for space is of great concern today. Humans live in cramped spaces and cities with no sense of freedom or privacy, creating a longing for this primal need to roam around and move. Even vacations to campsites where space is even more limited due to plethora of people who have come with the same yearning. One solution might be to revert to portable or transportable structures. Portable, defined in Webster's dictionary as "anything that can be carried out or moved with ease," and architecture defined as the art and science of design and erecting structures. A combination of both, easily transportable structures, make up the idea of portable architecture. Transportable architecture is used in conjunction with portable architecture; both having similar meaning. However, transportable is defined as to carry from one place to another through ship or craft. The interrelation of the two describes this renewed movement in architecture.

As mentioned, portable architecture developed in response to social needs. One was a lack of space as seen in major cities. A second was a response to an easy, comfortable way of moving across long distances. This architectural form is moveable in some form and is designed specifically for deployment in different situations and locations. According to Robert Kronenburg's *Houses in Motion* (1997) there are three specific categories of moveable building types.

Figure3. (from *Design Mobile*)

Portable buildings are those that are transported whole and intact. It incorporates innovative construction systems and building methods This group includes, "... the wide diversity

in form and function of portable structures and the expertise that has been developed outside the building industry to assist with their manufacture" (Kronenburg, 1997). Sometimes they include a method of transport within their own structure and can be towed or carried. A few are) described as self powered. In both the dividing line of vehicle and building is blurred. An example of this is Imobile by Jennifer Siegal.

Example of Jennifer Seigal's Project

As in the case of the early nomadic group, the author believes that the way we live our lives is an ever-changing phase. Lifestyles, working patterns and ecological issues are altering the way we use buildings and the part they play in society and the environment. In her office, work has focused on the development of "mobile" architecture. As seen in the statement of Office on Mobile Design (OMD) in Jennifer Seigal's web page, www.designmobile.com, she "specializes in finding non standard solutions to unconventional and unique problems." They believe that by designing nonpermanent site structures that move across and rest lightly upon the land, they are rethinking and reestablishing methods of building that generally crowd the landscape. OMD no longer believes in the "monumental, the heavy and static, and has enriched sensibilities with a taste for lightness, transience and practicality" (OMD, 1997). This is to say they believe in a more minimal, lighter way of living and the structures we inhabit should represent this. This researcher believes in this minimal approach. Life has become increasingly complex without need. In our search for comfort humans have created a more diverse way of living that is represented in our culture and architecture.

According to Seigal's philosophy, projects built by OMD's projects bring innovative community based programs to their users much like the aboriginal staff provides a space that generates activities for a community. It becomes a center of interest, bringing a community together. By bringing in a foreign object with many representations, spatial conditions and different configurations in terms of typology as well as form activates the site "Vision melts with desire for user-based program inspired by machines and accessible through mobility" (www.designmobile.com). Their list of projects and use of mobile structures vary from many different prototypes. From residential design and portable housing to the Imoble computer hub, OMD designs touch on many aspects of human activity.

The innovations mentioned represent new ideals and methods combined with age-old building techniques. New methods of construction and theories in architecture have helped create the intricate and environmentally sensitive designs of today. "Ecological considerations that measure the use of renewable resources, recyclable components and building costs based on a life-cycle basis are now significant as is the context of sensitive and historic sites and the reconstructions placed on building design by planning controls and other legislation. Economic pressure on the building industry now results in fast track programs for higher specification buildings built with fewer, and in many cases, less skilled personnel" (Kronenburg, 1997).

The use of portable architecture to provide aid to these concerns is what makes it so important and revolutionary. Today, the premise behind portable designs is to use experimental materials and methods that can adapt to almost any condition and at the same time be sensitive to community and environmental conditions.

This is mostly seen in Jennifer Seigal's Imoble designs such as the IMobile unit, which is designed to showcase new computers to schools and rural areas. The Eco Lab and the Portable Construction Training Center are other projects Jennifer Seigal has worked on that are community based structures highly mobile and used. These projects and others are written more extensively in Jennifer's book *Mobile, The Art of Portable Architecture* (1999).

Figure4. (pictures of Seigal's work; Eco lab, Imobile, Eco village)

Second Type, Relocatable Buildings

The second type of moveable buildings described by Kronenburg are *relocatable buildings*. These are buildings that can be transported in parts but are assembled at the site almost instantly into a usable form. They are almost always carried but in some cases have a transportable system built into their structure. The main advantage of this type is that it can

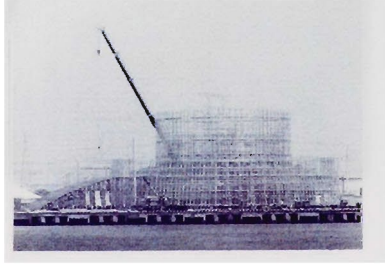
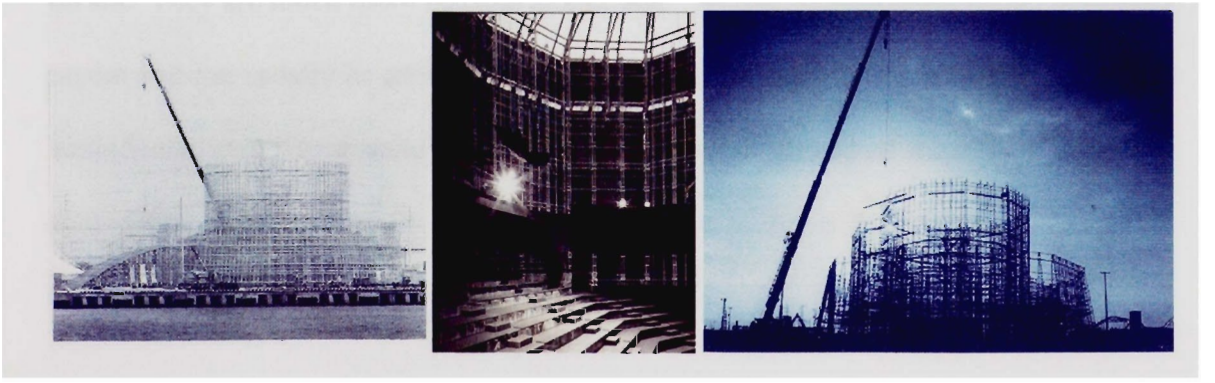


Figure 5. (from *Portable Architecture)*

provide space almost as quickly as the portable building without restriction in size imposed by transportation. This is also a negative aspect due to the need of a skilled labor force to assemble the structure.

Example of Relocatable Buildings

Tadao Ando Architects and Associates designed the Karaza Theater in Sendai and Tokyo, Japan. This design was for a traveling avant-garde theater and performance company. The building itself consisted of a wooden scaffolding system made of black stained timber board shell, and common bleacher seating. These bleachers accommodated six hundred people in the comfort of carpeting. The roof consisted of a red tinted tensile cover that can be traced to the red tent symbol of the circus. The entrance to the structure included a taikobashi-arched bridge that symbolized the transition from the real world to the world of illusion. With the plan laid out on the ground, two cranes could begin the erection of the scaffolding. This process took fifteen days to complete (Kronenburg, 1996).



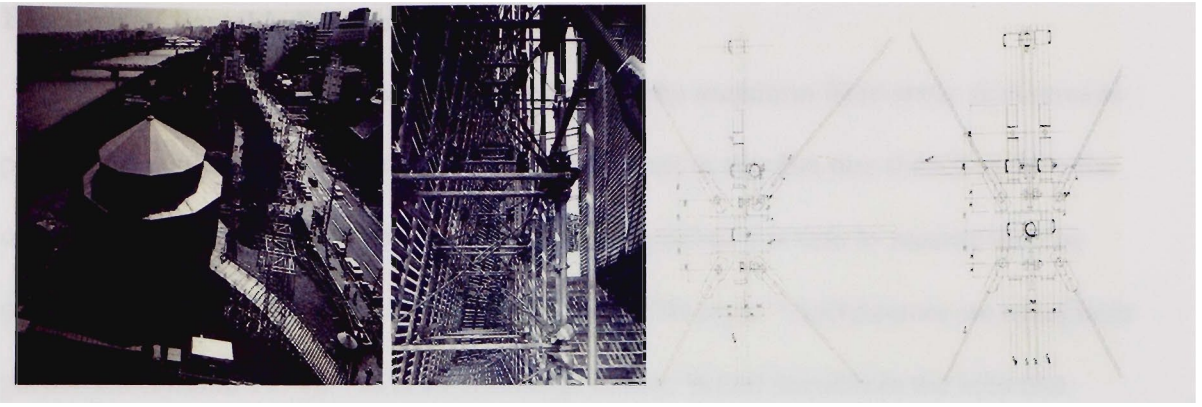


Figure 6. (from Kronenburg *Houses in Motion*_)

A second example of this is the Carlos Mosley Pavilion (see example 3, the Rossi Moving Theater and example 4 in back appendix).

Third Type, Demountable Buildings

The third type of moveable buildings described by Kronenburg are *demountable buildings*. These units are transported in a number of parts and assembled on site. They are much more flexible in size and layout and can usually be transported in a relatively compact space. However, they have some limitations. These include size, complexity, and ingenuity of the system that in some cases is not as instantly available. An example of this is the IBM expo 1984 by Renzo Piano.

Figure 7.(pictures From *Houses in Motion*)

Elements of Portable Structures

If one were to revert to a nomadic lifestyle the transition from static structures to portable structures would not come easily. This is not to say that one should replace the other. Given the lack of portable living structures around, it is safe to assume that the general population is reluctant to such a change of life style. "Architecture we imagine is permanent (Brand, 1994)." In *How Buildings Learn*, Brand introduces the idea that technology, money and fashion are elements that control buildings. The design and redesign that occur in the studio along with changing conditions of the site, methods of construction, cultures and people make portability a challenging topic to investigate. The fact that buildings are constantly being readopted, changed, retired and removed, shows the impact of new structure usages. The rootedness of static buildings to a particular site demonstrates part of the problem when changing a building's function. A local example of this is seen in the adoption of the Vietres Haus building in Florida International University, Miami Florida that was turned into the School of Architecture. This is not a successful transition due to the lack of studio space, work areas and windows in the small classrooms.

Figure 8. (pictures from Adrian Villarao's Shop at FIU showing lack of space for shop tools and of Graduate Design Studio showing lack of workspace and cave-like conditions)

Site and Structure

According to Brand, "site demonstrates the structure, which dominates the skin, which dominates the service, which dominates the space plan, which dominates the stuff" (Brand, 1994). The ability of portable structures to relocate and readapt allows the influence of systems on each other to change and readapt. The hierarchical relationships of these systems also change due to the adaptation of multiple sites and multiple programs. This obviously allows portable structures to adapt to change more readily than static structures. "Where as architecture may strive to be permanent, a building is always building and rebuilding " (Brand, 1994). However, it is important to note that the term architecture is not changing but rather the translation and perception of architecture is taking new form.

Sukkot Example

The history of the portable structure can include a religious component. The best example is the sukkot. According to Rabbi Daniel Swartz from The Coalition on the Environment and Jewish Life (COEJL), the sukkot is a temporary shelter used in the Jewish festival of sukkot. As described in the book of Liviticus 23:42
"you shall live in huts seven days; all citizens of Israel shall live in huts in order that future generations may know that I made the Israelite people live in huts when I brought them out of the land of Egypt."

In this case, the structure became an important part of the culture and religion of the Jewish people. After leaving Egypt, the Israelites traveled for 40 years building structures out of found materials in the desert. This was the sukkot. It was an open-air structure made of "twigs, grasses, corn stalks, and other natural materials," (Swartz,

1997). The construction of a sukkot follows certain criteria. The materials to construct the sukkot must be natural and gathered by the participants. In this structure family and friends feast and sleep for a week. After the celebration is over the structure is disassembled and material either discarded or reused.

The University of Florida offered its students the opportunity to build a sukkot as a method of structure in Materials and Methods II class. The modern sukkot was constructed of wood purchased at the lumberyard and elevated with blocks. The function of providing protection from the elements while eating and sleeping remained the same as the original concept of the sukkot.

Even though it focused on the ancient and religious significance and use of the structure, we used modern materials were used and contemporary building methods to construct the unit. The use of material weaving and light were important in creating shadows as a means to produce an interesting interior. The importance was placed on the detailing of connections and the articulation of the structure that served to fulfill requirements of the construction class, as well as creating meaningful connections to a past community.

The experience offered another dimension of design involvement. This was the act of building, which involved tactility of materials and attention to connection and problem solving was otherwise not seen on drawings. It was carrying the lumber on my back and cutting the pieces to size. There was no experience like bringing the stack of lumber and timber to life by blood and sweat and time.

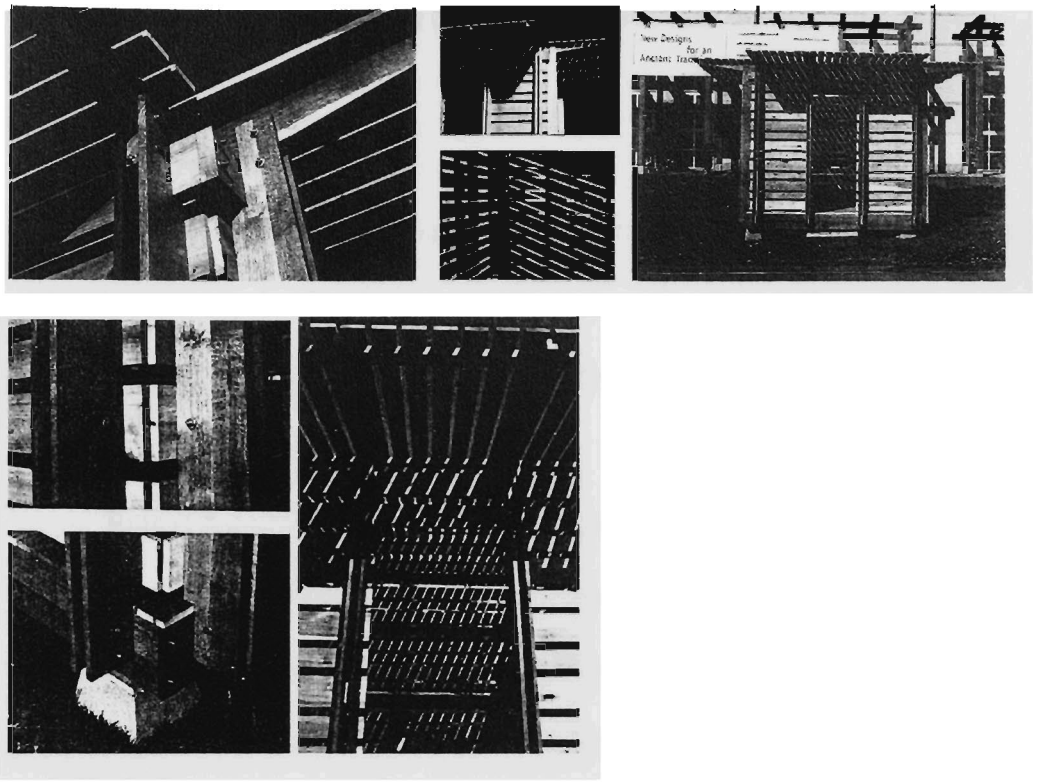


Figure 9. (sukkot pictures from the Ball State, JAE 53/1)

The nature of the sukkot example show the simplicity and efficiency needed for portable structures to function. Many experts like Kronenburg and Burns believe this knowledge of assembly is beneficial as a basis and foundation for the future of portable architecture and the perception of designs.

The ability to analyze and combine the use and reason between past and present portable structures is beneficial in determining the path to follow for future mobile structures.

"Case studies are a valuable resource of first hand experiences that quantify the physical attributes of a project by telling the story of its inception, design, manufacture, and operation…Precedent studies provide a foundation of knowledge for current works

and allow successes and failures to be assessed with the benefit of hindsight" (Kronenburg, 1996).

Methodology-Case Studies

In order to define and determine the best way to create a portable structure, research and analysis of case studies is important. The lessons learned from past constructions will inform and help in the success of designing a contemporary portable structure.

Robert Krogenburg wrote several books on portable structures. One of these books, *Portable Architecture*, includes a collection of case studies that are examples of portable structures from the conference in London. These case studies are arranged into categories that share common construction methods and transportation systems. The first group uses philosophical concepts that represent the general ideas of portability as a means to develop a design as seen in the works of Sant Elia's and Baird's studio projects.

The evaluation of case studies leads to interesting findings and direction towards a design concept. The evaluation of five projects from Kroenenburg's books provides an understanding of the types, styles and characteristics common to portable architecture. With today's portable architecture we seek a balance between the latest in technology combined with an environmentally sensitive structure. The case studies show how materials are used to express a certain feeling for a space as well as being responsible to the environment. This is used in the design of non-portable structures but must be adopted to use any type of structure. Beside the use of materials, what is important is the maximization of space and use of gadgets to perform tasks. This is mostly seen in Seigal's Ecolab project and Piano's IBM Pavilion (See example 6 in the appendix).

In addition to research of case studies it is important to be aware of one's surroundings. There are modern examples of portable structures with which the general population is familiar, yet they are often hidden in the background architecture of a city. These include portable classrooms, fast food stands, ice cream carts, play spaces, tool sheds, modular offices, motor homes, fabric structures, inflatable devices, modular houses and the basic car shed, which all serve various functions in a community. However, the most noted is the mobile home.

Figure 10.(pictures From *Mobile Arch*)

The use of the motor home as a portable dwelling shows the evolution of the primitive dwelling through the ages. The ability to carry one's house on your back or use pack animals to move from place to place has now been replaced by the automobile, transporting a structure. The use of a lightweight frame structure covered by plastic also shows the evolution of the early tent and tipi. The modular panel system of portable classrooms shows the evolution of the hut. The ability to transport a building to a site and have it ready to use immediately incorporates the age-old traditions of our nomad ancestors and ties us back to the primal urge of movement and exploration.

Carol Burns Mobile Homes

Carol Burns is a designer who has explored portable architecture through the mobile home. An architecture professor at Harvard University, she has explored the possibilities of "physical design, communicable knowledge, and informational expertise" though a design studio (Burns, 2001). Her students explored all aspects of a mobile home, from fieldtrips to parks and hands on informational process where they disassembled a mobile home and toured a factory to learn about assembly. The also furthered their study by investigating how they are presented and advertised to the public (See example 5 Carol Burns Studio in the appendix).

Her research extends to the idea of the modern mobile home which came after World War II. The United States at the peak of industrialization and a population explosion was in need for quick solution, factory-made home. This is also expressed by Jennifer Seigal's philosophy when she writes "owning your own home is the American dream, but for many it's a compromised dream when the only affordable choice is a trailer" (www.designmobile.com). After the war, there was a need for a quick way of producing homes. A good economy, new techniques in factory assembly and stronger lightweight materials turned the travel trailers to a chassis-based house. According to Burns, there are more than 12.5 million Americans in chassis-based houses. That accounts for over 25% of all homes in the United States. The mobile home is a popular option in means of an economic standard and it provides an option for affordable housing with varied designs.

These units began to assemble into communities. Trailer parks were developed and mobile homes were used as permanent housing. This provided a stable place for the trailer to be stationed for a long period of time. A non-portable home also developed a unit that was transported to a site and the experience of mobility faded from the design. The construction industry took this into account and focused its efforts into a portable unit that would only be moved once and mobility became an incidental part of the construction. These units became larger.

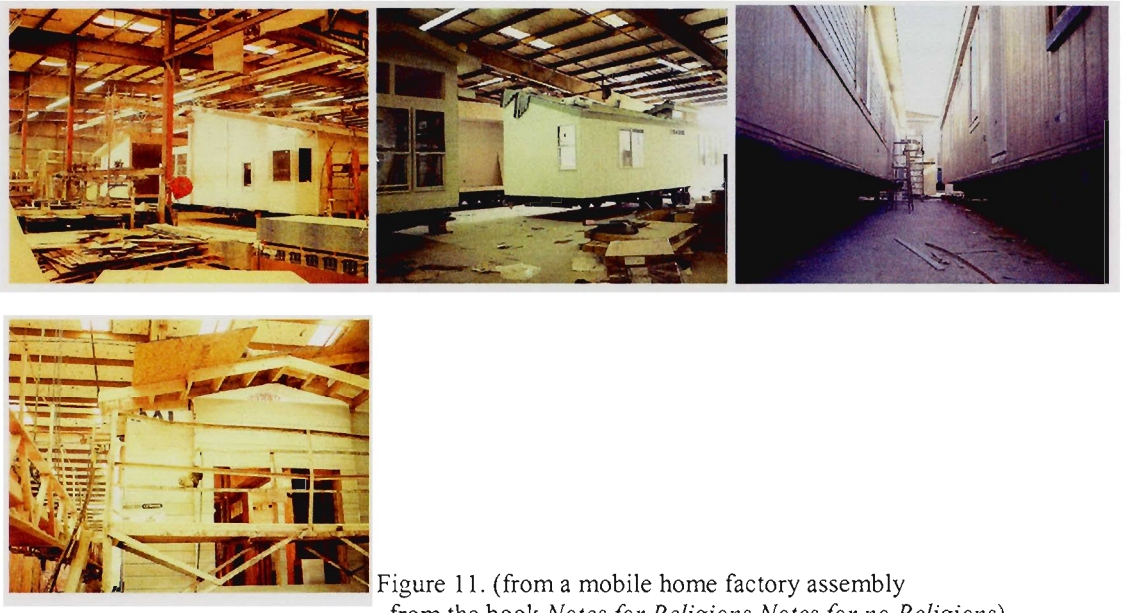


Figure 11. (from a mobile home factory assembly from the book *Notes for Religions Notes for no Religions*)

With new technical and powerful modes of transportation, units became larger and heavier. The family car now was not able to pull the 30-plus-feet units. There were also a variety of units created with design concepts not important or applied in the early designs. Words like "long, ex trailing, double and multi section" were used to describe the trailers (Burns 1998). The movement now was to make the portable a stable unit. Not only was this concept applied in its design but also in materials and general aesthetics.

This created a split in manufacture's production and developed two markets. One was a demountable unit (the larger mobile homes that eventually remained a stable unit), and the other was a portable trailer that was made purely for recreational purposes.

Figure 12. (from Carol Burns; Journal of Architectural Education 1998)

In the book *A Guide to Archigram* by Ernst and Sohn (1961-1974), there is a chapter that explains the idea of what trailer parks have become. The study concludes that trailer parks have become immobile and try to imitate suburbia. This is seen in the decorations trailer homeowners place on their front lawns. They try to imitate suburbia by placing porches, garden gnomes, pink flamingo with windmill wings, and other extras to make the trailer look like a "real" home.

The problem seen in trailer parks is the energy source. There is no long-term energy source provided to the homes. They in return have to count on batteries or gas cylinders as a means for electricity and heat. Many trailers now have built in batteries to

power and heat the units. *A Guide to Archigram* says that the newer models of trailers are equipped with rock plugs that contain a homing signal located in a hut like structure with an energy source within radar of one mile. The instrument works much like a car radio using wavebands to locate a hard routing system. Plugs are said to increase service to communities and can be used as a support to universities, schools, workplaces and trailer communities. This method of energy can be adopted into the proposed project. There is a certain poetry and hope to this moveable source of energy. The writer goes on saying

"For the present we have to go on waiting for the steel and concrete mausoleums of our cities, villages, towns, etc... decay and the suburbs bloom and flourish. They in turn will die and the world will perhaps again be a garden" (Archigram, 1994).

Kinetic Design Studio

A second group of students exploring mobility in Architecture is the Kinetic Design Group of MIT. Though a more abstract approach is taken to the studio, the findings are important to note.

"The goal is to create architectural solutions that can demonstrate responsive and intelligently active behaviors with respect to changing individual, social and environmental needs. Kinetic function is used as a technological design strategy for building types that are efficient in form, lightweight, and inherently flexible with respect to various contexts and a diversity of purposes. Intelligent kinetic systems arise from the isomorphic convergence of three key elements: structural engineering, embedded computation and adaptable architecture. Such systems shall serve as a practical means for

inventing entirely new ways of developing spaces, and the designing and building environments that address dynamic, flexible and constantly changing needs" (KDG, Concept).

Through a series of projects the studio explores engineering, design, materials and concepts. The projects give the students a hands on approach of movement and possibilities through mockup models. Projects such as "kinetic wall," "folding egg," "rail reflectors," "kinetic acoustics" and "energy wall," and the exploration of corrugated kinetics found in the Kinetic Design web page, http//kdg.mit.edu are great examples of the endless exploration possibilities in which movement and architecture go hand in hand. The most successful projects are then submitted to the Kinetic Design Group that publishes them. One of the projects submitted is a study done by Michael A. Fox and Kristin Little from MIT and Maged Senbel from University of British Columbia.

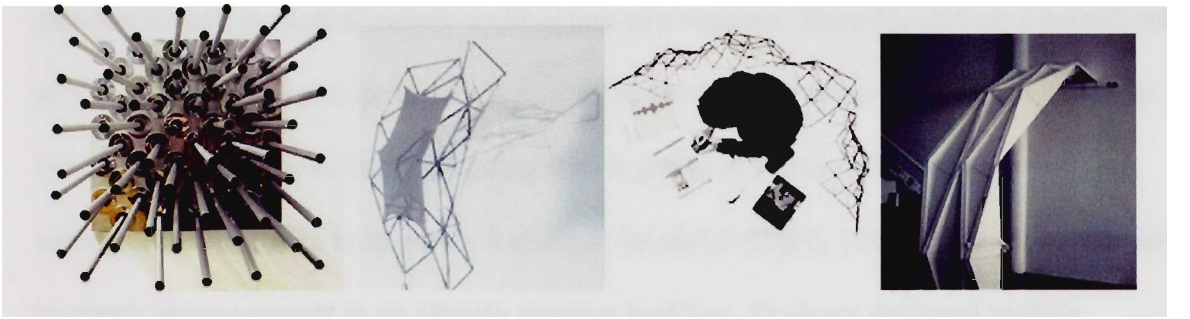


Figure 13. (from Kinetic Design Webpage; http//kdg.mit.edu)

The project is a study that demonstrates the "kinetic function as a technological design solution for an efficiently deployable building system used to maximize space in single story informal setting" (KDG, Multistory Settlements for Urban Environments).

This study focuses its efforts in the mobile building or home away from the trailer park and back into the original concept of mobility and, in the process, solves urban

problems in cities. Their proposition is a "low cost, two story, disasemblable, kinetic house design." Their solution is purely based on geometry, kinetic design, mobility and variable location as a means to solve overpopulation and maximizing space within a city. This project is worth mentioning because it contradicts the idea of a mobile unit becoming static as seen in Burn's study of the mobile home becoming a permanent unit.

David Baird LSU Studio

The best example this researcher found that combined technology and issues of portability is the Mobile Studio Project by David Baird of Louisiana State University. The project was to use a space for an off-campus design studio that would double as a center for community projects. The goal was to attract attention to an otherwise unused space in downtown Baton Rouge. The space was unwilling to change and the designers decided to look at natural mobile architecture as a concept. They decided on a hermit crab as a framework for the conceptual design. "The hermit crab seeks out an empty shell to use as a protective covering, discarding it as it grows in search of more suitable accommodations. As a crab grows it changes its shell" (Baird, 1999). The objective was to create improvements to an already existing building. Students designed mobile workstations that would occupy a shell of a space. The workstations were to house one design student with all necessary space built into the unit. "The unit is equipped with an adjustable drafting table, layout surfaces, book shelves, file cabinets, a secured storage compartment for a notebook computer, a stool, lighting fixtures, display presentation surfaces, and a power strip. The unit can be packed up, moved through a standard

doorway, rolled on a truck, driven across town, and deployed in another location in less than an hour" (Baird, 1999).

This example of portability shows how much effort and planning goes into maximizing each square inch of space as well as working with the assembly and deployment of the unit. However, it is much more difficult than just moving out and moving into a larger space such as a hermit crab does. Issues of adoption and mobility are important. There also seems to be a great deal of competition in all the studio projects for the amount of time it takes to disassemble, move, and reassemble the project. However, to revert to nature as a means to solve a problem is of greater value than any mechanical solution. This goes to show the importance of being aware and knowledgeable of our environment and that the solution to a problem does not only rely on technology but can be found in nature.

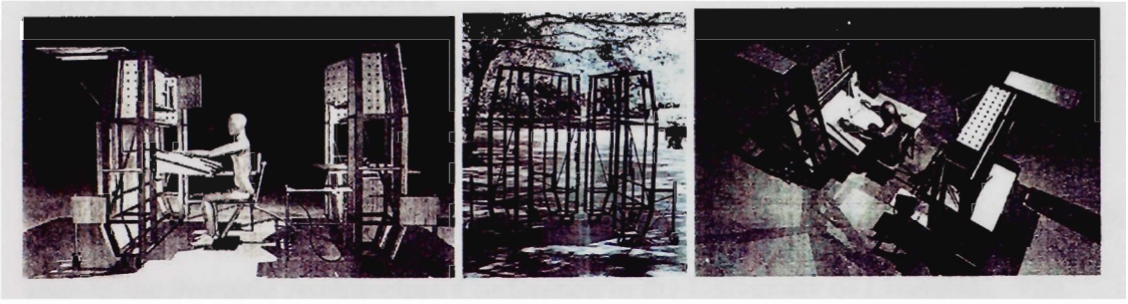


Figure 14. (from Baird's studio project, JAE 53/1)

Though the projects used are case studies of portable architecture, other modern examples, found within our society, are looked upon as less successful portable units. An example of the less popular portable architecture unit is the portable bathroom, cargo containers, hotdog stand, military structures, and construction elements such as scaffolding and walkways. Though when needed they are there and serve a function.

These less desirable structures can be turned around and used as an architectural element and methods of construction which is then adopted into a desirable structure. Tadao Ando did this in the construction of the Karaza Theater.

Figure 15. (from Mobile Arch web site)

Theory of Portable Structures

Methods of construction have taken over the idea of reason for the design of portable architecture. Conferences are now being held around the world, mostly in European countries for the developing of new ideas and methods for portability. Such is seen in the Portable Architecture Conference in the University of Liverpool. The structures discussed here took a wide range of forms. They discussed portable architecture and the future of mobile buildings. The symposium had keynote speakers from a varied range of field such as "Lorenzo Apicella (architect), Maurice Agis, (environmental artist) and Ian Liddell (engineer)" (PBRU, 2). With this range of professionals they discussed production of units, materials being explored, procedure of

assembly, users, and most important technology available in other applications and how they can be applied to portable units.

An interesting topic discussed is the importance of architectural expression. As an architecture student, this is as important as the portability factor or assembly. Though many different views and positions were taken in the conference, all agreed that portable architecture is being reassessed as a valuable design route in search of a more sensitive architecture.

"The aim of this conference is to expand understanding of the history of temporary and portable buildings as an integral component of all architectural design, to show a range of significant contemporary examples designed through out the world" (PBRU, 2).

Designers of the conference took part in setting the agenda for the research and design strategy of portable building in the future. The conference report has been published in the book *Transportable Environments:Theory, Context, Design and Technology* by the International Conference of Portable Architecture.

Futurist Movement

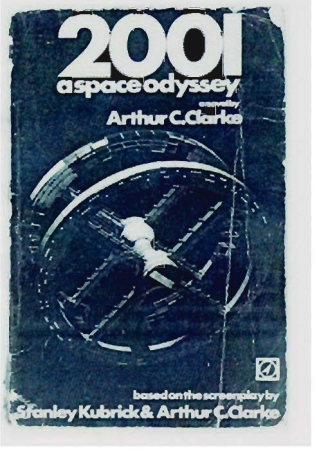


Figure 16. (book cover 2001)

Many have wondered where the future of portable architecture will take us. Though some have discarded the idea in general, others have considered the possibility of large-scale projects. One of the propositions is the idea of a portable city. This is first found in the *Futurist Manifesto* by Sant'Elia. He believed that the city has a potential to be a machine like moveable object. Antonio Sant' Elia was a graduate of the Accademia di

Belle Arti at the turn of the last century. He was a leader in the radical movement in architecture, which tried to define an era with no reference to the past. Sant' Elia believed that each should build its own environment and not inherit it from the past generation. "New architecture was to be based on calculation, audacious daring and simplicity" (Sant'Elia,1912). Though his designs were heavy massive soaring towers anchored to the ground, he believed inspiration should come from machines "efficient, fast –moving machine, with a technocratic ring". (Sant' Elia,1912) His view on what a city should be can also be related to movement. This is one of the earliest forms of theoretical portable architecture mentioned this century. Elia sees "the futurist city as an immense and tumultuous shipyard, agile, mobile and dynamic in every detail" (Sant' Elia,1912).

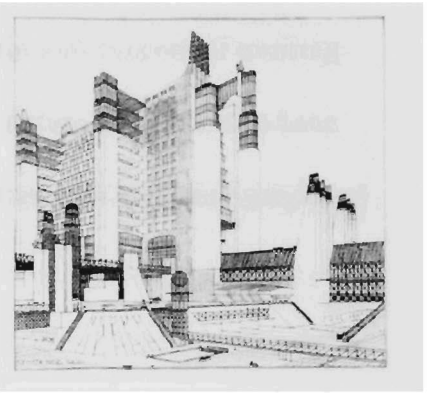


Figure17. (from www.geocities.com)

Example Blow Out City and Plug in City

This idea was carried on and can be seen in examples of large movable structures such as Navy carriers and oil plat forms which can function as moveable cities on water. As seen in projects such as the Blow Out City and Plug in City seen in *Archigram* (See example 7 on Appendix).

It is obvious that the proposed cities mentioned are a collection of several ideas and though some poetic and others idealistic they cannot be applied in the definition of a

city. That is to say neither the Plug in City nor the Blow Out City could ever replace New York, Rome or Paris.

A city is a product of its natural region, and the time at which it is settled, permanently fixed. There is a connection to the land and region that needs to be stable. It also needs a grid system to define its order and an exterior unit of production to fuel the city. This is the thought of Gedes and is supported by the obvious success of exciting cities such as New York, Rome, Havana and Paris, and the failure of others who have tried to redefine and design cities and the less successful cities such as Chandigargh and Brazilia.

" a city is not really just a network of interesting information and commodity flows. The city is still localized as a place or region, but locality now means the feeling of being somewhere. Of having a place in context where life has some relevance...it is no longer a public domain but a concentration of diaspora-relates public domains in which numerous cultures are settled but linked via the media to similar context elsewhere" (Eichorn, 2002).

Studying cities is advantageous to widen the spectrum of thinking of a portable object. Examples of buildings, stages and homes are more or less of a specific size; however, a city involves issues that would not be seen in small structures. These issues extend beyond portability and assembly. Presented in cities are issues such as transportation and movement in a larger scale and are explored in the design stages of

case study cities. As in a city, movement is also important in the design of a performance space; the ability to move "on stage" is what gives the performance a third dimension.

Exposition Spontaneous Construction Display

The Exposition Spontaneous Construction Display held in London in 1997 introduced the concept of portability and demountable building systems with reference to construction, design, and experimental prototypes, manufacture, and users requirements. These components can serve as guidelines for promoting a valid research and design. The exhibition curated and designed by Robert Kronenburg displayed models, videotape and audiovisual presentations. These methods are useful to display a completed building if a full size structure is not feasible also worth adopting when presenting this thesis project. The best part of this experiment in portability is that the entire community took place in conjunction with the exhibition.

One of the displays that ties back into the mobile home and the original concept of living on the move was Living in Motion. The project was designed and sponsored by Vitra Design Museum in Weil-am-Rhein Germany. They addressed the theme of mobile living and working spaces. This exhibition included architecture and furnishings at the end of the exposition, a workshop for architecture students was held in July 2002 in Domaine de Boisbuchet, France, sponsored by Vitra and headed by Robert Kronenburg. Information on this exposition can be found in the Portable Architecture Exposition web page http://www.liv.ac.uk/abe/portablearchitecture/Exposition.html and the workshop at http://www.boisbuchet.com

Elements of Portability

Examples of case studies have been provided in this paper demonstrate many points from issues concerning types of portability and construction methods to a variety of ways of transporting the projects. This is probably the most challenging aspect of designing portable architecture. There is the possibility of movement through land, air, sea and a hybrid of these elements. With the case studies already mentioned, one gets the general idea of the many possibilities of movement through land. This is either with the use of an automobile pulling or pushing it or by the structure supplying its own means of transportation. A true portable structure must satisfy at least one method and a great portable structure satisfies two or all. This is hard to find.

Transportation

Movement through air was seen in the first thoughts of portable architecture, as seen in the books by Kronenburg with examples of hot air balloons and the exploration of air ships. Written in a section called "non-architectural precedents", one could see as the possibility of air travel as an under developed resource. Though airships have had a troubled past with the use of hydrogen as a means to inflate the zeppelin, most notable case was the Hindenburg disaster which "oh the humanity" sealed the fate of the use of airships, today there are technological advances in engineering and materials that can prevent this type of accident from reoccurring.

Another possibility of transportation through air is the use of helicopters. Inventors such as Buckminster Fuller used helicopters to transport his design of a geodesic dome structure to show its lightness and strength. This is seen in Kronenburg's

book *Houses in Motion*. A second image is found in the book *Archigram* that shows a prefabricated home attached to a helicopter. The use of helicopters is probably used most extensively for portable military applications of disaster relief.

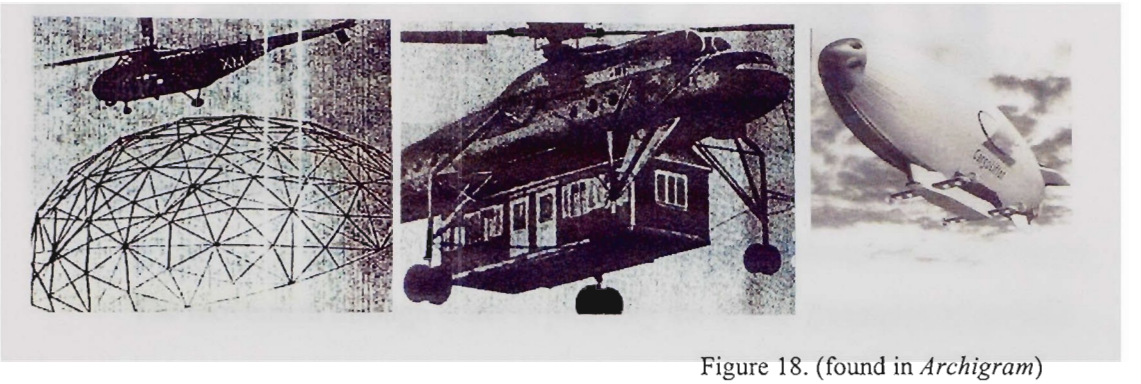


Figure 18. (found in *Archigram*)

An example of architecture that is transported by air was the Instant City. This project was found in *Archigram* on page 237 (See Example 7 in appendix).

Christo's Example

The best example this researcher found of portability through air is not given by an architect nor engineer but rather by an artist. The Cubicmeter Package was Christo's contribution to Documenta 4, Kassel, Germany. For three months, an oblong balloon floated in air secured by cables to the ground. This tower of air weighed 13,000 pounds and measured 279 feet in height and 33 feet in diameter. Though the structure was not transported by air, but rather by trucks and lifted by cranes it could as well been easily floated into place much as hot air balloons move around. This example is important to mention because on the non-architectural application of the piece. Yet in essence it is a structure and very architectural in scale and can been a foundation to inflatable structure that can move and most important like a lot of Christo's works serve as a temporary icon to a city.

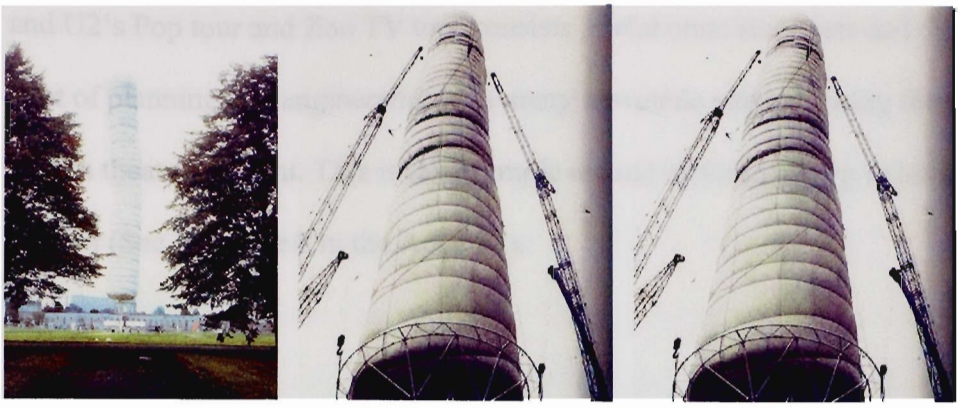


Figure 19. (form Christos' *The Reichstag and Urban Projects*)

The movement through water is probably the oldest. Examples of portable structures through water take many forms, from sailing ships to moveable cities; carriers already mentioned. In the book *Vessels and Fields* there is the project of a moveable zoo taken place on a Navy carrier. The idea of a floating zoo can be dated back to Noah and his ark however the idea of a technological craft as a zoo is very innovative.

Other examples of portable architecture moved through water is seen in *Houses in Motion.* However it is the simpler structure that would be more suitable to my project. A notable project is the floating abortion clinic found in the website for Waves for Women, www.wavesforwomen.com. This small structure uses two steel drums as a floatation device and a small clinic on top of a platform.

The decision on how the structure is going to be moved impacts its method of construction. The case studies listed before all had all a different modes of construction. Some were assembled on site, others were transported already assembled. Case studies concerning a concert stage due it its necessity to be easily and quickly assembled and transported, can best address issues of assembly. It also has a lot of common elements with performance spaces. The more contemporary shows such as Pink Floyd's the Wall

and U2's Pop tour and Zoo TV tour consists of elaborate stage sets and designs that take a lot of planning and engineering with many moveable parts allowing for the architecture to be a theatrical event. This is the example is used by Kronenburg in his book, *Houses in Motion* (See Example 8 in the Apendix).

Theatrics Art Basel

A local example of portable architecture which created a theatrical event was Art Basel. Art Basel Miami Beach, the International Art Show, took place for the first time in Miami Beach, Florida from December 13 to 16, 2001. It offered participating galleries an area to present and promote their art. Along with this new event 20 galleries were provided with shipping containers refurbished as exhibition spaces. Grouped together, they formed a container village named Art Positions. It offered an interesting presentation space for art. This village developed together with innovative architects sets a spectacular event in the Art Deco District of Miami Beach.

The promotion of innovative design galleries and art is a tradition of Art Basel. In 19 booths, galleries can present young artists to the public. Most interesting was the Art Video Lounge, another off-site facility of the new art show, that presented an extensive program of new video work. This gave me the idea of creating a virtual theater rather than the design of a specific performance area for a written work.
The following 20 galleries were exhibited in "Art Positions":

Air de Paris, Paris; Catherine Bastide, Brussels; Carlier Gebauer, Berlin;
China Art Objects, Los Angeles; Cohan Leslie and Browne, New York;

Jack Hanley Gallery, San Francisco; Galerie Martin Janda Raum aktueller Kunst, Vienna; Galleria Francesca Kaufmann, Milan; Andrew Kreps, New York; Kuckei + Kuckei, Berlin; Lombard-Freid Fine Arts, New York; Meyer Riegger Galerie, Karlsruhe; Galería Espacio Mínimo, Madrid; Mizuma Art Gallery, Tokyo; Rare, New York; Sandroni.Rey, Venice LA; Barbara Thumm, Berlin; Vedanta Gallery, Chicago; Galleri Nicolai Wallner, Copenhagen; Galerie Fons Welters, Amsterdam." (www.artbaselmiamibeach.com)

The conversion of shipping containers to mobile exhibition spaces was created by the firm Steinmann & Schmid. "Conditions were placed by the architects before considerable challenges: the shipping containers could not be altered in any way, and the refurbished containers had to comply with the strict safety regulations of the Building Department and the Fire Marshal of the City of Miami Beach.

Figure 20. (www.artbaselmiamibeach.com)

The containers were lined with white wooden walls that turned into white cubes. The lighting was provided by daylight and by roof lighting. At night, the containers can be locked to protect from burglary. Electrical connections, an emergency light and a fire extinguisher were also part of the standard equipment, as well as a railing for the small ramp by which visitors access the containers. Every container had a plastic front with a door. The outside of the plastic can be inscribed with the gallery name. This is also seen in all shipping containers around the world where the signage Maersk and Sealand is as big as the units. As a further measure of protection from the climate, a

silver-colored plastic sheet was put up over each container, which also gave the container village a unified appeal. This exposition gave me the idea of creating a moveable performance with the restrictions and use of a shipping container as a site.

Why a Theater?

The question still remains… why a theatre? Today there is no obvious relationship between a performance space and architecture. It seems like any room can be fitted with a stage, projector and a screen. Peter Brook wrote in *The Empty Space*, "theater is an art of the lucid, it is written on sand." The space theater creates should be determined by both the performance and architecture. To find the true heartfelt significance of theater and its architecture I sought advice form Natalia Roman a senior theater major specializing in set design on the aspects of theater as a space and as an institution. She believes that theater is not only a distraction, but also a necessity. A way in which a society can play out its myths relatively free from the restrictions of the real world. It can express its most fundamental dramas, fantasies, and dreams without risk. Architecture in essence should do the same.

If one over examines the reason for theater, it looses its strengths and purpose. "Theater is always emergence, perpetual revolution… the day becomes static, and something begins to die…life evolves, theater is relativity" (Carlson, 1989). As stated before, theater does not need to take place within an architectural setting, or more specifically in a building. In the architectural history class, students learned that Greek theater consisted in the use of natural sites, hillsides, squares and other open areas. Medieval theater was a temporary open-air set up; operas were performed in the gardens

of Versailles, and today many performances take place elsewhere than in conventional installations. We see them on subway trains, public gathering areas and now even through virtual space.

This proves that even with the confinements of architecture, theater transcends the concrete and steel space provided by the designer. The experience is larger than any building. It seems that a theatrical experience only truly comes alive when it is taken beyond the walls and into the audience's imagination. In other words, the architectural framework may add or take away from a dramatic emotion but it is not the source of this emotion.

The history of theater has a tendency to break out of and question the place built for it. " To create an event, you don't start out with a shell, you start out with an impulse, with the source" (Brenton, 1989). Here the theater is referred to as an urban monument, a space for social gathering the need for a structure as a space to gather became more important than the idea of theater. Hence, architecture became complex in program and drove apart the essence of what theater is.

To create an effective performance area one needs a proper understanding of space in conjunction with the written works. According to Breton in his book *Theaters* plays written by Shakespeare, Moliere, Ibsen and Sophocles require knowledge of a physical space and each had in mind as he was creating his dramas a collection of known theaters in which the works were to be performed. That is to say, the works were to be performed in a designated theater and most likely to a designated audience.

Brenton believes that the theater is no longer approached as a physical enactment of a written work. This is seen with the development of new entertainment media such as

the already mentioned video performances. With the use of technology we now are likely to look at a theater experience in a more global way today. People went to the theater to be seen rather than see the performance. Architecture became more important than the written work. With public performance, the focus would revert back to theater rather than a structure. Therefore, the theater should be of and for the street. The view should be as much a part of the performance as the setting, story and with kinetic architecture even the structure.

This change in focus requires a change in the way we look at places. The way the audience interprets the performance is now not limited only by what happens on stage but by the entire experience. Audience arrangements, public spaces, physical appearance, and location within a city are new important elements by which an audience enjoys a show.

The ideal is to carry this experience through different sites and audiences and challenges the elements of audience arrangements, public space, physical appearance and most important location this goes against the theory expressed by Brenton on the works of Shakespeare and Ibsen. Like theater, portable architecture is an area of design that intrigues the viewer. It is a type of performance created by moving parts of architecture that is mostly seen as static. The range of purposes for which portable structures are being used is wide and in most cases still prototypical, however many more are being commissioned by clients and organizations that are setting aside a more conservative approach in order to find a solution to their specific problem. Rather than a temporary solution, portable architecture is reentering the architectural mainstream. Portable architecture can be seen as a mirror of what is happening in the construction industry as theater can be seen as is a mirror of society.

Cargo Container

As mentioned before the true portable structure ideally can take place in any location on any site. This in fact is a challenging issue addressed in the design of a project. How can one design a project for a site that is meant to constantly be moved? The solution is to have the option of many sites. Portable architecture must be flexible, imaginative, and be able to adjust to most conditions. Logically one must seek a site familiar and easily moved around the world.

Malcom McLean is credited with inventing the cargo container in the 1930s. According to the article Tribute to Maclom McLean Founding Father of the Freight Container by Michael Bohlman, McLean while sitting at a dock in New Jersey waiting all day for cargo he had carried there in his truck to be reloaded onto a ship he figured out a better way to pack goods and transport by sea. His idea was to secure them in large steel boxes that could be easily loaded onto ships. He later founded the company SeaLand which merged with Maersk Line in 1999. Today it is hard to drive down any highway, port, and airport without seeing a cargo container.

Shipping containers are being left in harbors because it is cheaper for a company to leave empty containers rather than to ship them back. If every object had its day then the cargo container can develop into the portable wagon of the 21st century. There is self-effacement in that not everything needs to be built from scratch. There is a thrifty and environmental turn to the reusing of a cargo container. They are attractive objects otherwise over seen with enigmatic and practical qualities. They are both romantic and

mysterious. Weathered objects that have traveled all over the world carrying all sorts of goods.

An object seen and moved throughout the world is a cargo container. Other architects such as Lotek and the designers of Art Basel Miami have explored the limitless possibilities of cargo containers as means of cultural expression. However, with these limitless possibilities there are strict dimensions to a cargo container in which one cannot escape. There are many manufactures and transporters of cargo shipping containers. The largest and most popular seen is Sealand and Maeserk. They make a variety of shipping containers and all sorts of sizes depending on the items being transported and its use.

Maersk Sealand's dry containers come in several sizes and designs:
20' with a payload up to 28.3 metric tons
40' (8'6" and 9'6" high cube) with a payload up to 30.4 metric tons
45' (9'6" high cube) with a total capacity of 86 cubic meters.

The 45' high is the most common container. It is sometimes called the "40 high." Maersk constructs its containers from 14 gauge steel and with solid steel doors, or roll up doors (www.maersksealand.com). Other containers are made of minimal 6-8 gauge steel approximate 1 inch thick. They also customize a container for whatever modifications you need.

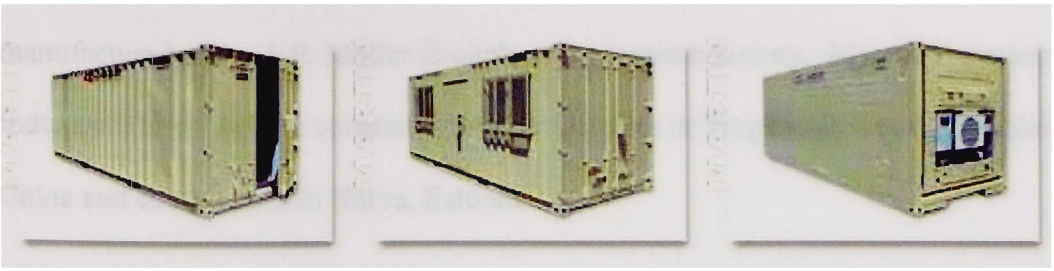


Figure 22. (found in Maerks Sealand website http://www.maersksealand.com/)

Dry / Steel		Door openings (ft)		Internal dimensions (ft)			Weight (lb)			Volume (ft^3)	
Type	Size	Width	Height	Length	Width	Height to load line	Max. Gross	Tare	Max. Payload		Capacity to load line
20" std	20' x 8' x 8' 6"	7'8 1/16"	7'5 1/2"	19'4 1/16"	7'8 1/2"	7'9 7/8"	59,523	4,739	54,783		1,179
40" std	40' x 8' x 8' 6"	7'8 1/16"	7'5 1/2"	39'5 13/16"	7'8 1/2"	7'8 1/2"	71,648	8,156	63,491		2,390
40" high	40' x 8' x 9' 6"	7'8 1/16"	8'5 7/16"	39'5 13/16"	7'8 1/2"	8'10 3/16"	74,954	8,377	66,577		2,714
45" high	45' x 8' x 9' 6"	7'8 1/16"	8'5 3/4"	44'5 11/16"	7'8 9/16"	8'10 3/16"	71,648	10,317	61,330		3,071

Dry / Aluminum		Door openings (ft)		Internal dimensions (ft)			Weight (lb)			Volume (ft^3)
Type	Size	Width	Height	Length	Width	Height to load line	Max. Gross	Tare	Max. Payload	Capacity to load line
40" wide door	40' x 8' x 8' 6"	7'8 3/16"	7'5 11/16"	39'6 9/16"	7'8 3/8"	7'9 5/8"	71,648	6,150	65,497	2,393
40" high	40' x 8' x 9' 6"	7'8 3/8"	8'5 11/16"	39'6 9/16"	7'8 3/8"	8'9 5/8"	71,648	6,393	65,254	2,714
45" high	45' x 8' x 9' 6"	7'8 1/16"	8'5 11/16"	44'6 11/16"	7'8 3/8"	8'10 1/8"	71,648	8,597	63,050	3,071

Table1. (found in Maerks Sealand website http://www.maersksealand.com/)

Maersk Sealand's containers claim to be manufactured with the most advanced specifications and on the basis of extensive research. The vast majority of the units are

manufactured at the A.P. Moller Group's own container factory, Maersk Container Industry. They fabricate containers in their factories in Tinglev, Denmark, Qingdao, China and components in Narva, Estonia.

The unique design of their containers allow…

- low tare weight to maximize payload
- spacious internal volume to provide maximum cargo space
- minimal heat leakage to maintain optimal product temperature
- minimal air leakage
- hanger beams which allow the transport of garments
- an extra high payload and door width version
- bull rings and lashing bars to give cargo added security

(http://www.maersksealand.com/)

Containers are equipped with bottom air ventilation. This means that the cold air is supplied from the bottom through the T-bar floor. A big concern with mobile units is the power supply. Maersk gave certain specifications for its power needs. The power supply used must be either 380 volts/50 Hz or 440 volts/60 Hz. The power cables used are fitted with ISO standard CEE-17 plugs. These specifications can be found in Maersks offices in Miami .

MaerskInc.

790 NW 107 Ave.

Suite 400

Miami, Fl 33172

http://www.maersksealand.com/

Please note there may be slight size variations for some containers, as well as limitations regarding acceptance in certain locations and suspected use of storage for chemical weapons in the Middle East.

It is natural to wonder what or better yet how much fits into a shipping container. Standard cargo containers include every commodity imaginable retail such as clothing and electronics, automobiles, agricultural products and industrial goods. They are equipped with special features such as hangar beams which allow the transport of garments on hangars without further packing, an extra high payload and door-width, bull rings and lashing bars to give your cargo added security, and ventilated containers for agricultural goods.

The 40' high container is 39'-4" long, 7'-6" tall, and 7'-8" wide inside. The container holds 2261 cubic feet of area. That is about 84 cubic yards. In the business, ships are divided into 20' container units known as TEU (twenty foot equivalent units). The 40'high containers are usually stowed on deck.

So, want to send some shoes to around the world? One 40' high container can hold 12,384 shoeboxes. Importing Marlboro cigarettes? One 40' high container can hold 55,511 cartons of filtered cigarettes. Other interesting facts can be found on the website www.cockeyed.com.

While container architecture might be another passing trend, it seems to be making at least some headway. It is not a domestic reality. One must consider the person

moving through the container and provide comfort, program, space and an artistic quality to the unit.

Container and the Contained

One must find the poetic connection between the coldness of a metal object and humans. There must be a connection between the container and the spirit being contained.

It is in the planting of an idea upon the still earth that allows the light to most perfectly shine through
It is in this stillness that science becomes speech, and is integrated back to the formless ripples in a hole.
It is the space of the first moment, the first energy that invites the visitor.
It is implied from nothing, the purest form of a divinity, sublime and ridiculous.
It is combining the elements of the container and of the contained; the light and the dark, that the fullest measure of potential and kinetic meet and become one.

Poem by researcher

The relationship between the container and the contained is one of the most important connection in our society in a creative moment. According to Dale Keiger in *A Sleuth in the Garden of Forking Paths*, the word *qlippah* is an extension of this thought. In http://www.jhu.edu/~jhumag/495web/sleuth.html *qlippah* is also a covering or a container, and as each half acts as a shell to the other. According to Keiger, what should remain united becomes divided, and the boundary between one thing and another can be regarded as waste. The *Zohar,* a Jewish cabalistic book, attributes the primary cause of evil to the act of separation. One can attribute the act of separation as the dividing of a container and the contained a separation of the whole (Keiger, 1997).

One could see that the normal world is clearly characterized by divisions between one thing and another, between black and white, right and wrong. In this technical sense one could say that we are part of a world of empty shells. These shells are, by themselves separated from the original, an undivided whole. They can be seen as the residue of previous unit much like ghosts: dead skin, an empty car, leaves on the floor, seashells on the beach, or in architecture, ruins. They are dregs remaining in the bottom of a cup of coffee.

In our biology, it is our skeleton that is the archetypal shell. By itself it is a warning or symbol of death, but introduce it with a spark it becomes a living organism. The empty shell is seen as one of the most common elements in horror themes, a skull and an empty grave.

Figure 23. (from www.airdisasters.com)

There are two basic concepts, the container and the contained. A comparable method is seen by Dr. Joseph H. Berke in *The Jewish Mystical Tradition and Psychology.* His study is based on Freud's belief in the removal of disturbance layers, to expose hidden thoughts set to an understanding. This transformation from sick to sane took place when the concealed in thought and experience became revealed, when the container is

opened, when the unconscious became conscious. Here both the shell and mind were reunited.

This leads to the question, how does one re-establish the container and the contained? Religion would say that we can reunite the two parts by establishing a close relationship with God. In the same idea Berke says that we can become a complete container of our own impulses and life forces by establishing close relationships with those who share love and care.

If so and combining both theories to make one whole, it is life's experiences and emotions that are the unifying force between the container and the contained. This is the fine line between relationships, chaos and order, theater and reality. We seek a strong container containing functions that serve as a means for order, which is connected with peace and wholeness. A river to flow needs strong banks.

Wrote the mast Gyalwa Genden Gyatso (the second Dalai Lama):

" This then is an easy understood explanation
of the glorious practices of higher being
that plant the imprint of the two buddhakayas.
I urge you to practice it.
The purest essence of the great Mahayana."

According to His Holiness the Dalai Lama in his text on universal responsibility and the environment, Buddhists believe that the Dharmakaya and

Rupakaya are to be obtained simultaneously. One cannot be without the other. They have the relationship of the container and the contained. In other words, Dharmakaya is non-physical like the spirit, while the Rupakaya is of the body or shell. It is for this reason that Buddhism emphasis is placed on the generation of wisdom and merit, without neglecting one or the other. Therefore, the ultimate purpose is to use both the container and the contained to serve and merit the happiness of all beings.

What ties these religious, poetic thoughts to design and also what is the relation between philosophy and design, container and contained? Answers to these questions can be explored in Umberto Eco, *Kant e l'Ornitorinco* (Kant and the platypus), Bompiani, 199 .

" The language of poets seems to place itself in a free zone...They seem to be those that not only celebrate necessity, but often they allow themselves (and us) to deny the resistance because for them turtles can fly, and even can escape from death" (Eco, 1990).

Video Space

Our view of space grows ever more complex as art, video, virtual space and architecture become increasingly intertwined. It should challenge spaces turning the geometry of a container to cathedral-like performance space. This generates a new vocabulary around terms such as installation, video, imagery, flexibility, sound, and virtual art. In a space, this could include hanging sculptures, like cutout remnants,

proving an unreal lightness to the mass of the structure. Images found in an environment and reproduced in a light material can be attached to the container walls, reinventing their original purpose and using them as structural elements. Framed views from the structure can visually unite sections of the container to the landscape, creating an overall collage effect that challenges the idea of windows, and the open and closed.

One could conceive a modular construction of ratios and standard space between the visitor and borders with the goal of an interaction. By changing measurements and dimensions and exposing viewers to their inner feelings, virtual dwellings can create another interactive environment that invites viewers inside where they can witness and listen to visual and audiotapes. The structure is kept up by a series of screens and the inner structure of the container.

Floor-to-ceiling translucent partitions filled with lights and images can further divide the space while a low row of wood can serve as rhythmic counterweights, or datum and mechanical systems. While exploring material concerns such as volume and texture, the piece must also address the unoccupied space and the relationships between viewers and their surroundings whether in an empty space or cityscape.

This is seen in the exhibit Cityscapes in Darmstadt, Germany by Torsten Schmiedeknecht. Cityscape was in response to a competition and won the first prize because it addressed two issues: the existing nature of space that was changed by advertising and signage in the city, and the way the city accepted the visual public space by images being displayed. This project was successful because the public was willing to accept and inhabit not only the messages and images being displayed but also the

occupation of space. This does not mean that every public is willing or open to such a change.

It is a handmade wooden box that holds the sawdust remains of an identical box. This modest piece can be seen as a metaphor for the whole experience, in which the container and the contained become inseparable and rely on each other for meaning, impact and identity by means of the virtual space and experience of the visitor.

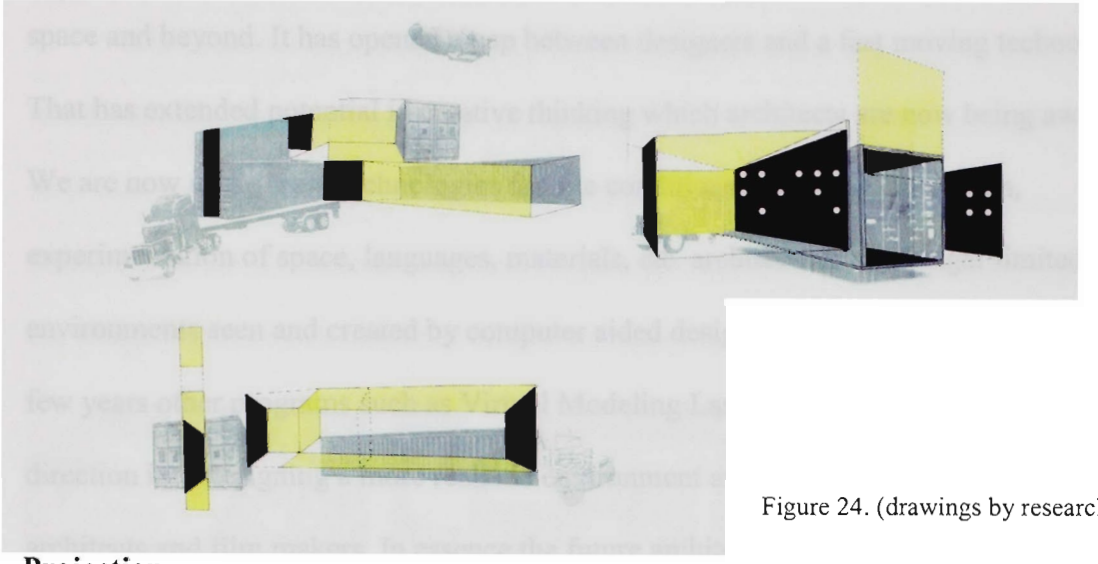


Figure 24. (drawings by researcher)

Projection

"In the future not a single grounded structure will remain on Earth. Nothing will be fastened of tied down. This is the true nature of the universe. But while each unit of matter is a singular part of nature, it will soon merge with the whole. This is what Suprematism means to me, the dawn of an era in which the nucleus will move as a single force of atomized energy and will expand within a new fourth dimension of motion. We have pulled up our consciousness by its roots from Earth. It is free now to revolve in the infinity of space" Kazimir Malevich (Christopher Romero, Vortex 2000).

This fourth dimension and distortion of time and space is seen and represented in the making of movies. There is something intriguing about watching a story unfold on the big screen. It is something even the best written story cannot deliver. With today's cutting-edge technology such as digital projection, silver-screen viewing experiences are taken to new heights. They can virtually turn a two dimensional element into a three dimensional experience. Our world has been expanded to new possibilities to occupy new space and beyond. It has opened a gap between designers and a fast moving technology. That has extended potential in creative thinking which architects are now being aware of. We are now using these technologies for site conditions, modeling, animation, experimentation of space, languages, materials, etc. architects are no longer limited to environments seen and created by computer aided design systems (CAD). Over the last few years other programs such as Virtual Modeling Language (VRML) offer new direction into designing a more realistic environment and closes the link between architects and film makers. In essence the future architect has to be not only a designer of space but also a film maker. Technologies such as (VRML) and others under development have brought these two fields closer and in some cases interrelated them creating a new specialized filed.

An example of this is seen with the partnership between Disney and Pixar, a manufacturing production company who took full advantage of these new mediums with their blockbuster Toy Story 2. This popular sequel was created digitally using computer animation tools. In order for most theaters to show the feature, it had to be transferred to film. However, at the AMC 1000 in San Francisco, movie-goers had the pleasure of watching Toy Story 2 as shown on a digital projector.

Bill Kinder, Pixar's senior manager of editorial and post production described the technology as "consisting of two parts, one is a hard disk called QuBit, that stores all the images, or frames, from the film as digital files". (www.techtv.com) Kinder added, "The other component, of course, is the projector which is the light source and a really fascinating technology that's extremely complicated, but if you think of it as a bunch of mirrors, and hopefully no smoke, that's what the digital projector is."

The projector used was made by Texas Instruments and is actually a prototype. Inside, the projector contains three, one-inch-wide chips, for red, green and blue. Each chip contains over one million mirrors that flicker up to fifty thousand times a second to produce a particular shade of color and brightness. Each mirror corresponds to a pixel, so the image you see on the screen is created by nearly four million mirrors.

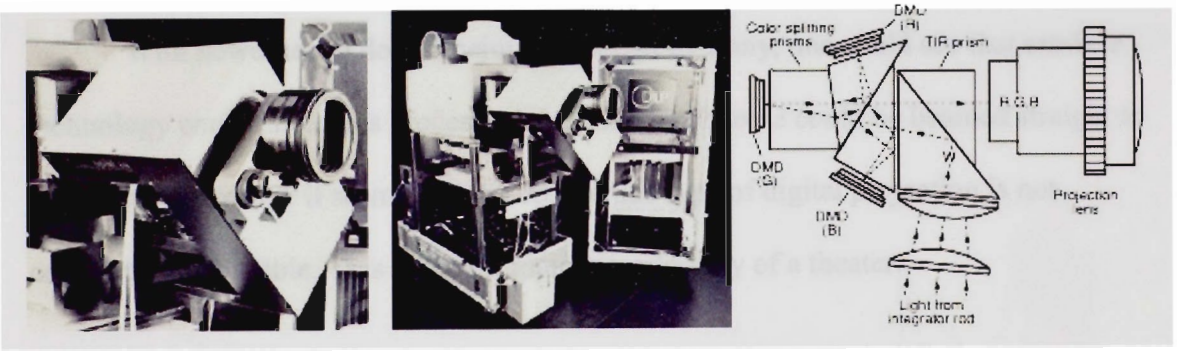


Figure26. (from Texas Instruments site www.spie.org/web/oer/march/mar99/micromirrors.html)

To examine the differences between film and digital, a study by Pixar observed that "digital of course was much brighter and sharper looking, more colorful, more accurate; there was no grain, and there was no projector movement." Another factor contributing to the bright quality of digital is the lack of a fly wheel shutter. With film, but not with digital projection, the light is constantly hitting the screen so there is no

flickering effect a quality I think is unique to viewing film and adds a sense of nostalgic romance to the experience. Though one can see how primitive the quality is it has a certain attraction to it.

According to Kinder, one of digital projection's weaknesses is that blacks don't quite match black in film. Film can actually do a better job of reproducing a completely dark screen. Even so, digital format may offer many advantages over film. The physical size is more manageable. It can be stored on optical disks like DVDs or CDs. You can imagine fitting them into a Fed Ex pouch or carrying them around more easily than moving this film around in boxes.

Rear Projection

With newer technologies being developed by Sony, one could see that satellite technology could make this process even easier. The movie could be beamed straight to the theater. However it seems like the cost of this type of digital projection is not completely affordable. This is the ultimate in portability of a theater.

Rear projection is another technique used today to display virtual images. Rear projection screens are furnished by Da-Lite Screen Company, Inc., Polacoat Division, Blue Ash, Ohio. A screen can be a single element with two active lens surfaces. The back surface can be a Fresnel lens with a pitch of .5 mm and the front surface to be a lenticulation array with a pitch of 0.8 mm. The horizontal 1/2 gain angle to be 21°-3° and the vertical 1/2 gain angle to be 11°-2°. On axis gain shall be 3.0-0.5 and part thickness shall be >1/4" (http://www.da-lite.com/products/specs).

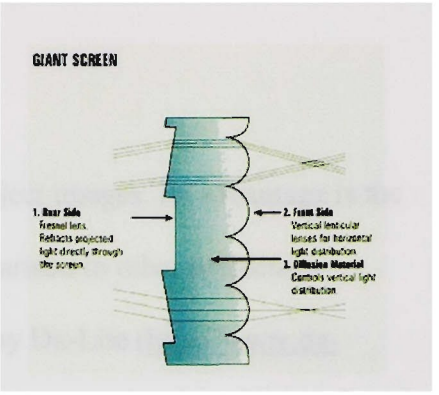


Figure 27. (picture From www.da-lite.com)

Screens

For interior small room projections Harkness Hall Matt Plus screens are considered by leading cinemas to be the leading projection surface. The flexible material is manufactured to a unique Harkness Hall formulation and specification providing: wide viewing angles, high contrast, bright pictures and excellent color temperature. The surface is foldable for ease of transportation, cinema access and installation. According to Harkness Hall Matt it is noted for its 'invisible' seams under normal projection conditions. This is useful if one were to create an unconventional size, shape, or dimension of a screening space.

Figure 28. (from www.da-lite.com)

Mirrors

Mirror systems can also be used as a means to project images. Its advantage is the space needed to project larger images is minimal in comparison to other projectors. Suggested mirror projector is the Millennium developed by Da-Lite (http://www.da-lite.com/products/). They believe the best system for a moveable object is a system held by matte-black, powder-coated, 14-gauge steel. The mirror supports consist of a truss frame design. The entire system is self-aligning during assembly to ensure proper alignment of the projector to the mirrors. The top mount projector base (Figure 28) provides tilt adjustment and has a top plate for the projector placement. Although Da-Lite designs for an exact specifications and requirements, the complete system is adjustable for fine tuning. Features provided by Da-Lite (http://www.da-lite.com/products/)

- Available as a one or two mirror system.
- Easy to assemble
- Fully adjustable
- Self aligning
- Frame constructed of heavy 1" x 2" rectangular tubing
- Adjustable projector base
- Durable black powder coated finish

Specifications provided by Da-Lite include a mirror surface on glass. The mirror is coated with a thin layer of quartz to increase durability of the aluminum finish. This mirror provides greater durability and is less sensitive to climate changes. It reflects up to 94 % for mirrors that at are 60-80 inches and decreases with the size to projection ratio. A flatness to thickness ratio maximum changes 2 fringes per inch. However Da-Lite can create sizes and specifications upon request. The standard glass mirror sizes are: (http://www.da-lite.com/products/)

- 18" x 30"
- 24" x 48"
- 36" x 48"
- 36" x 60"
- 48" x 60"
- 48" x 72"
- 48" x 84"
- 56" x 72"
- 56" x 84"

A truss system can be used as a framework to attach and support the screens to the walls of the containers. The best way to do this is though clips as seen in the Kunthaus Museum by Peter Zumthor. This system depends on clips which would be attached to the existing vertically and horizontal framework of the container walls. On these clips, the panes of glass screens would rest on angle irons and can be moved and adjusted.

A second source of support could be a fast fold truss system. Fast-Fold is a company that designs and builds trusses as supports for screens. Frames and legs are constructed of sturdy 2-1/2" by 1-1/4" aluminum tubing and feature easy release latches for quick set up and disassembly of the screen. Available with Da-Mat, Cinema Vision, Pearlescent and Dual Vision, all which use Fast-Fold Truss De Luxe surfaces as standards in their screen designs. The size and specification for the truss all depends on the video format size, height and weight, and type of screen used. This is seen in the Da-Lite and Fast Fold web page: (http://www.dalite.com).

Proposal

Is there an architecture that is impossible to construct? We think of an object and form images and find ways in which we can create them. A means for this to happen is found in video architecture. Architects who claim to be designers of video architecture or cyber architecture claim their freedom of designing in a digital space without the constraints of the real world. As cyberspace attempts to replace actual space, the notion of a flying building becomes reality bringing to life the vision set by Sant' Elia and other futurist visionaries. It appears that the meaning of the word architecture is expanding to include the space a camera displays and creates.

It is not possible to change the three dimensions of physical space in pursuit of an object and experience that can never be expressed in reality. This notion is nothing other that the brief appearance of a virtual space by means of images and video graphic effects.

The ghosts found in video are made of an immaterial architecture. They appear not restricted by form, light and other aspects of the real world. It is an architecture that is made up of abstract elements. This is why it is important to distinguish between tangible things and virtual things. Tangible things are things of the real world. They are real within themselves. According to French philosopher Gilles Deleuze in *Cinema: The Time Image*, the process characteristics of virtual things is not realization but rather actualization. So what is the difference between realization of possible things and actualization of virtual things? Possible things come after the concept of the virtual. After one discovers a question the means of creating a solution is "possible things."

This transforms the concept architecture into a question. According to Deleuze, questions are multiple and virtual, and they generate solutions that do not resemble their conditions. If so, then virtual architecture is a question that should be answered.

Portable architecture exposes itself to questions of this type. In its place it represents a new architecture that can capture the three dimensional expression of a society dealing with an electronic virtual culture with similar needs and wants. The virtual realm is not restricted by space without physicality or geography like the proposed theater. However, it will need identifiable places to interact among the infinite reaches of video space. It is these places of social interaction that will hold virtual architecture, the three dimensional element of a social electronic form.

What does this mean for an architecture student? What should the kinetic virtual theater look like? It is a ghost in the closet, an element without a container. How will one tie the elements of material, program and the infinity of virtual space and possibility into an object, a container?

The proposed design is a study in converting a conventional cargo container into a portable theater. From the beginning, it was important to maintain the look and integrity of the cargo container and have the theater open from within and transform itself into a new entity. One had to study the way the container operates and most important by the size, interior and exterior in order to start a defragmentation of the unit. This was taken from a system of stacked boxes that would be seen after pealing away the outer skin of the container.

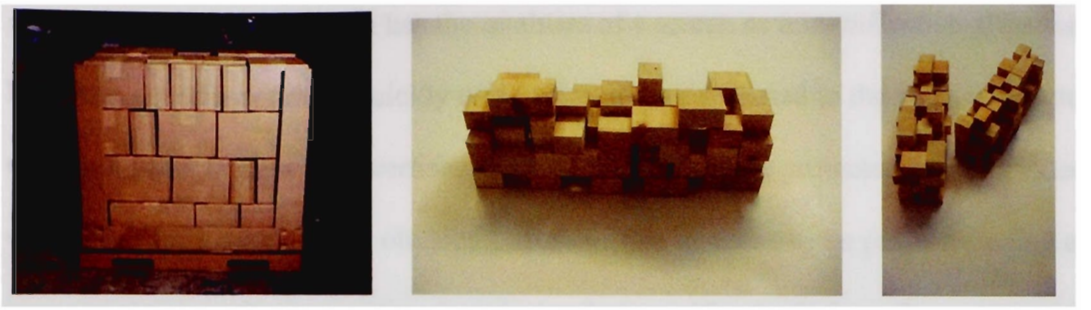


Figure 29 and 30. (picture and models by researcher)

The program of a conventional theater would not fit into the project proposed in space or concept. To reinvent the theater one must define the theater in question and create a program around it. The theater proposed is more of a temporary art installation much like the works of Christo and Jean Claude. This theater is to be an object along the landscape. A virtual physical for video imagery and installations. In essence it is a large movie screen for the public.

Figure 31, (thesis drawings by researcher)

Imagery and signage are very important elements in both theaters and the cargo containers. The majority of containers have Maersk or SeaLand written on them in large letters. This is the same case in theaters. Signs are usually advertising movies playing are in large red or black letters on an illuminated board. The treatment of the façade can be

seen as a separate element. It has the qualities of a screen or non- reflective glass that can be adjusted and assembled quickly using clips and pins faceted to the interior structure. On this screen, images of advertisement for the show can be projected and or a video work itself for a much larger outdoor audience. The images can be projected using either rear projection or the conventional projector that would extrude from the container itself.

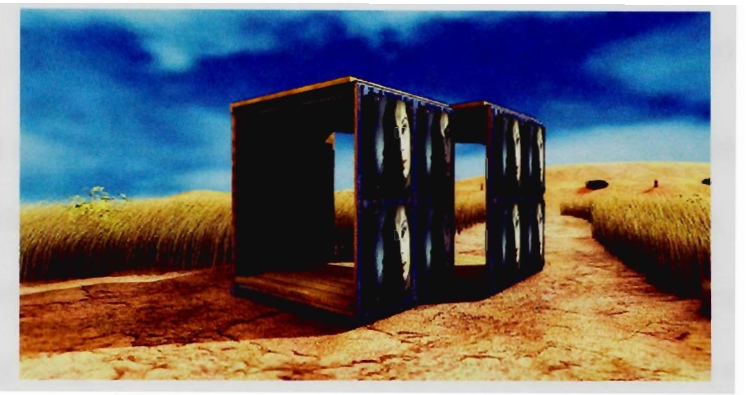


Figure 32. (rendering by researcher)

To simplify the design the container was split into seven parts. This idea came from the portable bathroom unit seen in public areas. Consequently a container can also be split into seven parts marked by the internal vertical structural columns. The division created a modular box measuring 7'-8" tall, 8'-10" wide and 7'-2" long. Within these measurements the container could be customized with many options. Turbines and rollup doors can open and ventilate the unit. Also paneling and partitions could be added to enclose a desired space. Electrical hookups and breaker boxes can be added as a source of power. Sky lights and florescent fixtures as a source of light when the container is closed.

Otherwise the container would be opened to define a much larger space or projection surface.

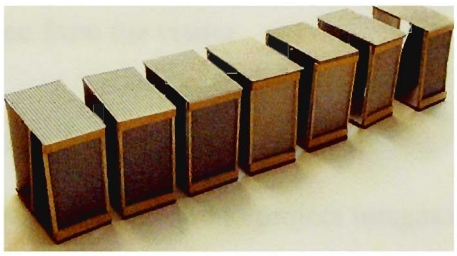


Figure 33. (photograph and model by researcher)

Being a theater, light and insulation are important. The container itself is a rather dark box. When it is closed there is virtually no light penetrating into the inner space. Outside of the general insulation, other elements can be added to further seal a container. Gardner asphalt fiber roofing is a great anti-corrosive element that is already used to seal container roofs. It also reflects sun light and UV rays to reduce heat. This chemical can be sprayed along the outside and inside of the container and serve the same purposes. An expanded metal mesh is also used to enclose areas of the container wall. In conventional use it is installed to cover any openings such as windows. However, its application can be used to create a screen or walking surface.

One could create a modular structure that would boarden the interior of a space and exterior, between light and dark, and the contained and the outside. As it stands, the container has a one inch thick exterior steel skin. Inside the container is lined with interior insulation and structural members. This interior could be replaced by floor-to-ceiling translucent partitions. These partitions could be filled with lights and images. The

interior structure would then serve as datum in which images could be broken up and the visitor could follow. Within this wall, the space between the exterior corrugated metal and the interior screens, electrical, network cables and mechanical systems could be easily ran through hidden during the performance from the visitor.

This system could be adapted to the ceiling. From the cross-bars, screens, sculptures and basically any material in which one would desire to project images onto could be hung. The use of these beams and hangars would allow for flexibility in a display, an area for sound and projection, creating lightness composed to the mass of the container.

Walking surface is created by plywood fastened to the bottom cross bars. These sheets of plywood could be removed and replaced by a thicker translucent material such as Plexiglass. The glass could serve as a projection surface as well as expose the wires and projection system used to create these images. It is much like the IMAX show where the screens hide the massive speakers during the show but the system is seen when the projection is off.

This entire system is a box that allows the possibility of many models of unraveling itself. In this proposal, the box, through the use of hydraulics, would lower one side of the wall and roof creating a larger surface to walk on and openness to the container. While this is happening, a larger more private tube like structure would be unwinding. This structure is seen as a wormhole. It is simply a slinky-like metal frame wrapped with flexible material such as treated canvas. As the structure is being moved, it

would retract itself from the container and work opposite as the container is being collected.

Through this wormhole, the visitor could move along the entire structure from end to end and have images projected on the canvas, a mist that could be injected into the tube or on themselves. This is created to disorient the visitor through imagery, sound and projection. This visitor would be lost among the art.

The container proposed could be a single unit of 7'-8" high, 8'-10" wide and 7'-2" long or it can be a series of these placed together along a landscape. In theory, this wall of images could be carried out as long as there are containers in the world. It could be an infinite gallery of images, news, art, projection, video and sound.

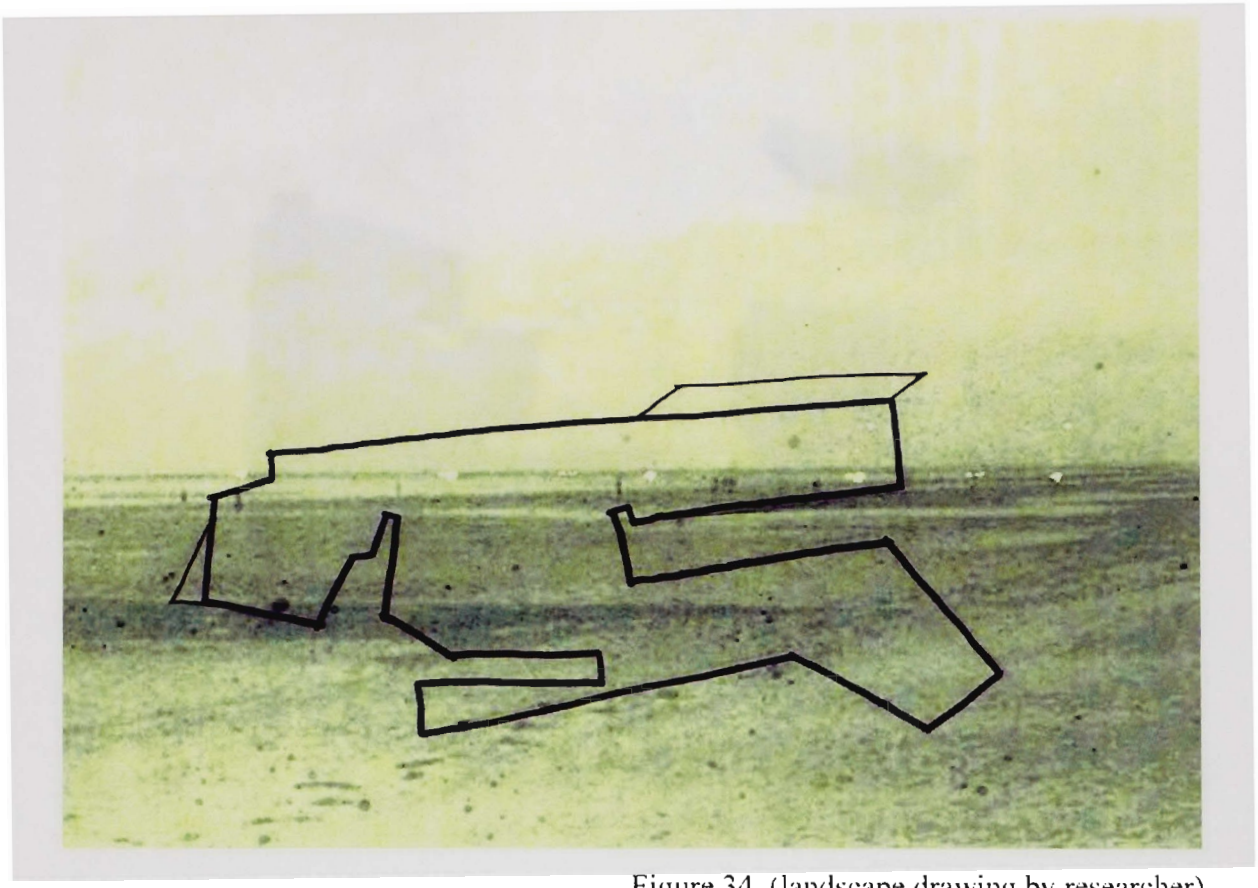


Figure 34. (landscape drawing by researcher)

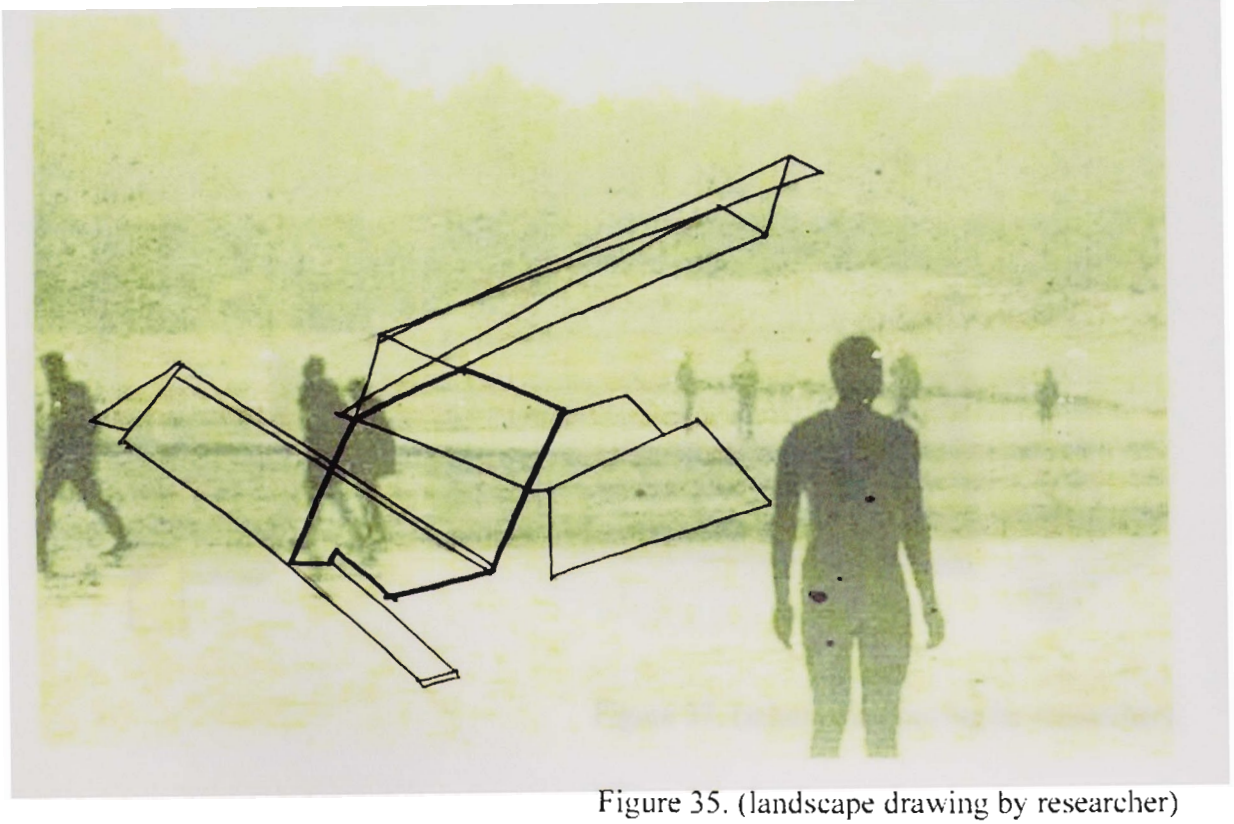


Figure 35. (landscape drawing by researcher)

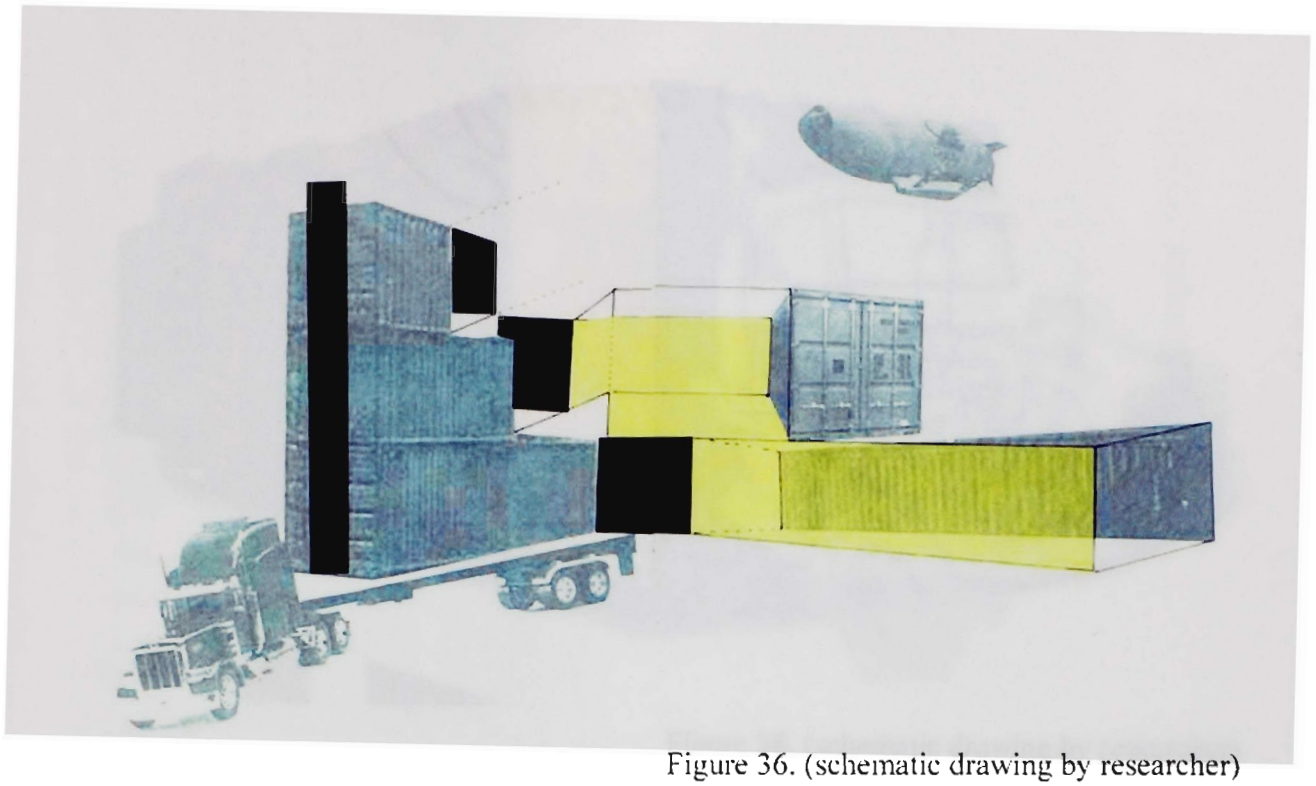


Figure 36. (schematic drawing by researcher)

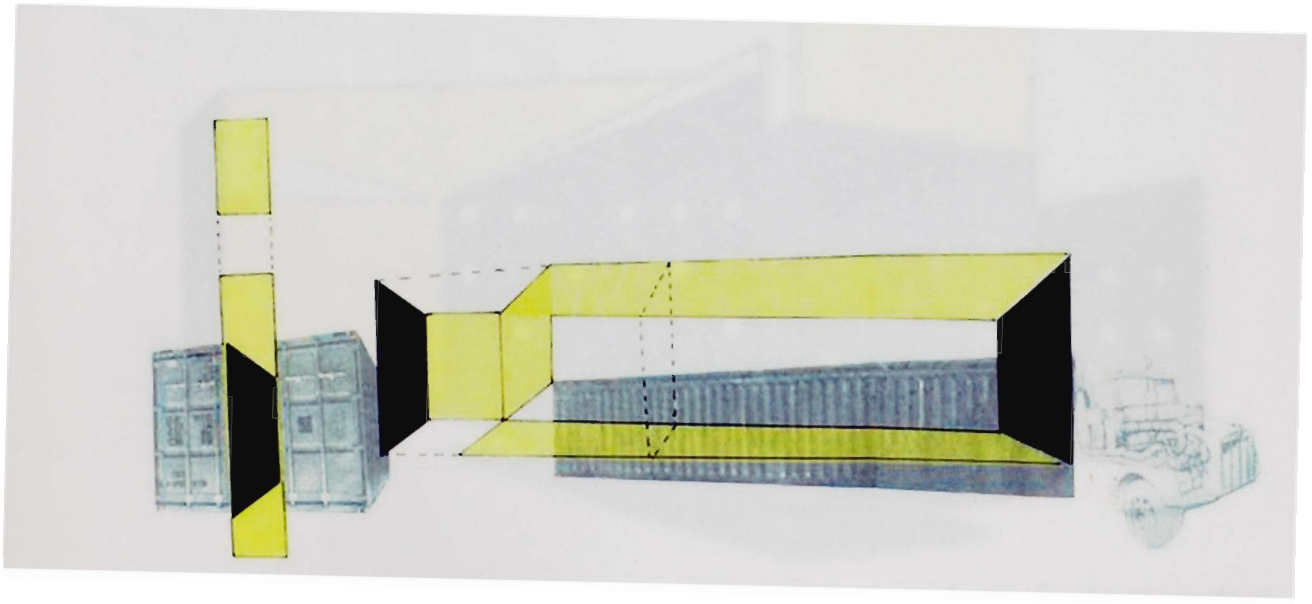


Figure 37. (schematic drawing by researcher)

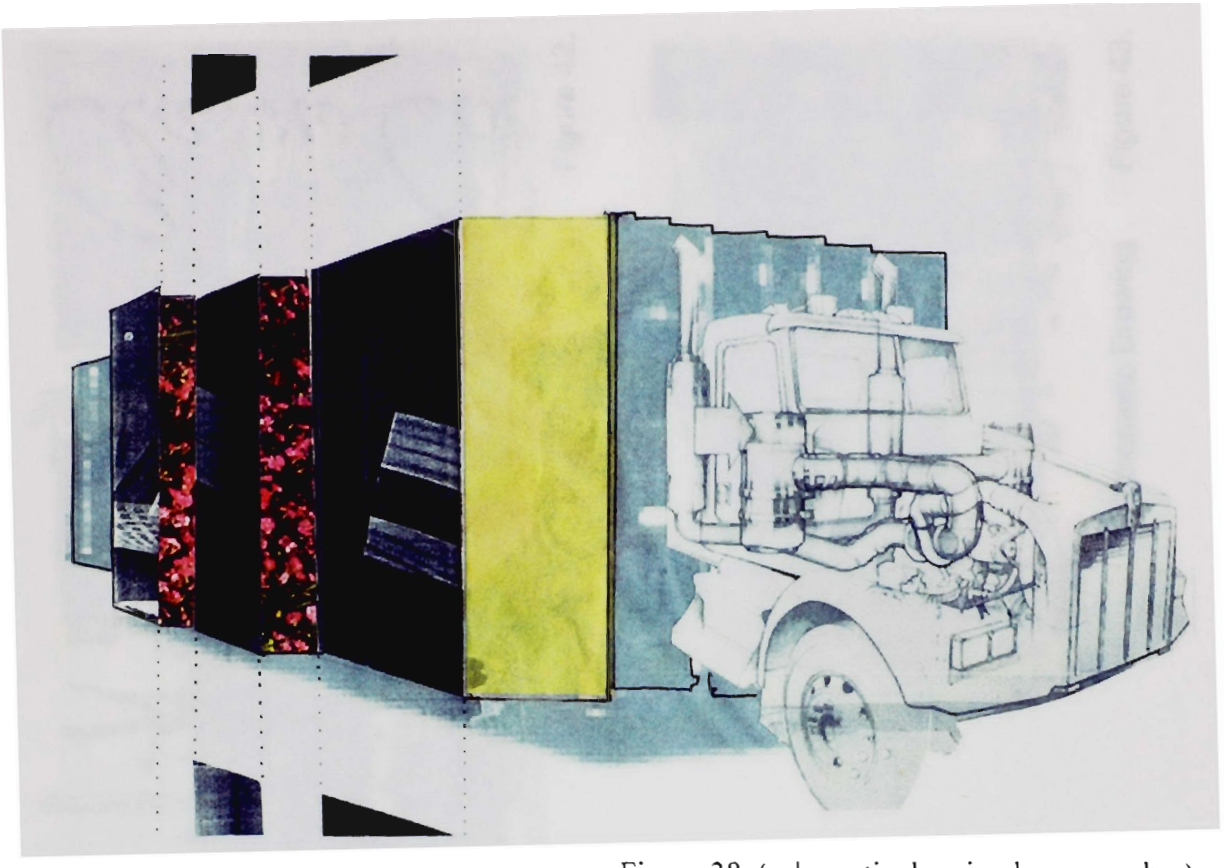


Figure 38. (schematic drawing by researcher)

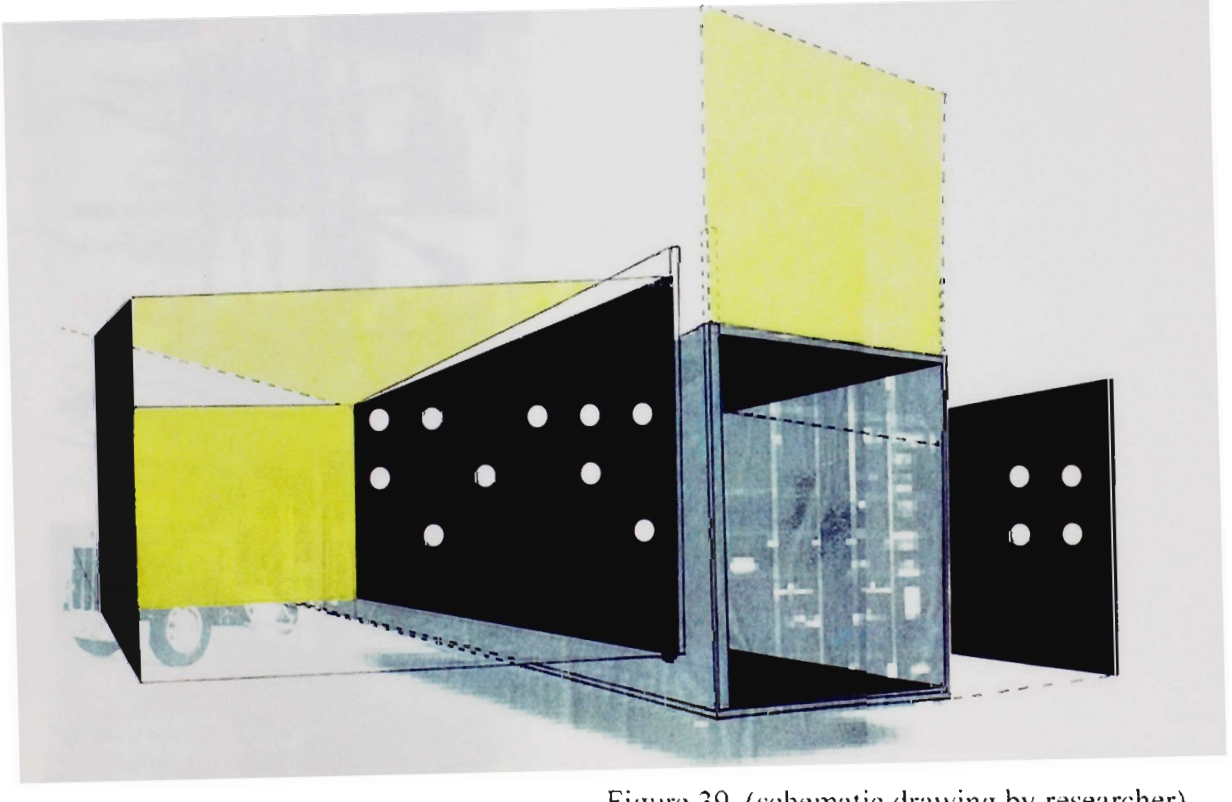
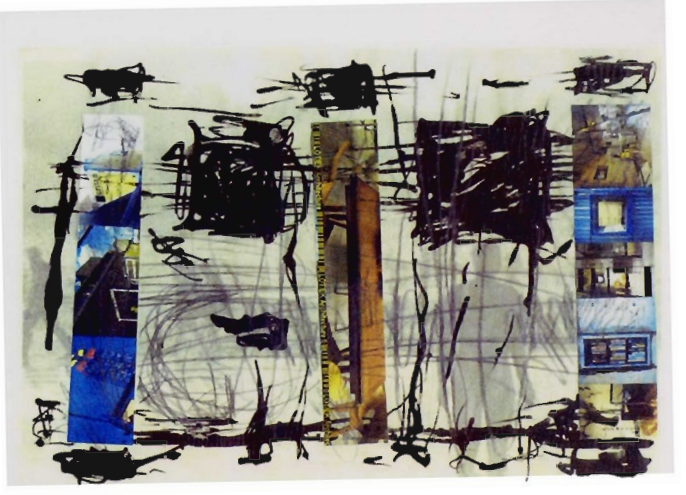


Figure 39. (schematic drawing by researcher)

Figure 42.



Schematic Drawing Figure 43.

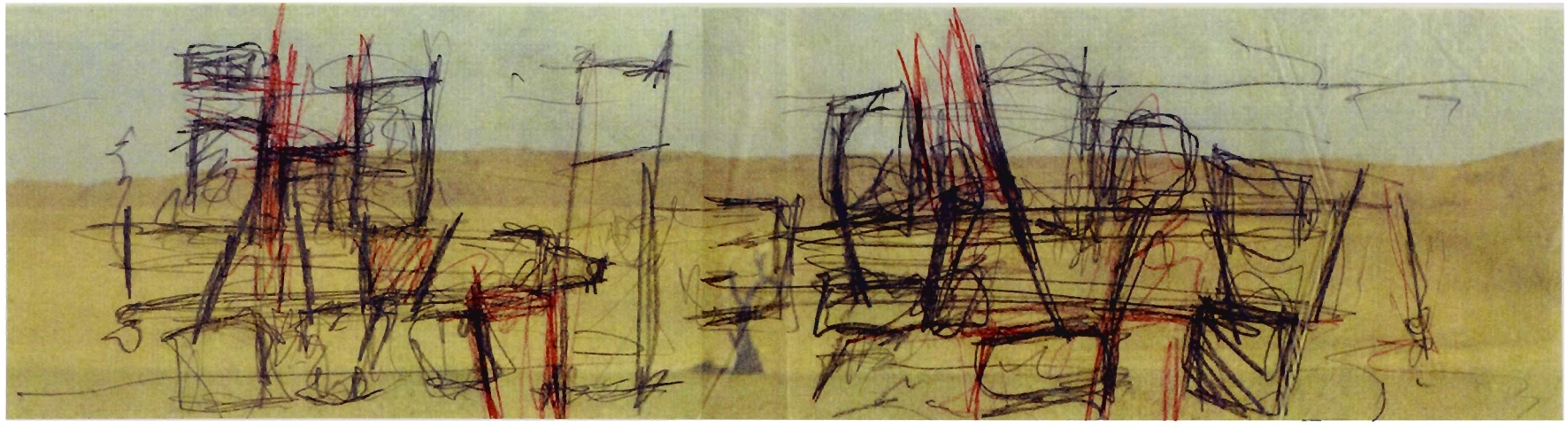
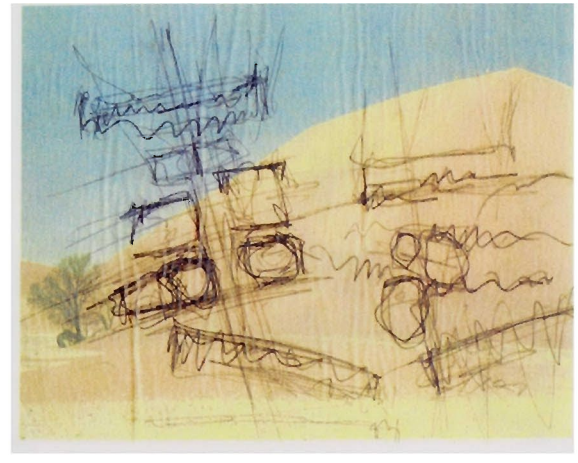


Figure 42B.



Schematic Drawing Figure 43B.

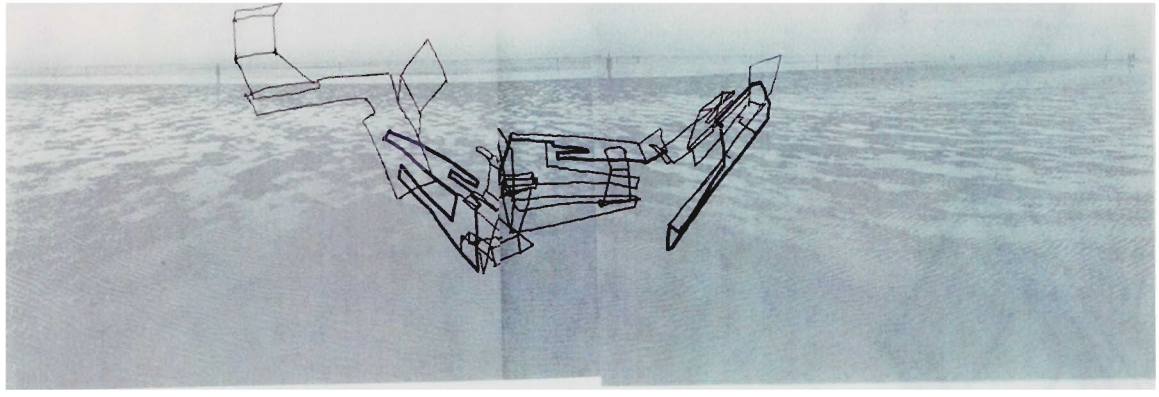


Figure 44

Figure.45.

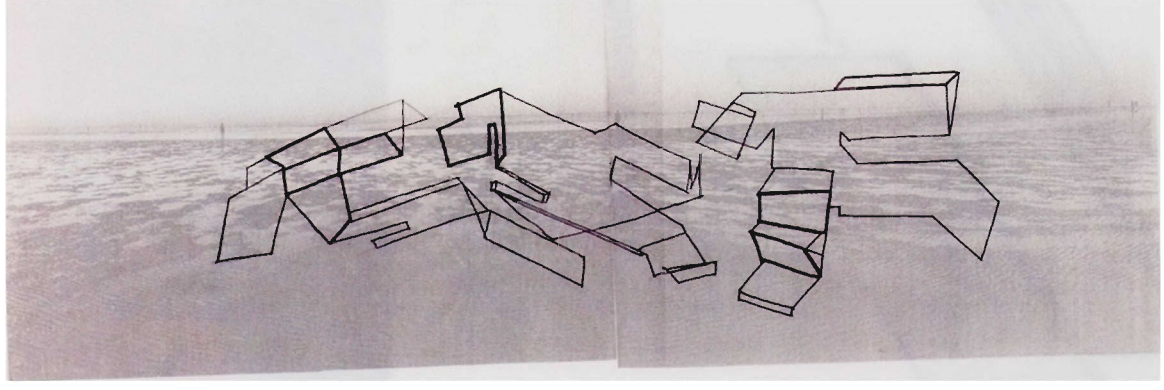
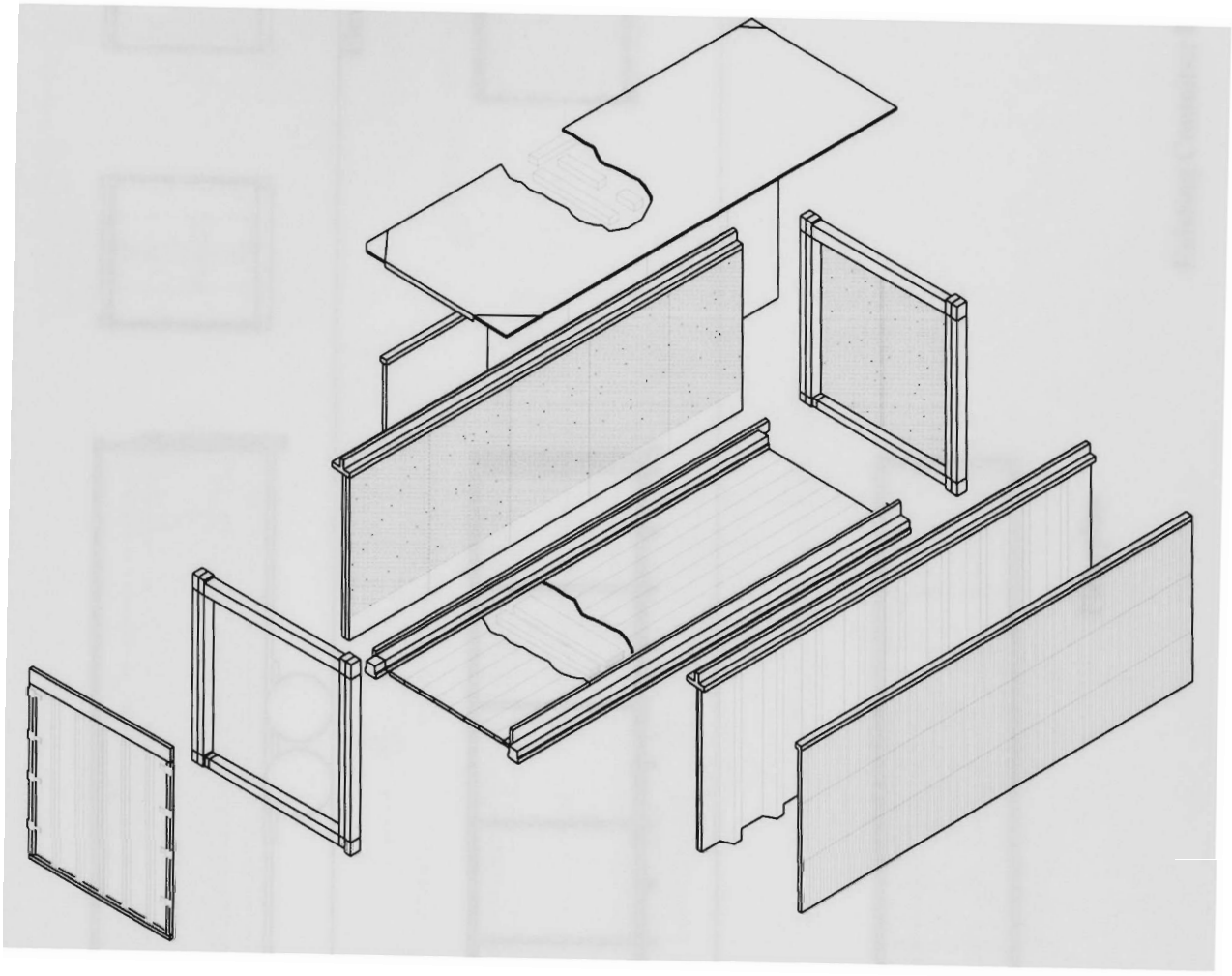


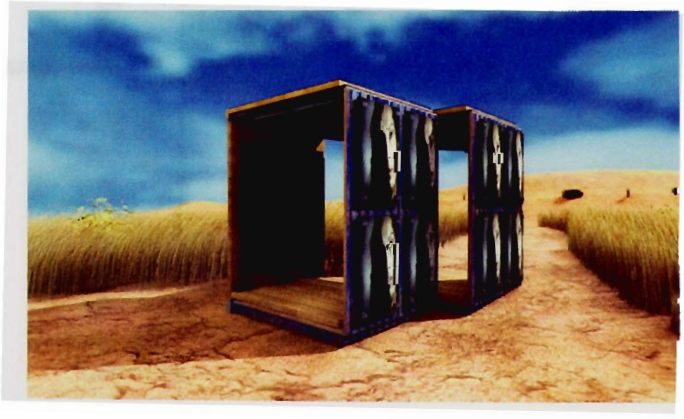
Figure 46

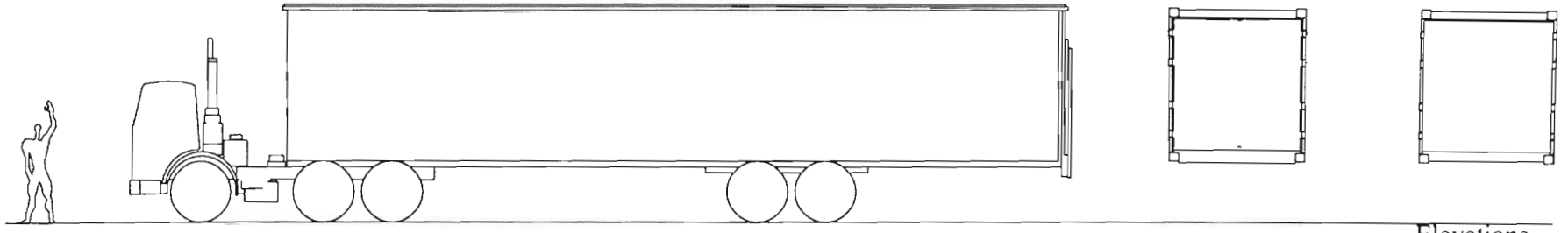
Figure 47..

Schematic Drawing

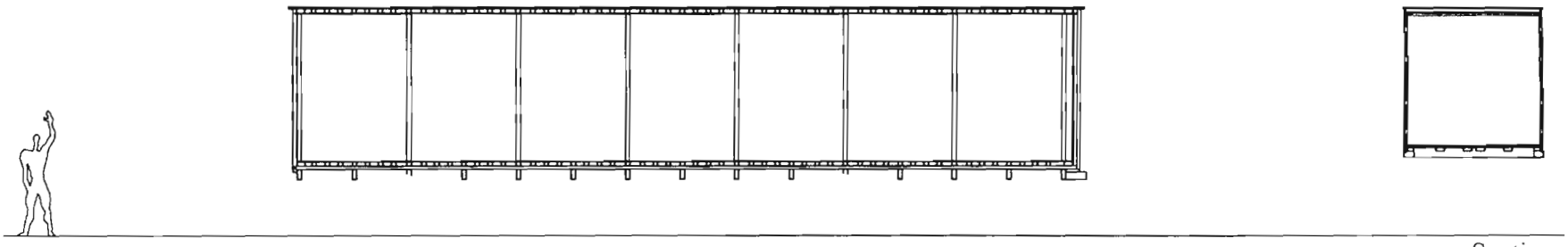


Exploded Axonometric





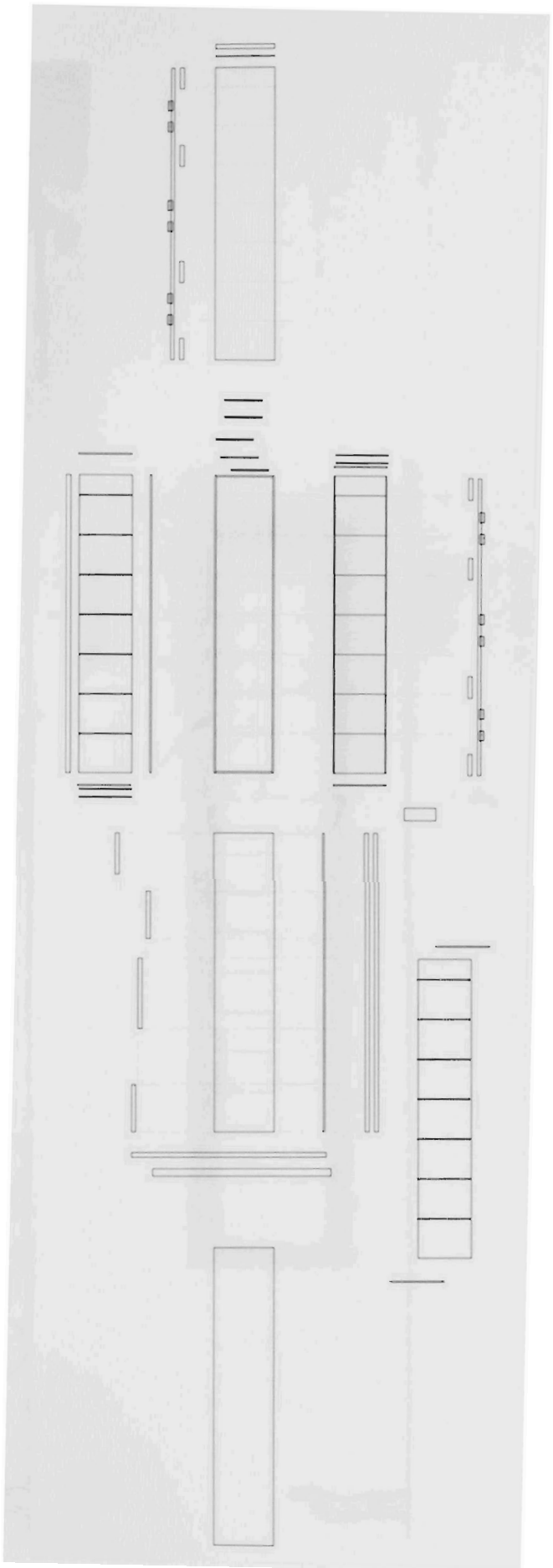
Elevations



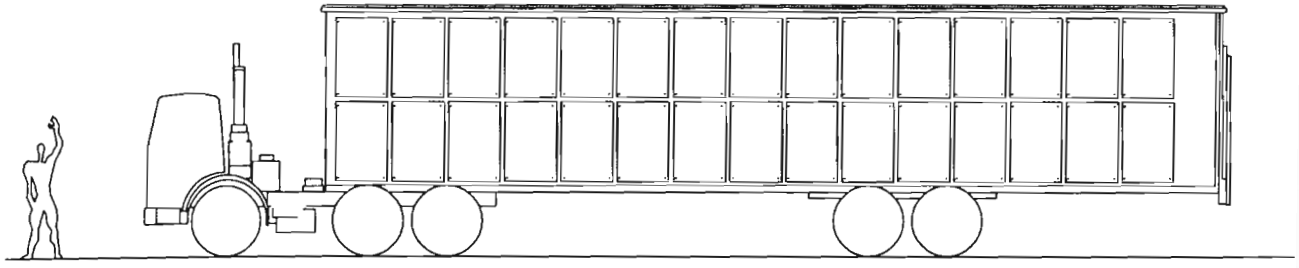
Section

Floorplan

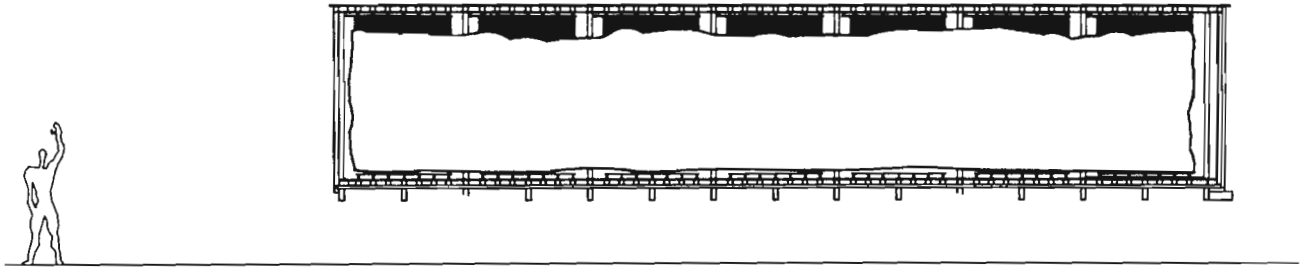
Existing Container Drawings



Existing Defragmentation



Elevations



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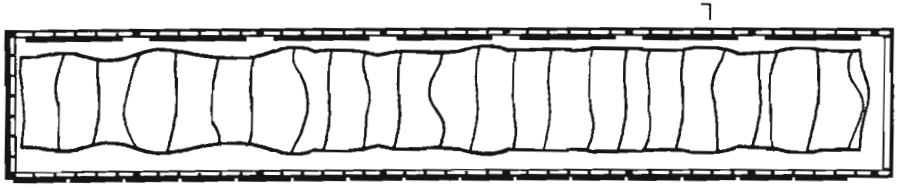
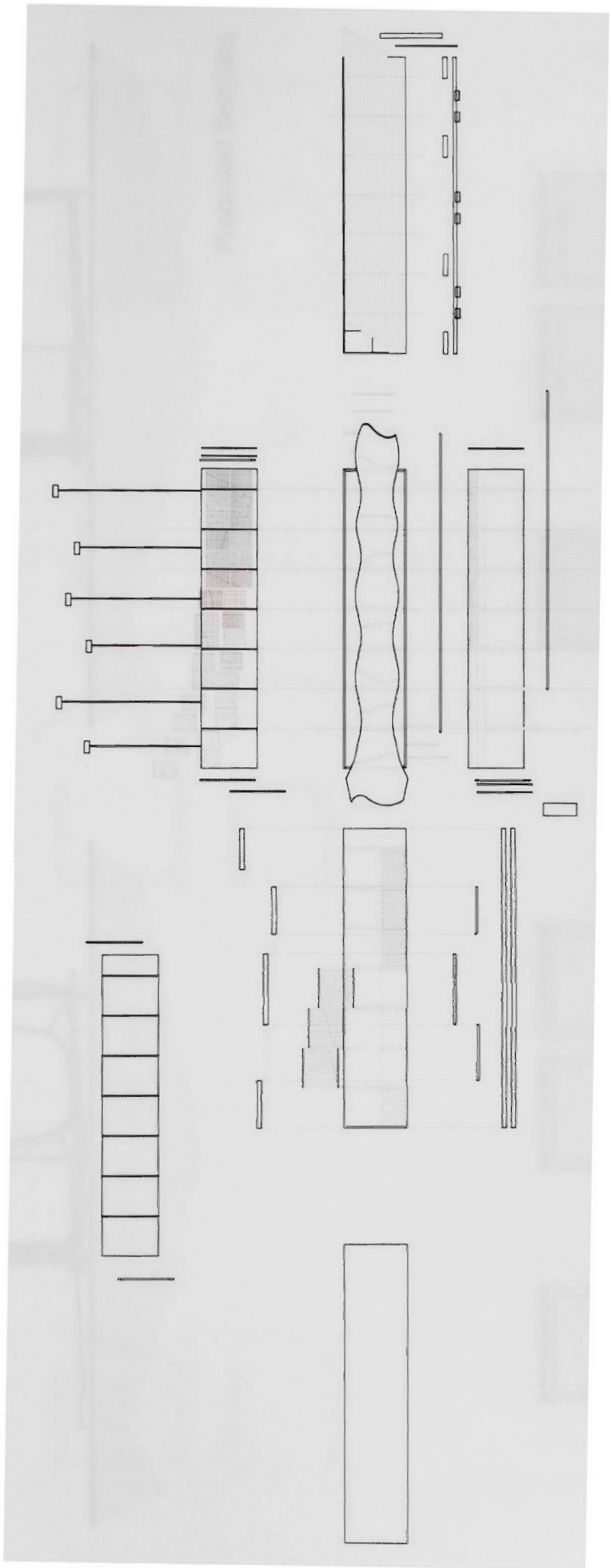
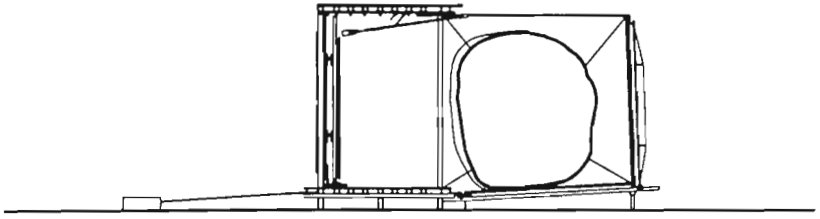


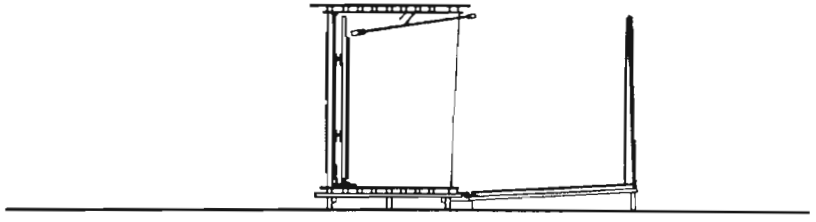
Floorplan

Proposed Container Drawings

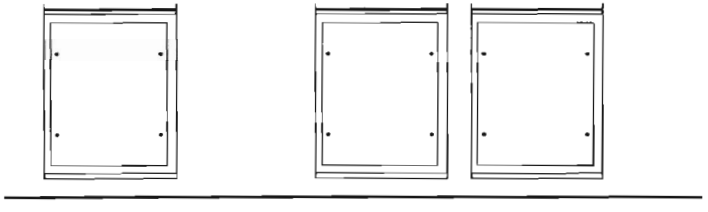


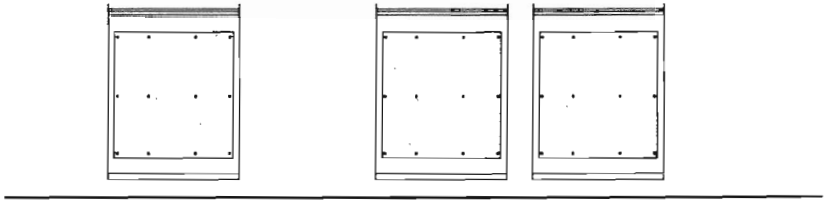
Proposed Defragmentation





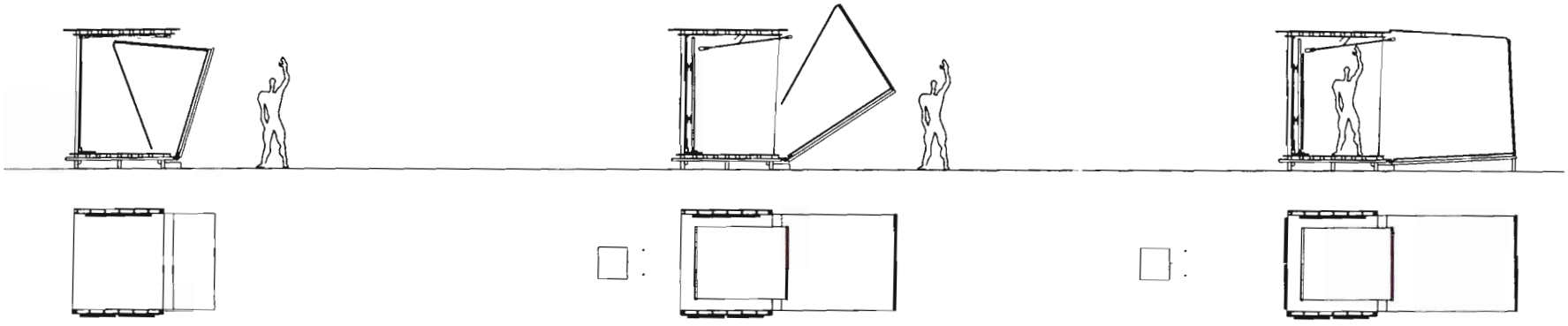
Proposed Sections





Proposed Elevations

Proposed Screening Unit



Kinetic Open Unit

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Appendix

Example 1. Asian Yurt

The yurt used in the Near East and Central Asia is easily transported yet so solid in look and construction. According to Kronenburg in his book *Portable Architecture*, the basic element is the wall lattice made of strips of wood that are tied together at intervals such that they can be expanded to form a larger wall section. Several of these sections are expanded and tied together with a door frame to form a circular wall. A rope is then tied around the top of the wall to help support the roof. Poles run from the top of the wall to a higher central ring compressing the unit. There are two pillars helping hold up the central ring and roof. The wood structure is then covered with various amounts of skins and canvas depending on the climate and weather.

The whole shelter is carried on one or two animals, probably camels. It can be erected by several people in a half- hour. After the outside covering is tied on and door shut, it is astoundingly solid and sedentary looking. The yurt is always pitched facing south, so the pool of sunlight shining through the smoke hole in the roof acts as a clock. This example of a portable dwelling is remarkable for its economy, resilience and portability. The structure has continued to appeal in modern times.

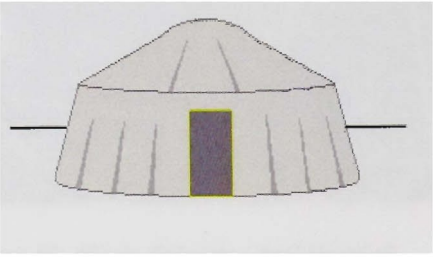

Figure 55. (From *Portable Architecture*)

Example 2. Aboriginal Structure

A more portable and unique type of architecture is found in the book *Primitive Architecture* by Enrico Guidoni. This is the case of the Australian aborigines and their ceremonial space. To the aborigines the geological territory is considered part of the activity of the group that lives in that area. Though they do not believe in ownership of land, the architecture is expressed in the territory they inhabit. The land in which a group moves about is the source of inspiration for their construction and art. It is safe to say that their artistic identity relates to natural phenomena and mythical ancestral legends. This is seen in carvings and paintings left on trees and rocks. The reasoning for these natural formations is expressed in the experience of the space rather than the direct comparison to the natural element. This suggests that space is more important than the natural elements.

Figure 56. (From *Primitive Architecture*)

However, Guidoni believes that water is most important to nomadic people and is represented in the aboriginal space through spirals and or circles. It is in wells and waterhole in which they believe life begins, so it is important that homes be placed near

the element of water. Structures were also erected near other elements such as rocks, and trees that serve as a landmark. At these places is where ceremonies took place. People gathered from many tribes to celebrate at these places.

The most impressive attribute of the ceremony is the use of a staff. This is very much portable yet its simplicity signified a world of architecture and space. According to Enrico Gudioni in the book *Primitive Architecture* the staff was representative of the earth and center of creation. It tied in aboriginal society with the real world. This gives the perception that aboriginal architecture is based on implied space rather than type of structure. Circles are drawn around the staff and filled with the ever-important element of water. Dances and other ritual activities took place around this staff

Example 3. Mosley Pavilion

Another notable structure in Brandenburg's book is the Carlos Mosely Music Pavilion designed for the New York Philharmonic and Opera. The building need to be flexible to accommodate different shows and is easily erected in about 6 hours or so and is disassembled in less. The building is designed by Happold Design and is transported on a series of trucks. Some become part of the structure and the stage is a series of folded hinged panels deployed with the use of hydraulic pistons. The canopy of the structure is also deployed hydraulically and is covered with a fabric membrane that is attached to a lower level.

Key to the design is the preservation of the natural environment in which these concerts are located. The design incorporates four elements, a tripod truss system, a tensile canopy, folding stage and a series of collapsible amplification towers.

The whole structure fits onto seven vehicles. The erection process takes four hours and it takes even less time to disassemble. The benefit here is the ability to re-erect the structure the following day allowing for great flexibility. The stage is comprised of three trusses connecting the front two truss systems to the first step. The use of a hydraulic system puts the third member into place. A coated fabric covers the stage via a winch system. The placement of sound speakers in the audience includes positioning them, stabilizing the towers with adjustable legs, and raising the tower system. This is an example of the efficiency, low impact, and simplicity portability a structure can provide (Kronenburg, 1997).

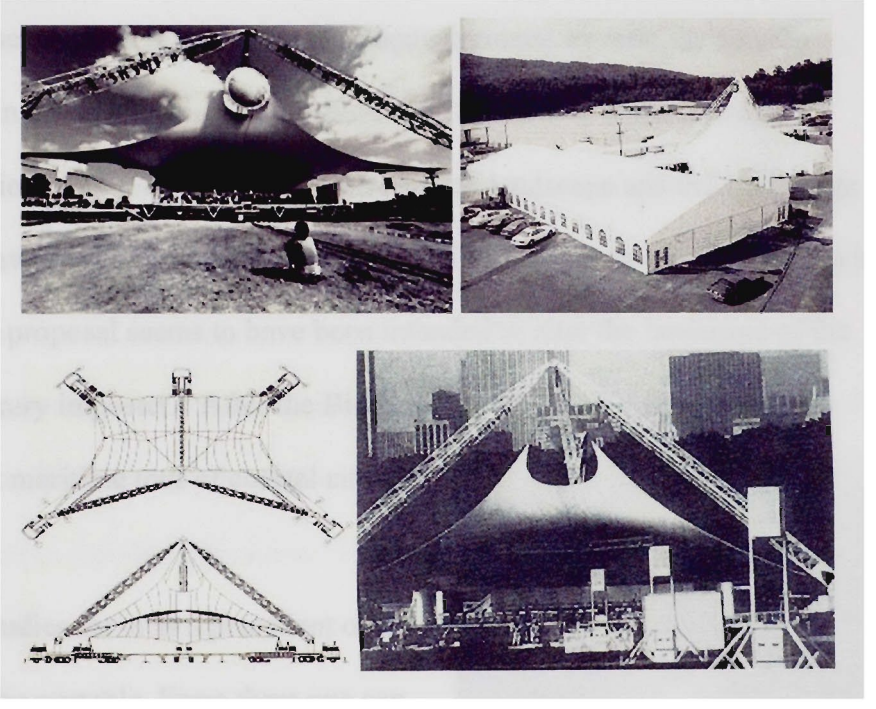

Figure 57. (from *Portable Architecture*)

This project was about cultural links and television effects on the world. The instant city project was based on the idea of a traveling metropolis. It is a traveling entity that moves around giving the idea of metropolitan life to rural regions.

Example 4. Rossi Theater

Before the Karaza was the Teatro del Monde made for the Venice Biennale in Italy in 1979 by Aldo Rossi. It was based on sixteen-century floating pavilions. The theater seated 250 and was built by steal scaffolding using a barge as a floating foundation. It was 17 meters high and 9.5 meters square and cladded in timber giving it a clear monolithic presence. This is unlike the ideology expressed by Jennifer Seigal's ODM who believes in a less imposing architecture. The monolithic structure had no reference to its kinetic nature melting into the surrounding landscape and the lands edge. Rossi's drawings showed it docked along the shores in Venice with towers and bridges in the background. The proposal seems to have been intended to alter the landscape of the city with the "temporary imposter." After the Biennal the theater went on a maritime tour of coastal cities of the Venetian State.

Figure 58. (from *Portable Architecture*)

These case studies serve as a precedent of theaters designed to be portable. Form them one can study the way they were moved. One was through the water on a barge, which affected the construction of it. It was not meant to be taken apart and erected again at another site. Ando's theater is the direct opposite.

It was designed to be taken apart rebuilt, probably for as long as materials permit, though it was only moved twice. It was also an example in the use of materials that can be easily moved and erected. These issues are important for any construction but more important if the unit had to be moved a lot and erected in little time.

Example 5. Carol Burns's studio

By disassembly of the units the students encountered the experience of carrying and touching the materials used. Also they developed a sense of time and effort that would take to assemble and disassemble the structure. This method of exploring the possibilities of such a structure gives a greater sense of what it takes to build, design and move a mobile home. Along with research came a design project relating to the same issues being researched. They focus on methods to alternative approaches to problems found in their research such as the obvious mobility, site, and HUD codes.

Burns believes that by working on research along with a design, it gives the student a wider spectrum of possibilities. The student can solve problems in one area with answers researched in the other. This is a great way of approaching a design in a challenging topic such as mobile architecture. The work in the studio was catalogued and now serves as a shared resource for ideas and research. It is important to note that the catalogue not only benefits those doing research in mobile homes but also gives great in-depth look into different materials and construction methods. "As a source model, the catalogue allows entry at multiple points. It is an "open work." Design thinking requires simultaneous evaluation of many variables that must be weighed together to reach an optimal solution. Design is nonlinear, and all working assumptions about motives, means,

and ends must be repeatedly challenged. It is an open process" (Burns, 1998). The website on manufactured housing done by Burns' studio is (www.gsd.harvard.edu).

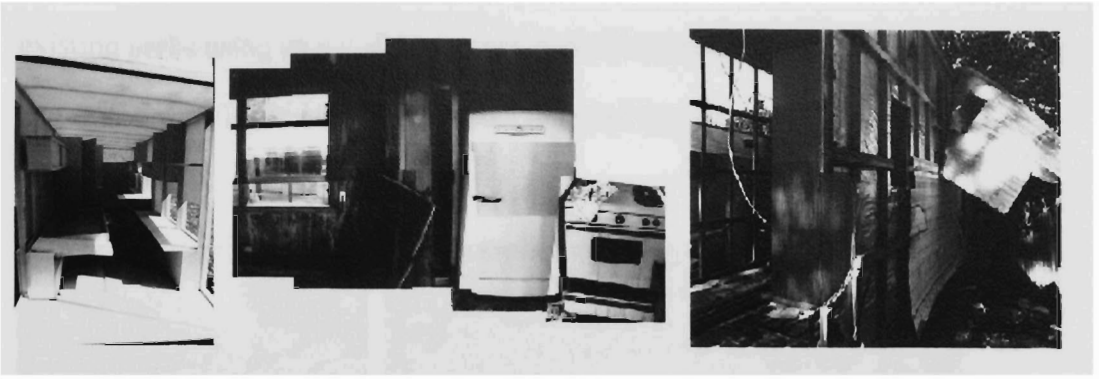

Figure 59. (from Carol Burns' studio class)

Example 6. IBM Pavilion

As mentioned before, Renzo Piano's design for the IBM traveling pavilion, which toured Europe from 1982 through 1984, communicates the quality and usability of computers while harmoniously existing in parks within the cityscape. The IBM Pavilion gives the "impression of being close to nature despite being enclosed within a building that contained the latest technological equipment available (Kronenburg, 1997)." It takes twenty-three trucks to deliver the structure to the site. Twenty-one of these carry the actual building, one carries the mainframe computer, and the last carries the chilling plant for the air-conditioning system used to cool the computer and structure. The support system consisted of spreader feet that were adjustable for the conditions. The assembly process went as follows: the steel floor is laid down; the arches are erected one-half at a time connected at the center, the rest of the floor is assembled, and the end walls, consisting of steel frame and wood panels are put up. This whole process took three weeks but showed the versatility of its design (Kronenburg, 1997).

"in this project the concept of nature was utmost importance: Renzo Piano thought of a traveling exhibition on informatics as one to be easily set up everywhere in existing parks using as pavilion a translucent structure that could readily be disassembled and transported like a circus from town to town" (Rizzoli International, 1989).

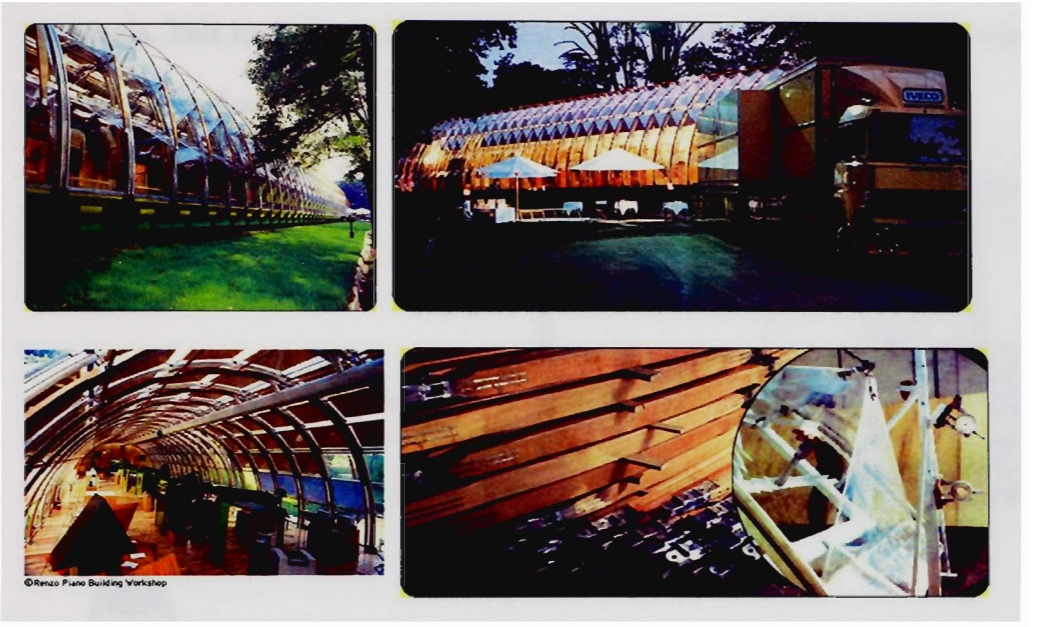

Figure 60. (From IBM pavilion Expo website http://www.calabrese-eng.it/italiano/realizzazioni/tunnel.htm)

Example 7. Instant and Blow Out City

The project Blow Out City is a case study that explores not only the idea of a large-scale moveable program but also the possibilities of using inflatable devices as structure. The project consists of a main mast that hydraulic arms extend outward. On the arms there is the possibility of connecting housing units. Air inflated ribs then circle the project and support a roofing membrane that covers all. The entire unit can retract and moved with the use of hovercraft motors.

Another possibility of a city is the Plug In City. In this project, which was worked on from 1962-64, consists of a prefabricated cabin that would be placed and removed from a larger structure. The Living City and other proposals, set forth during the 1960s, one much like this notion. However, aspects of what forms a city were not addressed. The question of quality of life, symbolism and independence are not in any of the city proposals. This leads me to think that the term city must be used carefully when referring to these examples.

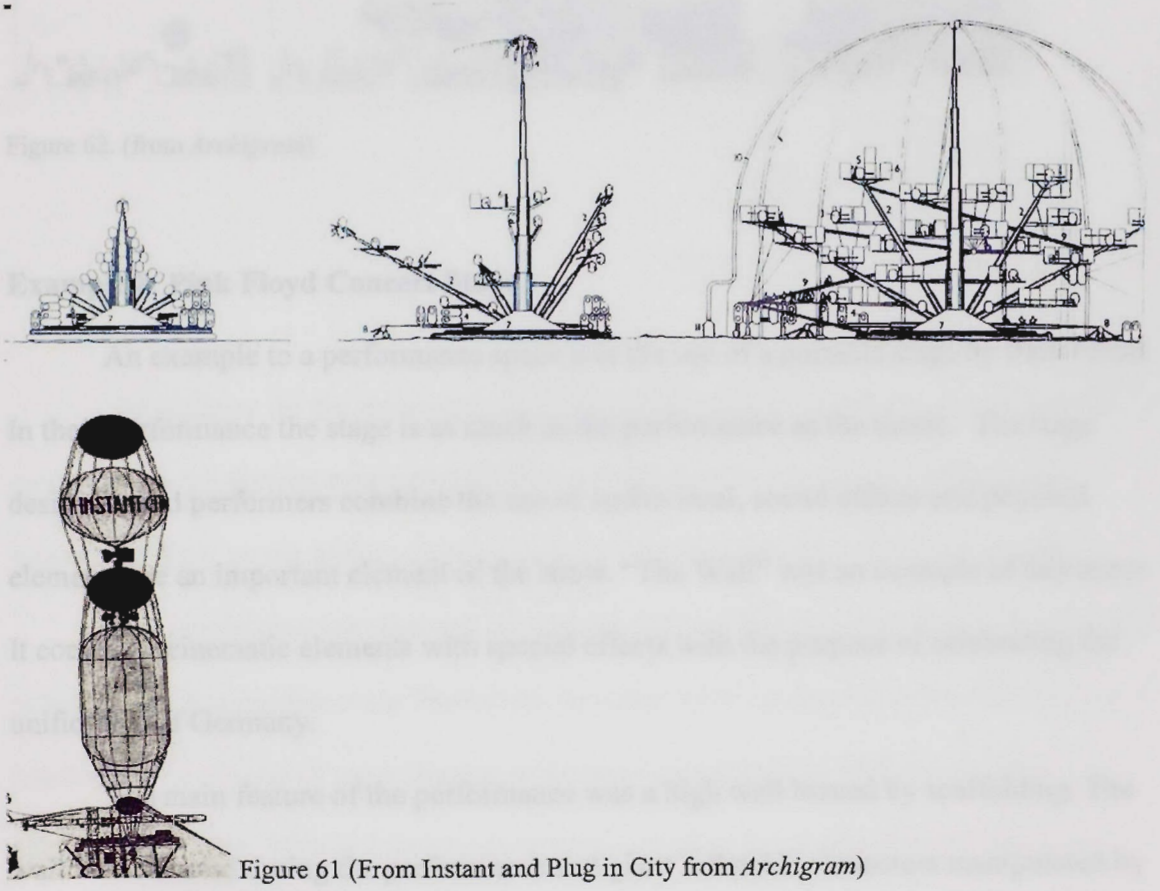

Figure 61 (From Instant and Plug in City from *Archigram*)

The Instant City is based on existing technologies. There is a combination of different systems used in the program to inflate a city of other available utilities. This in fact is a moveable promotional advertisement. Much like the Goodyear blimp has on its side. The first stage of the program consist of assembly these elements were applied in Los Angeles area in California. Later it became more versatile as an air ship and carried a greater meaning as the drawings below demonstrate.

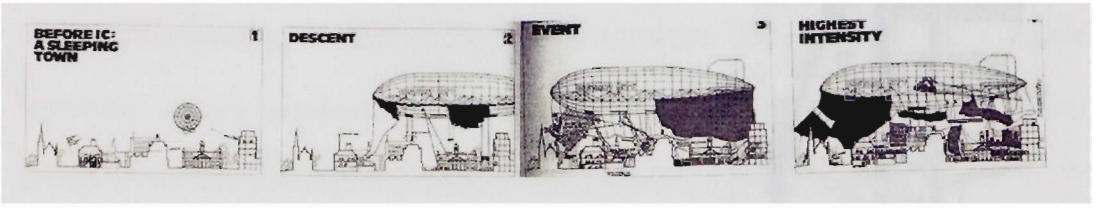

Figure 62. (from *Archigram*)

Example 8. Pink Floyd Concert Stage

An example to a performance space was the use of a portable stage by Pink Floyd. In their performance the stage is as much as the performance as the music. The stage designers and performers combine the use of audiovisual, sound effects and physical elements are an important element of the show. "The Wall" was an example of this show. It combines cinematic elements with special effects with the purpose of celebrating the unification of Germany.

The main feature of the performance was a high wall braced by scaffolding. The wall was elevated during the performance and giant inflatable characters manipulated by cranes danced around and knocked the wall down as seen in the video The Wall by Pink Floyd.. This is the ideal example of construction triggered by the use of portable architecture. Fisher, the designer of such sets believes that this example of a performance

space "is most interesting piece of work in architectural terms because although it utilizes techniques and strategies which have been developed specifically for the creation of stage design, they may be applicable in other fields of temporary construction" (Kronenburg, 1998).

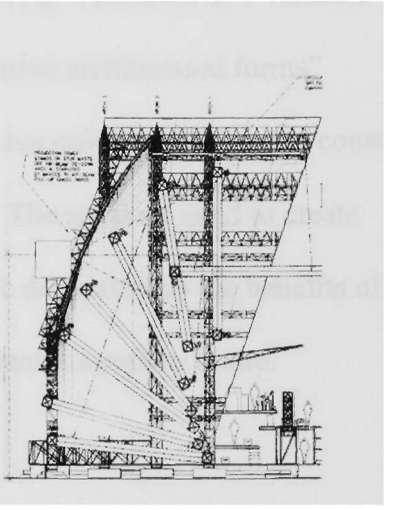

Figure 63. (From *Houses in Motion.*)

The designs for the structures were "a complex affair involving up to a hundred consultants with diverse areas of expertise, and clients who sought to emphasize the message of their music and to create a spectacle for the audience" (Kronenburg, 98).

This is probably the message one would want to convey in the performance space proposed yet at a smaller scale. However, the study of this stage and others like it show innovations in the use of stage designs and props in conjunction with construction methods and video. This is a good case study to explore the combination of glitz and construction assembly but it lacks in the issue concerning portability this is to say though they are portable structures a great deal of assembly and disassembly must happen in order for the structure to be moved.

These systems of construction involved in creating portable structures is beginning to revolutionize the way human beings perceive architecture and possibilities of new construction methods. "Because of recent advances in materials technology and construction techniques, Portable Architecture is now being reassessed as a valuable design route in the search for more sensitive and responsive architectural forms" (Kronenberg, 1997). The success of portable structures not only depends on the constant change of technology but also strongly on imagination. The apparent need to create structures that are transportable, versatile, and economic demonstrates the benefits of further study into portable architecture and definitely creates a certain future.