THESIS CERTIFICATE

DISSERTATION, SEMESTER X.
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This is to certify that the dissertation titled "HOMES, SETTLEMENT, COMMUNITIES ON THE MOVE" done by Krunal J Patel, 10SA122, is hereby approved as a work on the approved subject, carried out and presented in a manner sufficeintly satisfactory to the degree for which it has been submitted. It is to be understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein. But approves the study only for the purpose it has been submitted and that it satisfies the requirment laid down by the thesis committee.

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1. PROLEGOMENON

A BRIEF INTRODUCTION DISCUSSION ON PORTABLE STRUCTURES

1. PROLEGOMENON

CULTURAL IMPORTANCE

On wheels, propellers, turbines, rocket engines(space shuttles), nuclear engines(submarines), this kinetic objects have advanced tremendously throughout human design history. Power, speed, beauty, intelligence, automation, have significant technological advances throw time in the most visible way. Combined with other functions this objects can be widely used and through the process reinforced it or even reinventing. Moving buildings are among the initials creation by man from the tipi to a 90000 ton aircraft.

Impermanent, low quality building, not with a specific purpose nor appropriate to its site, are common perception of people to temporary architecture. There is yet no profound need to study such buildings not unless a disaster occurs or for some specific purpose.

In today's time, this buildings are already used in various ways and varied locations. In commerce, industrial, education, healthcare, housing and military. Even thou this products are considerably more sophisticated in materials and construction, they have evolved through an *ad hoc* design process. A little more care is considered will designing compared to that used by a refugee, where he has to built the best shelter in constrain to time and material.

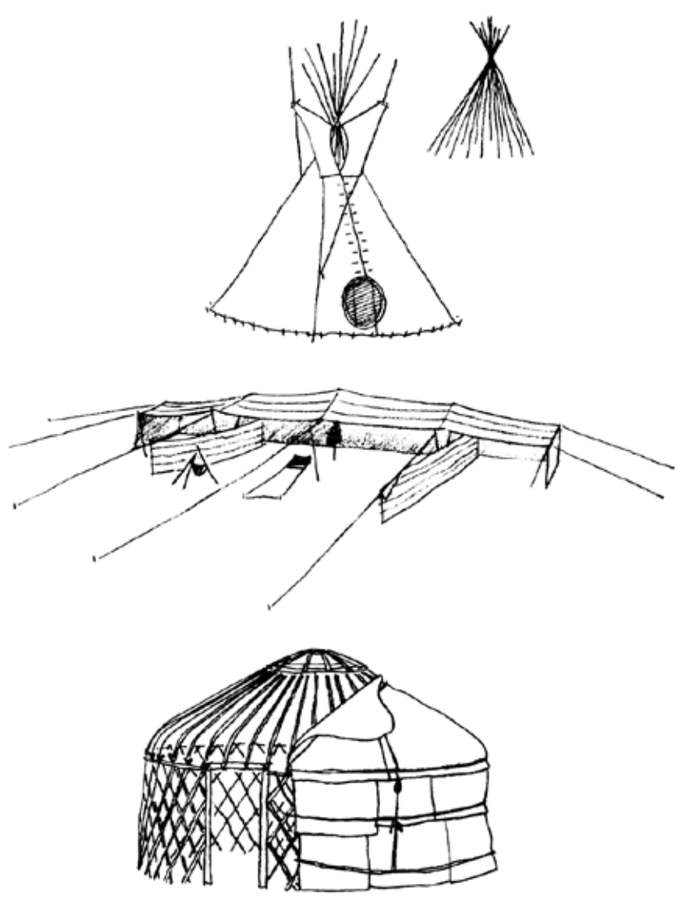


fig 1.1
above A mobile Chinese assault tower
below examples of traditional portable buildings

1. PROLEGOMENON

But the importance of portable architecture is very necessary to invent new material, construction techniques in today's rapidly growing world. Permanent homes have been evolved due to innovations made in portable architecture. Use of steel, concrete, tensile material all come up due to use in portable architecture.

Their is no portable building that can still replace permanent structures yet. But their will come a time when the natural resources will come to a halt. What will happen at that time? Natural disasters, or man made will increase at a point, reducing construction of permanent structures. Then what?

fig 1.2
prefabricated Butler Bin grain store, produced a wide range of portable buildings for use by the US Military during the Second World War

DEFINITIONS OF THE MOVABLE BUILDINGS

" *The architectural forms studied here are those that have a strictly ephemeral nature - that are movable in some form, and are designed specifically for deployment in different situations and/or locations. Though some possess characteristics from more than one category.* "

They can be simply classified into three types.
Portable buildings - moved whole and intact. Can have transporter attached or in the building system itself.
Relocatable buildings - moved in parts then assembled in some cases can have transporter attached to the system. They can rapidly be put up as portable buildings without restriction to size imposed by transporter.
Demountable buildings - moved in numbers of parts for assemble at site. Can be moved in compact space and assembled on site with flexibility in size and layout. Limitations comes when some site operations can not take place due to site conditions, context and availability of ingenuity of the system.

They can further be divided into deployment categories: Module, flat pack, tensile, pneumatic and combined system. All movable buildings from the first prehistoric shelter to international space station, from simple grass thatched dwelling to a large technological ambitious demountable exhibition building can be classified into this definitions.

1. PROLEGOMENON

Tadao Ando designed the Karaza Theater for the traveling avant grade theater/ perfomance company led by Kara Juro. It was designed for portablity, taking care off the Japanse architecture and culture. Totally built of wood, using scapfolding method. A twelve sided structure(dodecahedron) that represented the cosmos, having other 2 inside one another. Where the external structure formed the walls, and had the staircase inside it. The secound the auditorium and the stage at the centre. Covering the entire complex with woven bamboo to emphasises the other worldly.

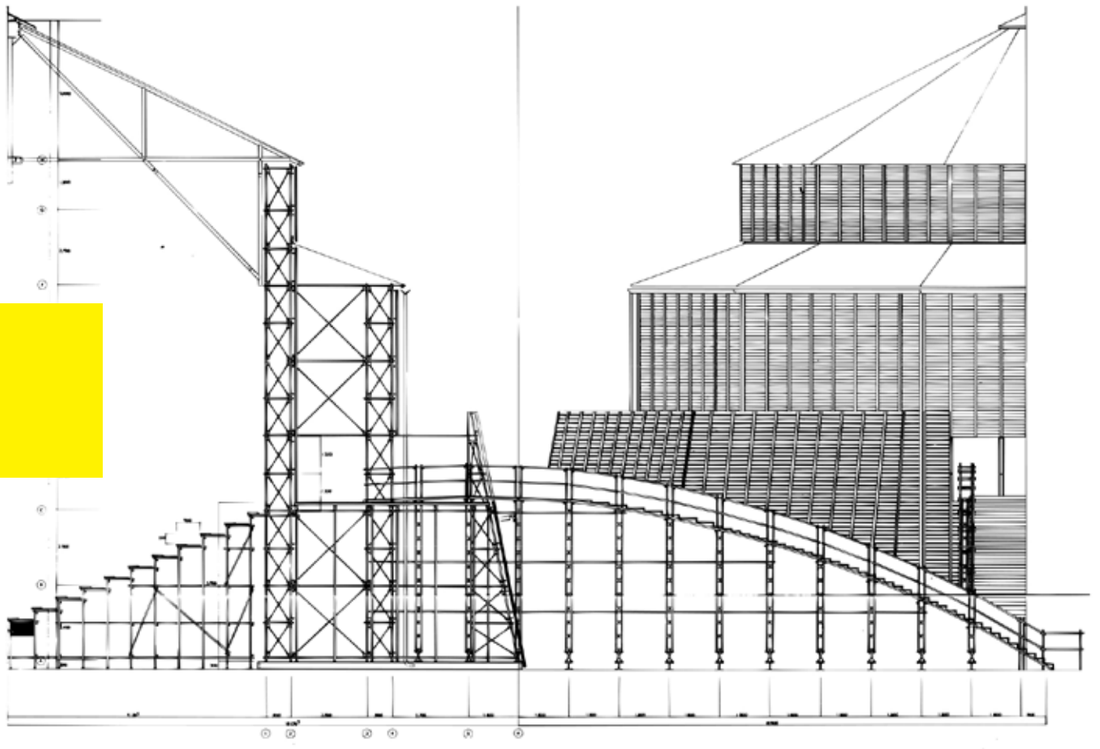


fig 1.3
Karaza Theatre, Sendai and Tokyo

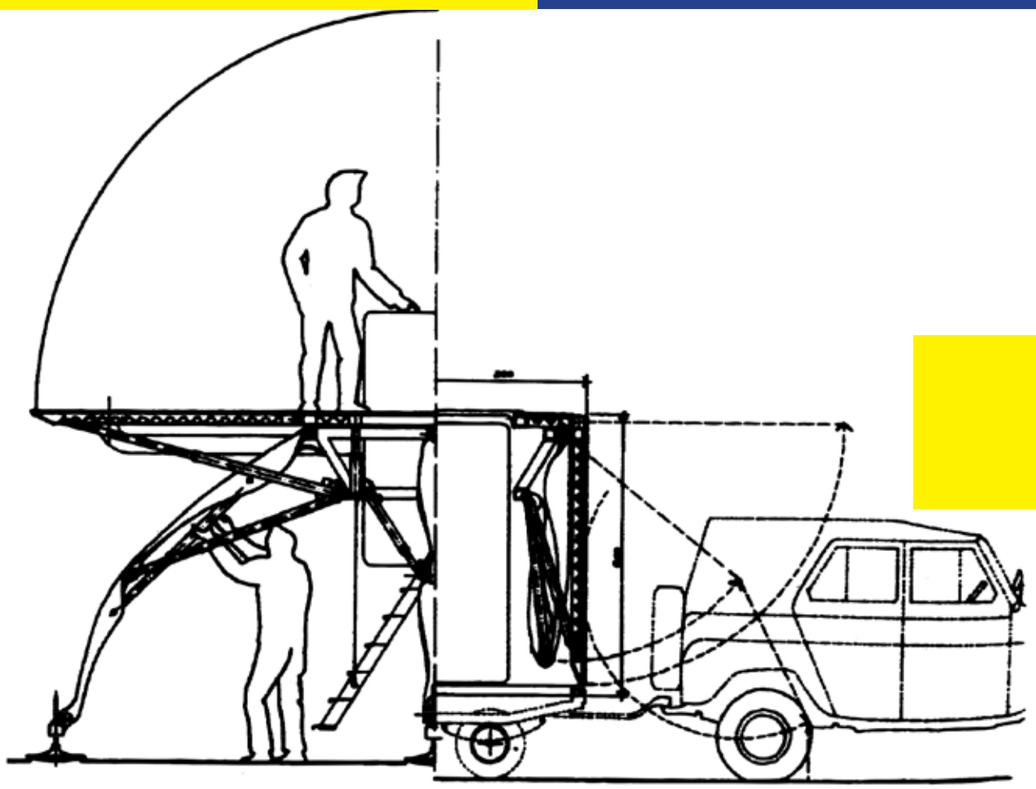


fig 1.4
Magic Box rapid intervention unit, Renzo Piano Building Workshop, 1985

It was built for intervention units during dissaster situation in the third world countries based on Piano's expercience. Foldable to a 2.4 meter cube, that can eassily transported through aricrafts and could be towed by a small vechile. It was built for communication and monitoring facility that could easily be deployed without the use of excessive resources. The portable structure consisted of a communication and analysis equipment and a small power plant to support its oparetion. Unfolded to a 36 meter square raised platform with a tensile shelther membrane.

1. PROLEGOMENON

HUMAN UNDERSTANDING OF EPHEMERAL ARCHITECTURE

"They don't have cultural or vernacular importance."
Its due to this ephemeral structures that today's cultural or vernacular existence came about. Archaeologists have proven the fact that domes and vaults you see been used in vernacular architecture have all evolved from ephemeral structures used by nomadic people before civilizations even started.

"They don't give the flexibility in building for the user."
Its true that most of the ephemeral buildings built till date have not much flexibility in form and space, rather they are designed for a specific use or user group. But the inventions that were invented in the process have helped to create the flexibility in building permanent structures. The first ever shelter built by man was a temporary structure were he could move around easily and explore. Its when man found agriculture and started building permanent structures as they dint have to move looking for food. After that the permanent buildings evolved due to inventions made in temporary structures as they were still been explored. One day will come that will all have to move to using ephemeral buildings, as the resources will come to an end or natural calamities will force one to have.

"They are very different and out of context."
Obviously they are going to be, as they are way ahead in technology, form and use, rather then permanent structures. For instant looking at a ship, its gigantic, admirable, breath taking with the advancement in technology that keep millions mouth open. Yet its just a dream for many to have such advancement in technology that can replace their permanent structures. But that's due to lack of design proposal for ephemeral structures that can be fully flexible as per user oriented. Today their are many attempt proposals been done to acquire this. Yet not many have succeeded. They are widely been used in today's time in small scale projects or even at urban level to bring that contrast to the context, be it in landscape elements or elements in a building.

"They last for a short time."
They actually don't last for a short time, in-fact they live longer then permanent structures. Its an issue of designing, as most of the portable structures were built for a specific purpose or time, losing the essences of strong and long lasting. But may I correct you that those buildings are still used but not for the purpose they were made for, rather they were recycled and used. Resources are limited and kept in mind and designed so that if they were useless they could be recycled and used else were.

fig 1.5
Museum of the Moving Image Hospitality Pavilion

1. PROLEGOMENON

VALUE OF PORTABLE ARCHITECTURE

Inventions are made due to trial and errors, exploration or in search of something new.

Affordable for a long run as well as when needed instandtly.

Material exploration is necessary sa as to creat something strong, light and affordable.

Advance then parmanent architecture. way ahead of time.

Anytime it can be erected or brought to site.

Anywhere it can be taken as long as the necassary equipment are their.

Automation is embeded so as the building can respond to the outer condition without the help of a Human.

Moveable is the reason why its known as portable architecture.

Widely used in various places, context, individual or group of people, purpose etc.

Beauty for the inventions made. Outstanding from the rest brings the beauty of portable architecture.

Flexible in size and layout to some extent, to give the user the freedom of creativety.

Recyclable material are used so as to keep the resources alive even after the purpose for creation is over.

Time saver is the reason why people go for portable architecture rather then parmanent architecture.

Construction technics are invented to erect them as fast as possible. They are also used by parmanent architeuce.

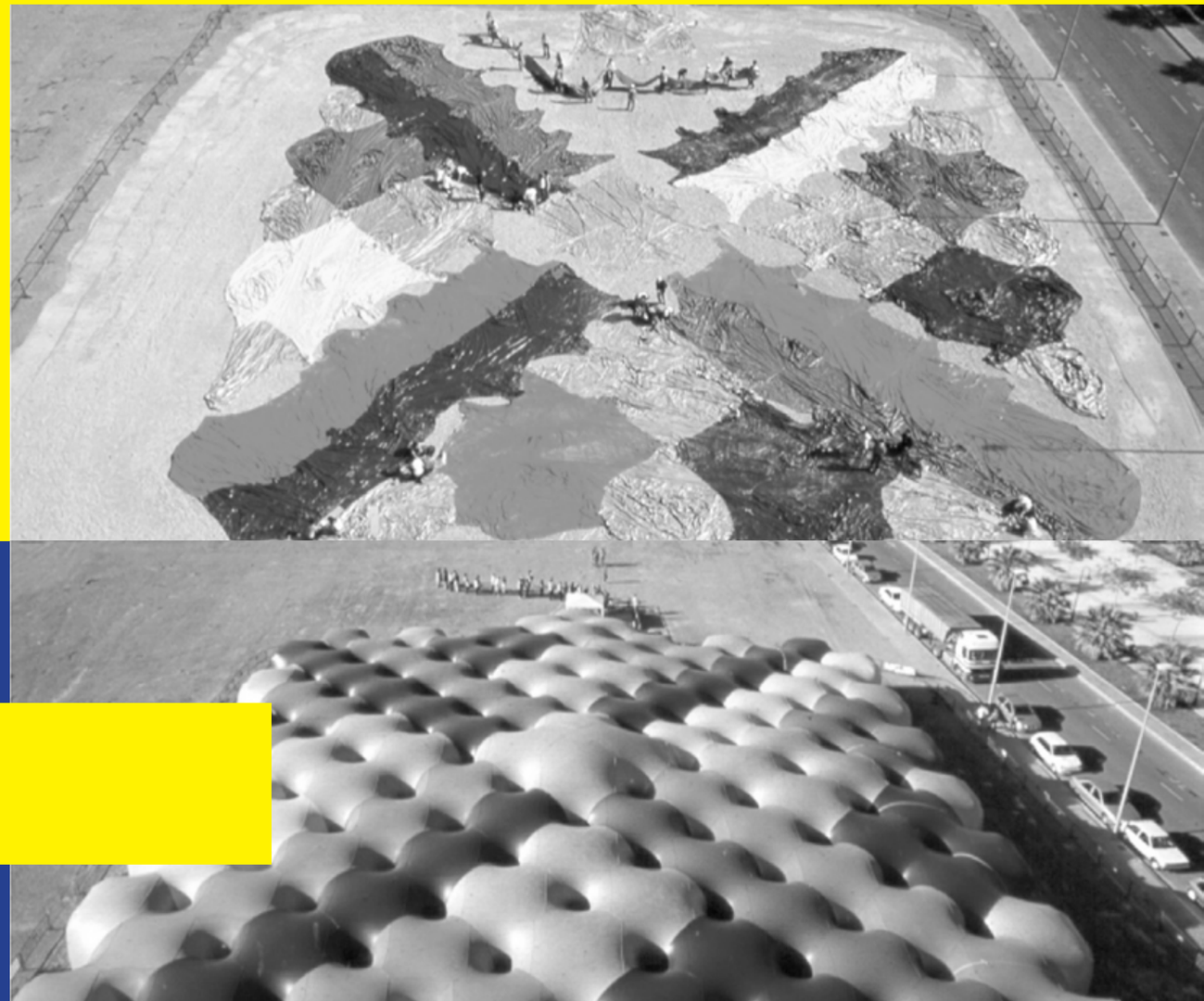


fig 1.6
Dreamspace model, Maurice Agis, 1995

2. HISTORY

A FALL BACK OF TIME TO UNDERSTAND WHAT HAS HAPPENED AND WHAT CAN BE LEARNT FROM IT

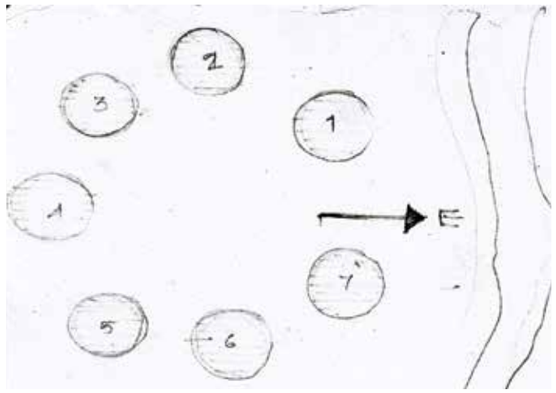
2. HISTORY

PREHISTORIC AND TRADITIONAL PORTABLE ARCHITECTURE

Humans evolved from apes eight to five millions ago in the continent thats now called Africa. The oldest tools that were found are about two million years old, found in the site at Olduvai Gorge, Tanzania, East Africa. It is imagined that the early Humans just hunted for survival and lived in caves as the environmental conditions are modarate in this regions. They didnt have to built any shelter to protect them from harsh conditions. Approximately ona and a half million years ago the first full Ice Age occured due to significante changes in climate. This is what probably made them evolve to building shetlers so as to protect themselfs from harsh conditions. Others traveled towards Asia and Europe for search of better environment conditions. Remains such as Rhinoceros and tools made of the bones are found in Bilzingsleben, Germany of hominids that moved and settled around 700,00 to 120,000 years ago. They are known as big-game hunting as they hunted wild animals as well as also relaid on nuts, berries, resin and wild honey. Hunted animals were also used for raw manufacture of skins to make clothes as well as cover the shelters, the first primitive shelters of such kind is found in Grotte du Lazaret near Nice, France (about 150,000 years old). The intial shelters where small as they had to move from place to place. It consisted of fire place and the rest was open. Planning changed from places to places.

THE TIPI

The early form of portable shelter were the Tipi between 12,000 to 6,000 years ago. Intial shelters were more parmanent then temporary as they found agriculture and did not have to move from place to place. But as time went they started hunting buffalos, as they were equiped with horses. They chased large heard of buffalos and eventually moved from place to place, thereafter giving birth to Tipi, a conical structure made of wooden poles and covered by animal skin(buffolos). The females were responsible for the ercetion of the home and own it as well. They stiched the skin to cover the entire dwelling unit.



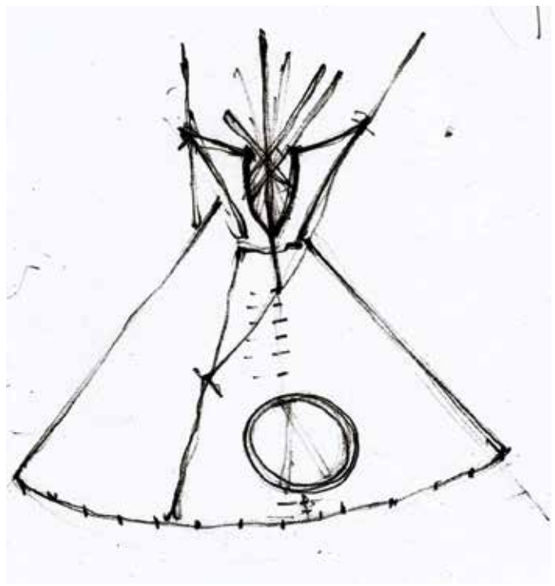
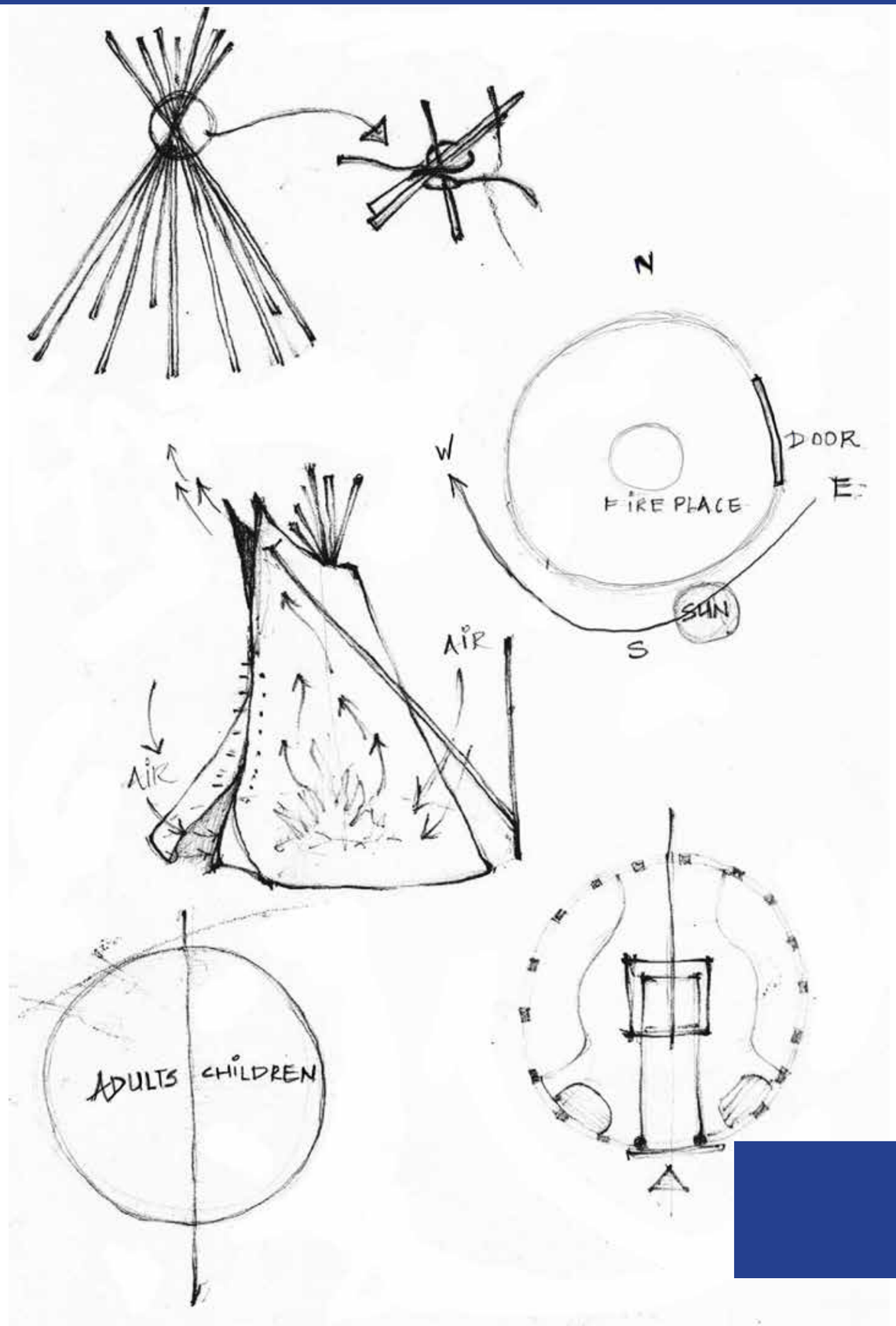


fig 1.1
above, showing the arrangment of postes.
below, typical view of the Tipi

2. HISTORY



Every dwelling unit was characterized depending on the owner, the Sioux had a three-pole main frame, Blackfoot had four-pole main structure. This poles were supllemented by subsidiary poles and were tied at the top. The Tipi can be erected in 20 minutes entirely by two people.

Even though its simple in form, its very comfortable and can sustain huge wind pressure due to the conical strcuture and the angle between the walls and the ground. It had a smoke flap which could be mode to avoid draughts and to help smoke from the fire to escape and not return in. Had a streaqmer on the tips to indicate the wind direction. To help the condensed moisture to run down-outside the living area a cloth is lined at a hight of 1.5m in the interior. This helped to insulate as well as prevent draughts to reach the living area.

Simple as it looked the Tipi had great cultural importance. The Plains Indian believed that the "Power" of the world does is in a circle, the sky, the stars, the earth. Same way the Tipi was circular like a nest and everything was arranged in that manner as well. The circle is of great aerodynamic advantage in preventing it to fail in harsh winds. Its erected according the rising and seting of the sun.

The interior was well confined and followed strictly, the adults on the right side and the childrens on the other. On the axis of the entrance lies the heart in near the centre as the centre had the smoke vent above it. Another sacred heart lied rear to it, where burnt offering were made. Around this lies the special objects and trophies.

Due to this strick feature and arrangement in a confined space it was possible to have it as a portable structure.

fig 1.1
sketches of the Tipi and how it functions and the orientation.

2. HISTORY

THE TENT

This portable structure is one of the most earliest form that is still in active use till today. It has survived the longest compared to other forms of building, also a symbol for shelter worldwide. In the North Africa, the nomads have developed themself over thousands of years and have built amazing Tents in the vast desserts considering the extreme conditions ovf climate and topography.

They are strictly functional, material detail worked out, lightweight and excellent protector from the extreme climate. They belive that the Tent should be carried by two people easily and can walk for miles and miles. Materials can differe from place to place as they used local material available on site. Nomads also believe that the Tents safety is more profound then the permanent dwelling units.

Generally rectangular in plan, wooden poles are erected with wodden shoes or rags to spread the load, and a large fabric is attached on the outerside. This fabric is made by combining small pieces of rectangular shaped clothes. The tent is then tensioned and pegged, in unconditional ground a rope is pegged and then burried into the ground with a bush at the end to give it grippe in the burried soil.

Interior is divided by cloth curtains and specific places are aloted for specific purposes such as cooking, sleeping, guest area. The walles of the tent can be lowered or raised to allow the cool air to pass through. The Tent varry from quality and size giving the impression of the wealth of the owner. The women are also responsible in erecting and maintaining the Tent. Its erected facing the Mecca to the east or south so that the back wall is to the north winds and the men's side is toward Mecca.

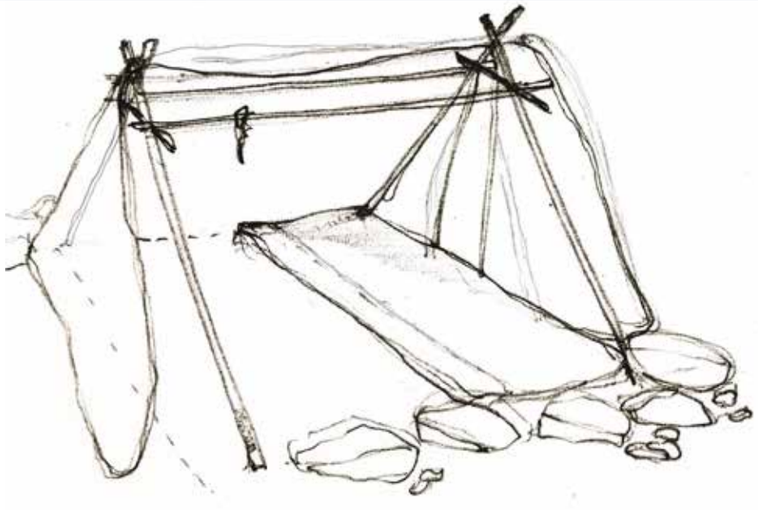


fig 1.1
above A mobile Chinese assault tower
below examples of traditional portable buildings

2. HISTORY

THE YURT

They are the dwelling units of the Asian continent, used by nomads from Iran to Mongolia, over 7,000 years ago. They are easily erected, taken down, transported and can be used in winters as well as summers. Even though they moved seasonal all their equipments were portable, and were carried by horses.

Still looking solid it was easily transported. The walls were made of strips of willow with swivelling joints, that helped it to contract while on the move and expand to form the walls of the dwelling unit. Were erected in circular shape, with a tension band on the top tied to the door frame. The roof is placed and attached to two poles at the centre and later other roof components are added. The covering was made of felt, which was plain, decorated or painted. They used upto eight layers of felt to keep them warm during winters and it also made it waterproof.

The men made the wooden parts and the women the felt, it was also their responsibility to erect and take down the dwelling unit. Took them about 30 minutes to erect the Yurt.

As the Tent, Tipi, the Yurt also had strict rules of etiquette in the interior. The door faced the south along with the smoke hole allowing the sun ray to enter in. The heart was in the centre, below the smoke hole. To the west was the women side, the east was the guest area and at the rear was the mens area, during the night the beds would be layed and during the day they would sit their.

As the Tent, the Yurt would working in a similiar way during summers and winters. The covering could be raised from the side to lent air in, and a layer of felt would also be floored during summers to keep it cool. During winter a layer of 10 centimetres of leaves would be spreaded below the layer of felt to keep it insulated. The building is so strong that it could be lifted up and moved aside to clean the building area.

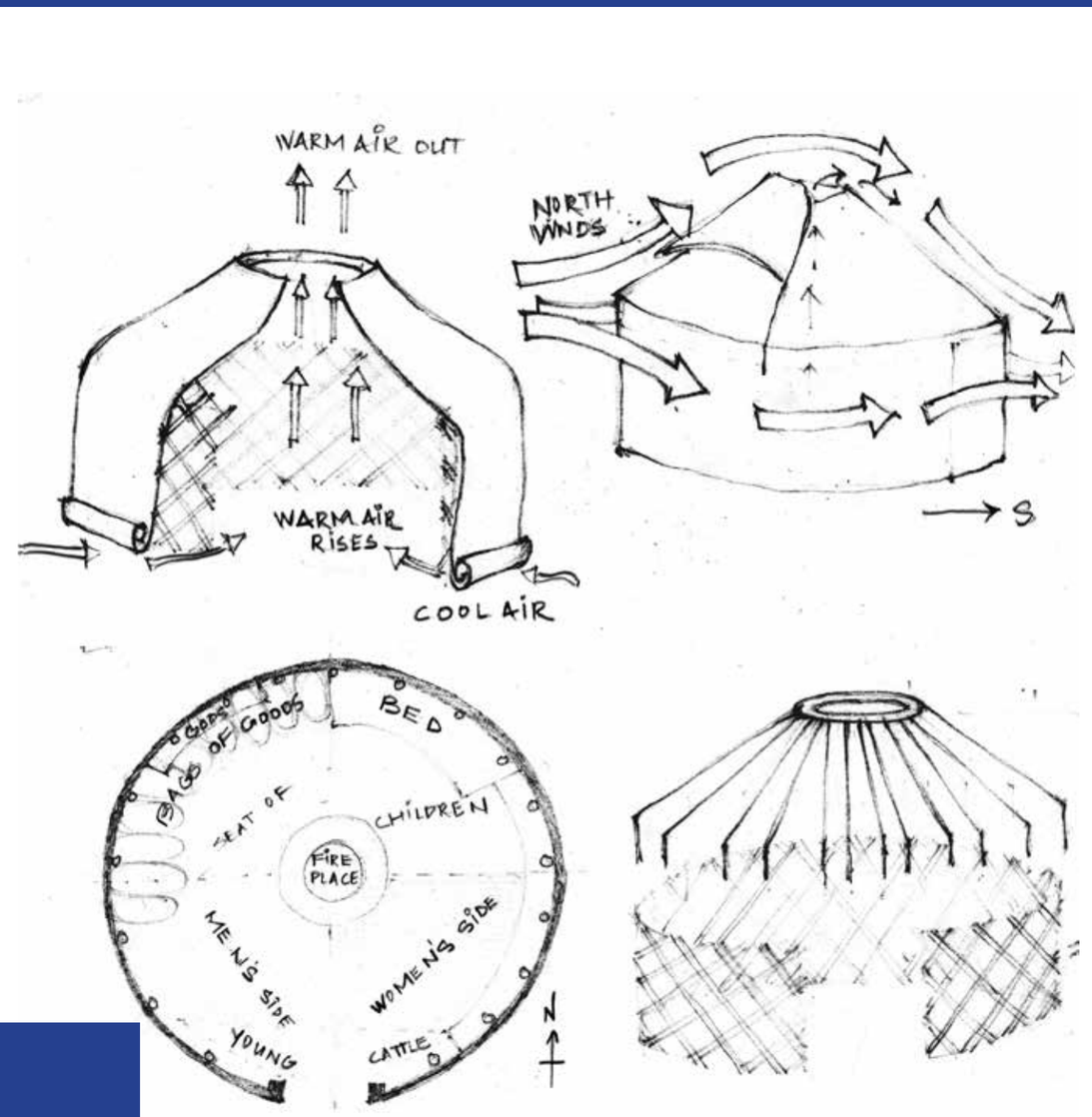


fig 1.1
Interior layout, Sections and Construction technics of a typical Asian Yurt.

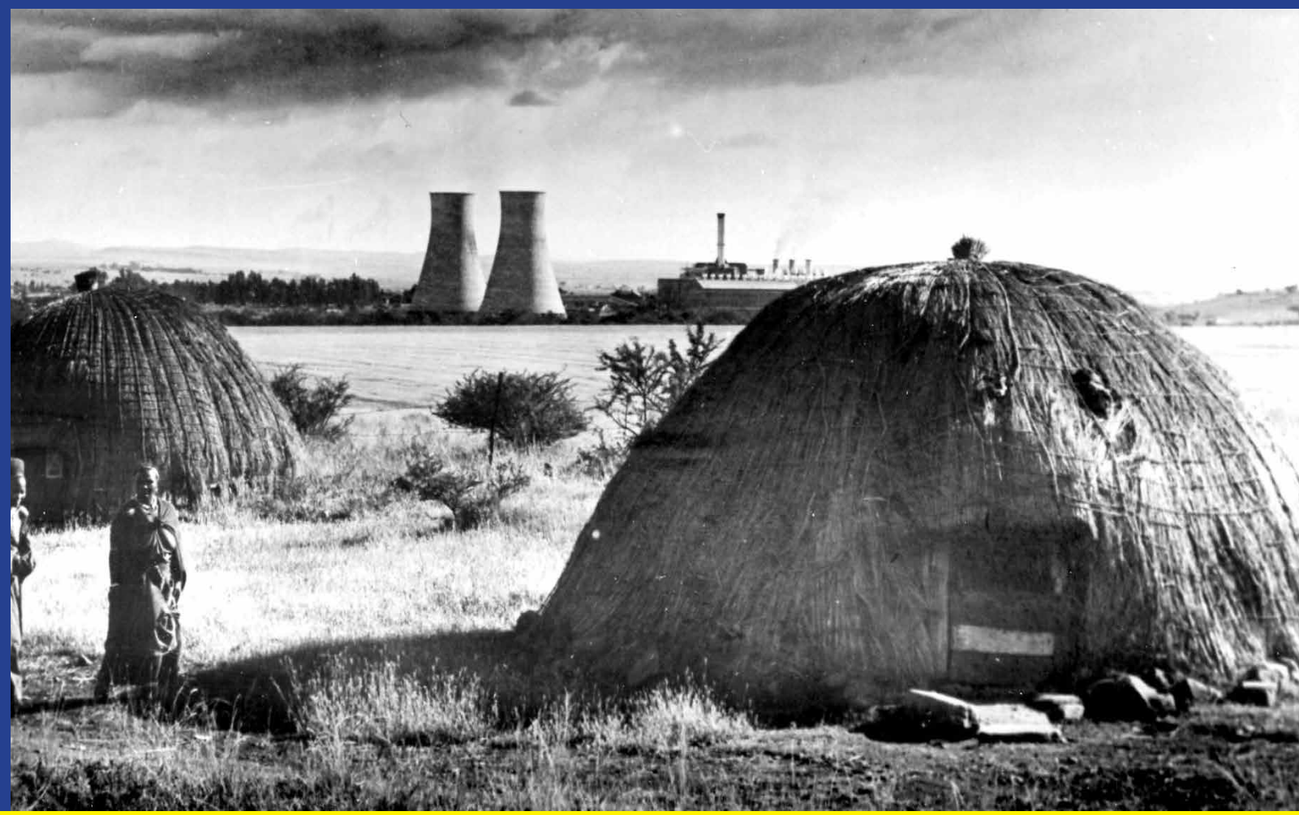
2. HISTORY

PORTABLE STRUCTURES

Some communities in the prehistoric period did not have portable building but had portable structures. Where part of the building would be relocated due to some issue such as someones death or for survival as the major reason for portable architecture during the period.

The Zulu hut or Indlu were built strong but keeping in mind the portable issue when one dies. The building was made of wooven thatch supported by different timber frame. The dwelling is burnt down with the remains of the dead. In some cases the timber frames are taken if the condition of the family wasnt good.

In Chad, their homes had portable roof structures as they were prefabricated then installed after erecting the walls. They would move the roof to a new dwelling during relocating or could be used by other dwelling if needed.



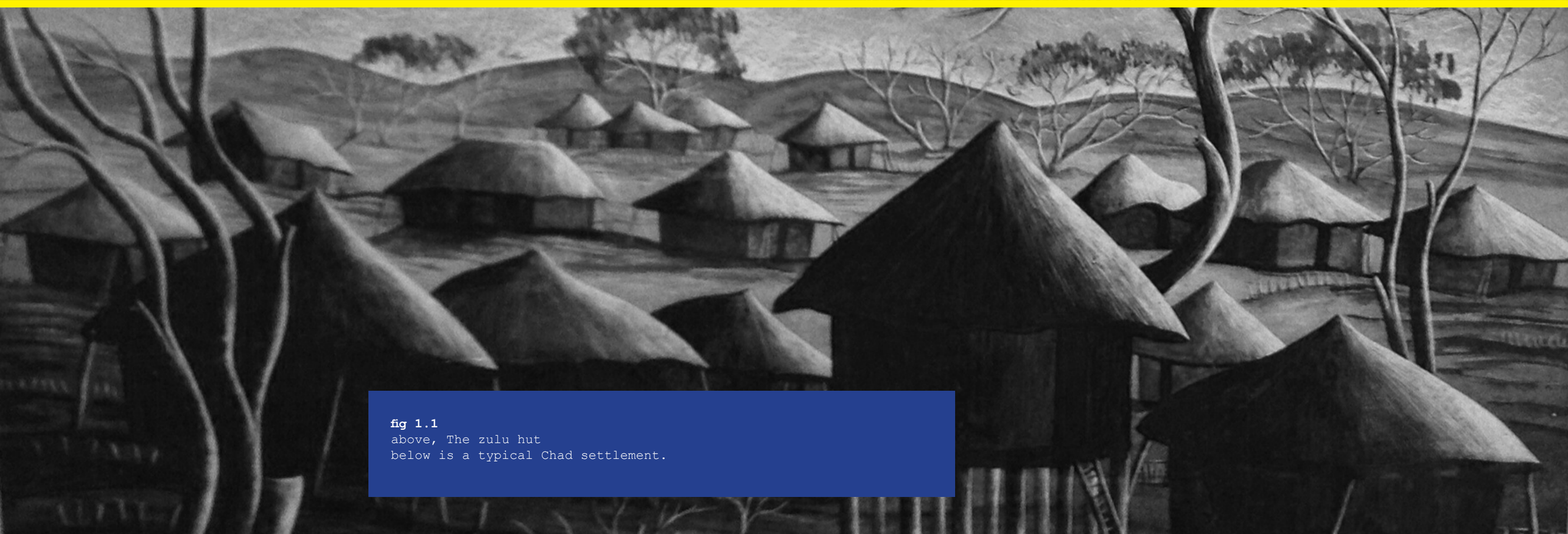


fig 1.1
above, The zulu hut
below is a typical Chad settlement.

2. HISTORY

BOAT BUILDINGS

They are many communities that lived along the waters and had issues of flooding that developed them to build floating homes. Area such as China, Kashmir, around the British canal have great examples of floating homes. They were a secoundary place to stay as they had homes on land but eventually developed in staying in it. Boats were used for transportation and moving. Some communities like Ceylon lived on boats and during ceremonies came on land and the boats were supported on postes and used as homes rather then boats. Boats also helped develope the joinery details of normal construction technics in such areas.

fig 1.1
above is a houseboat found in Kashmir, right we have the japanesse boats and above it are the Sumatra boat buildings.

2. HISTORY

WHEELED VEHICLES

They are a more recent creation of living on the wheeled vehicles, almost around seventeenth century where Cardinal Richelieu had a horse litter that had a bedroom and study and the Napoleons camping coach which consisted of a eating, cooking, working and resting facility. Such vehicles were used by Scythians as they were always on the move. They never had homes but wagos, which concludes that they would be having resting equipments in the wagon that would be pulled out or detached when to be used.

The most recent type of wheeled vehicles were used by travelling menagerie show operators that moved from places to place to perform as their living. We are talking about the eighteenth century period know. Later on this vehicles transformed to what we call caravans.

Concluding this chapter, They are great examples of prehistoric dwelling units that are still been used till date. Many of them have characteristics of flexibility were as they can be erected in various sizes depending on the user. They would erect anywhere and could sustain a wide range of environmental conditions.

Looking at the prehistoric period and the present senarial the use of empherial architecture has changed. In todays world portable is used as leisure, some case during disasters, for a purpose. Therefore the dwellign units produced are more specific and purpose oriented, rather then flexible in use. Will know look at some examples of portable structure that are present to date in the next chapter. How they are used, for what purpose, and how they are detailed out.

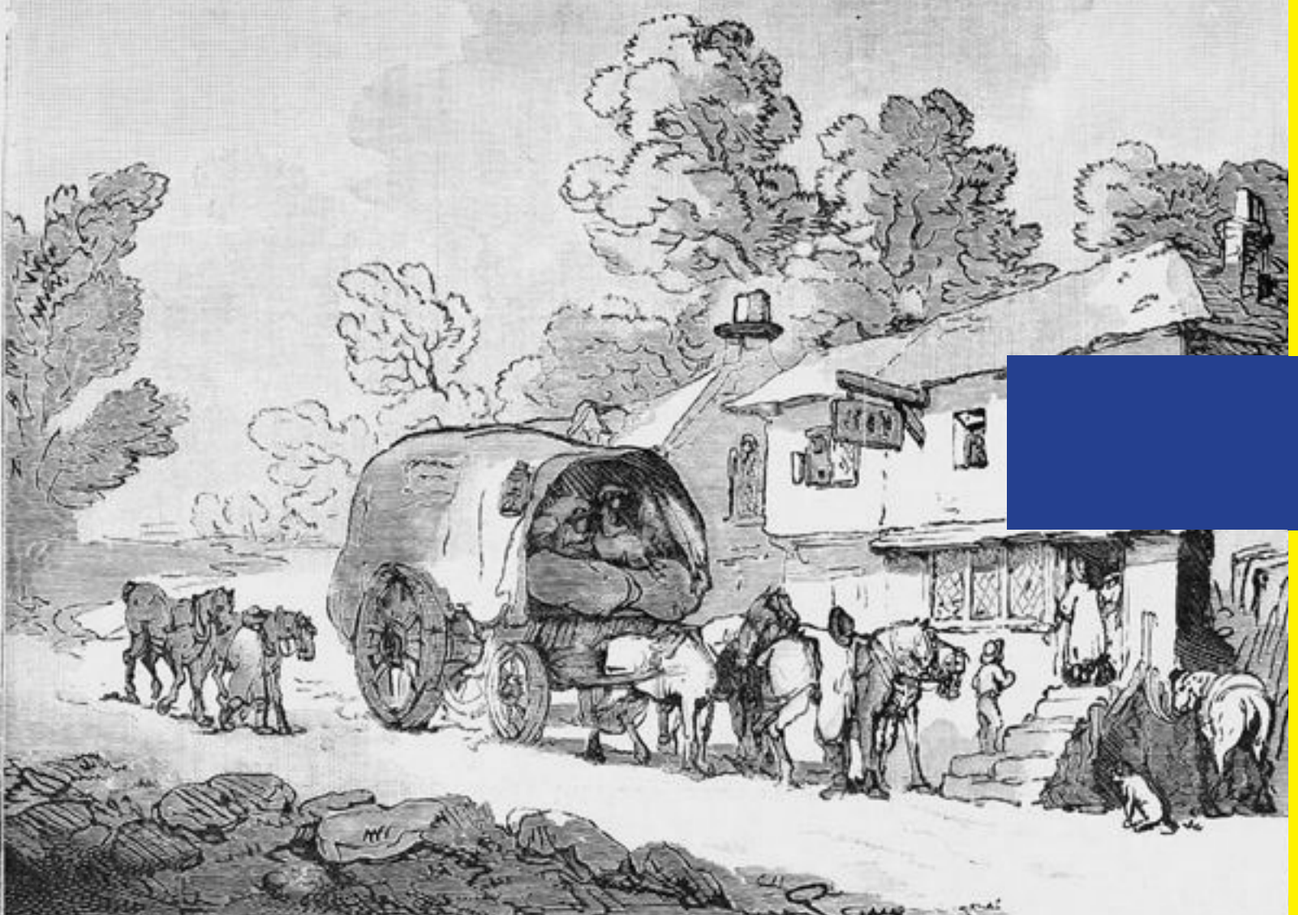


fig 1.1
early 17th century wheeled wagons that were used to move and stay were ever stoped.

3. ABSTRACT

WHAT WILL I DO AND WHAT ASPECTES TO I HAVE TO TAKE CARE OF SO AS TO ACCOMPLISH MY DESIGN

3. ABSTRACT

RATIONAL

In today's world resources are getting limited, nature is depleted to get resources, global warming is increasing in-turn changing weather condition drastically. Causing disasters such as droughts, floods, land slides, earth-quakes, tsunamis, eruptions of volcanoes.

Somewhere communal fights rises, interstate fights, wars between cities or countries. The political situations in cities, states or countries are getting very harsh, cor-rupt or unmanageable.

The economy is falling, losing opportunities for survival. He/she wants to go else where looking for something new in life, explore, running away from danger, settle, opportunities, relaxation, learn, discover and many more reasons to move.

About 8% of people in the USA have mobile homes.
7 out of 10 people want to travel around the world for different reasons.
As we grow our understanding changes and therefore our likes, priorities and hence movement becomes necessary.
Ever since an animal was created, it moved from place to place, grew understanding the surrounding and explored and still does to date.

AIM

Presently the homes are more rigid and to built a new home, the old is destroyed and the debris are a waste. Moving becomes expensive along with rebuilding, expand-ing or reducing. So as to over come all this, designing an amphibious prototype that's portable, both on land and water, flexible in space, recyclable completely, suitable in a wide range of weather conditions as well as terrains and the ability to grow in no with flexibility.

OBJECTIVE

Understanding portable architecture. HOW, WHY, WHEN, WHAT are some things to be understood. HOW are they built, using what material, geometries, construction technics. WHY was it built, for what purpose was it used for, and why is it not used know or more often. WHEN does it need to be replaced, changed or given for maintaince. This are some of the questions needed to be answered to help me develop the prototype.

Taking consideration of weather conditions and terrains and the effect that can be caused due to such conditions on the inbuilt environment. What can be done to prevent such condition or help resist and keep the inbuilt envi-ronment controlled at comfort level.

3. ABSTRACT

Explore the energy resources and advancement in technology, energy efficient usage, recyclable energy without losing everything completely. How can they be used in this prototype or can we modify new technology or even create for them to be used in this design.

Material exploration and compute new hypothetically material possible to over come the waste of resources as well as be used for a long run, perhaps for generations even.

Understanding flexibility through modular system and gemotries to derive a more suitable system for the prototype.

SCOPES

Who moves this days?
Travellers, Excavators, Researches, Artists, Explorers, Nomads, Army, Media groups or any individual wanting to seek for opportunities are beneficial.

Those looking for a one time investment. As energy efficiency, recyclable material and portability will reduce the cost of maintenance and future investments to move, grow or reduce.

Can a normal person use it?
Yes he could use the components in normal parmanent structures to help him expand, or even built an entire strucuture using this components soo as to help him move in the future or even expand and reduce.

LIMITATIONS

Technology - As we still are in search of new technology the possibilities can restrict the design of the prototype.

Material - Flexibility, lightweight, strength is all needed to accomplish the design. Such material are expensive to produce or even get.

Existing case studies - Their is no actual case study present to study. Therefore studying different aspects will be necessary.

Affordability - With all this hypothetical assumptions, the prototype can be expensive or even not.

Hypothetical - Most of the aspects will be assumptions and not actually experimented. While others will be created based on others ideas and knowledge.

METHODOLOGY

Identify and study the proposals made in various aspects.

Interpret theoretical laws graphically and explore the conceptual.

Understand the form of material available and been researched to help and built the conceptual practically.

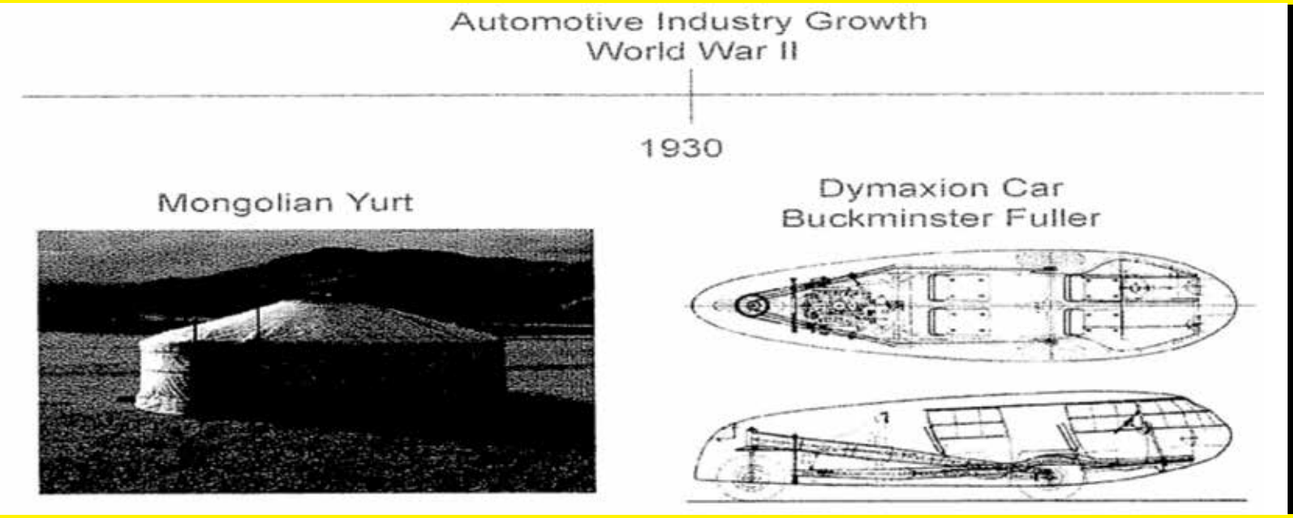
Explore the technology and mechanisms to help attain the feasibility of the form.

Propose a feasible design solution.

4. PORTABLE UNITS STUDY

SOME CASE STUDIES TO UNDERSTAND THE METHOD AND DESIGN ASPECT OF THE MODULES TO UNDERSTAND

4. PORTABLE UNITS STUDY



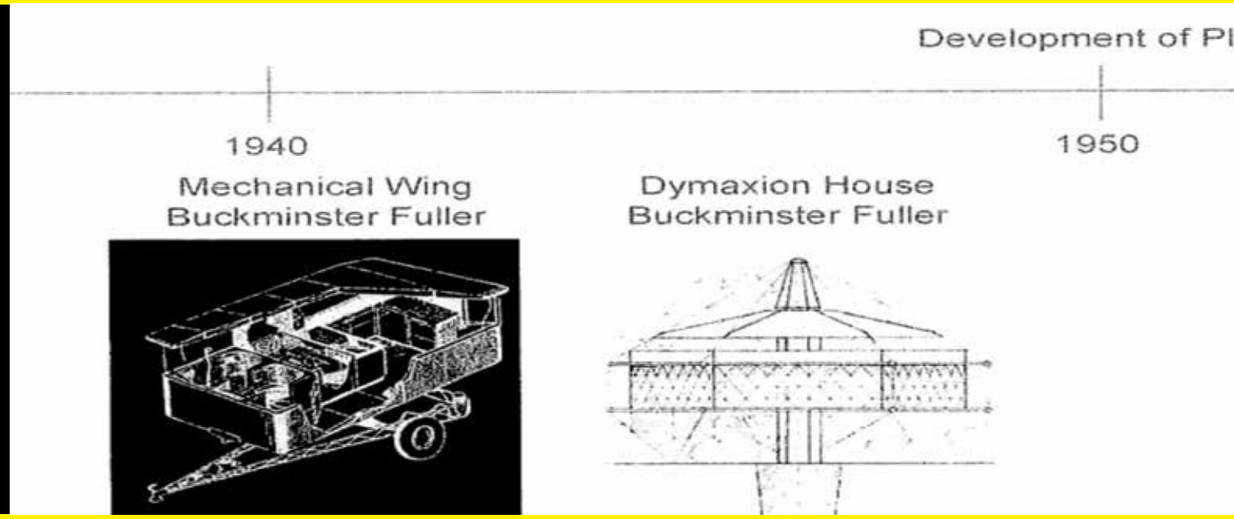
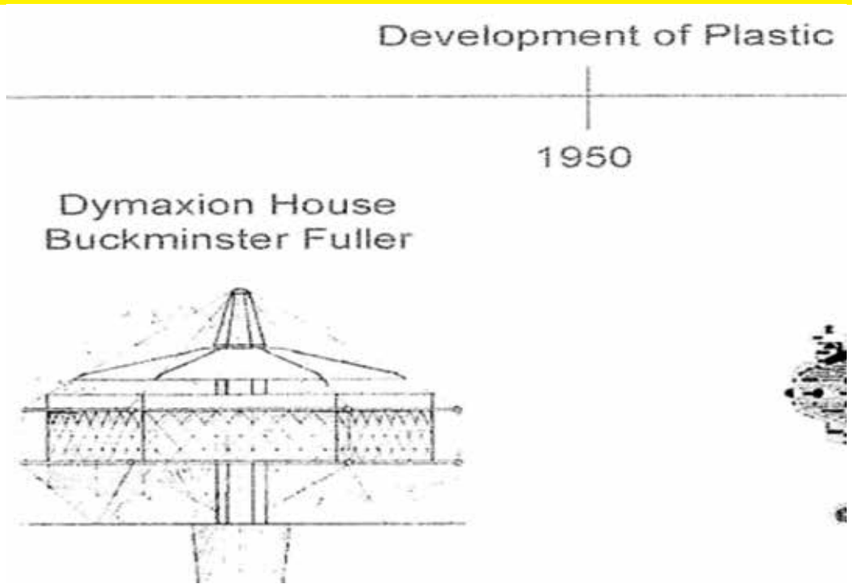
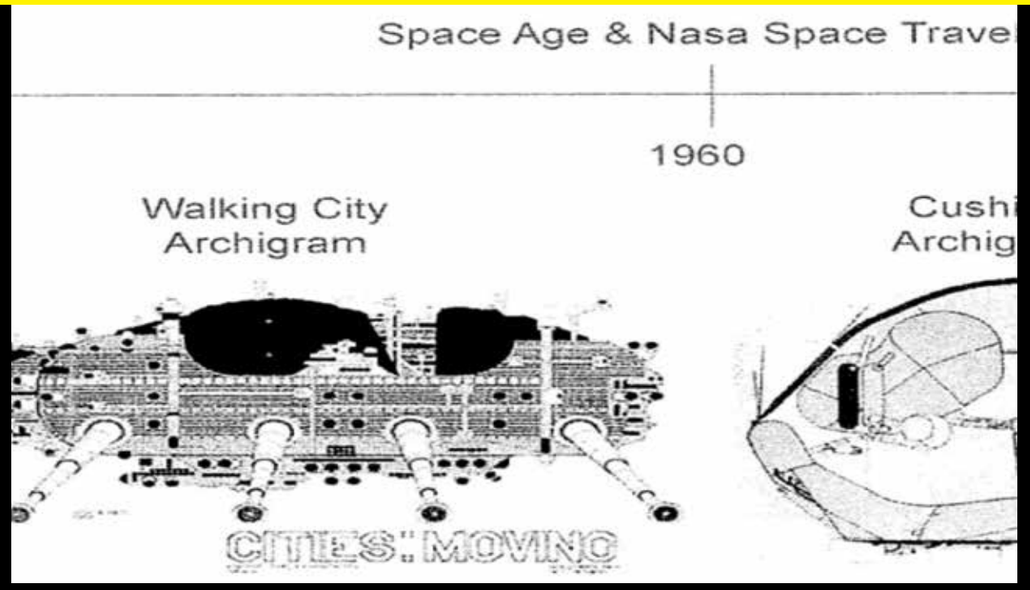


fig 1.1
A time line of the portable architecture



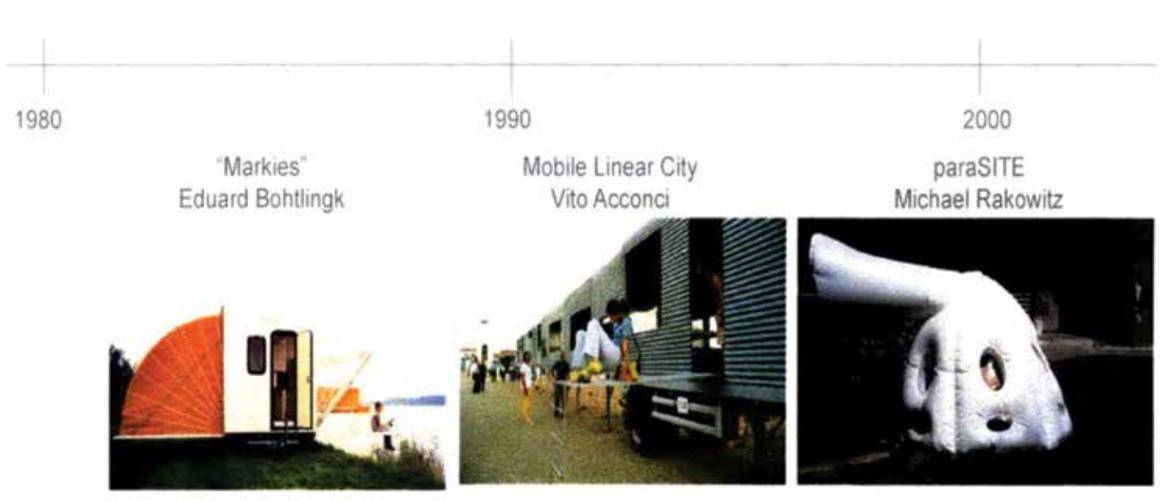


4. PORTABLE UNITS STUDY

fig 1.1
A time line of the portable architecture

The purpose of every module, typology, construction method, material etc, all have a specific reason behind it. The reason hav a vaste range from 1day use to life time, from one man use to mutipel people use, from dissaster relief to lavishness. Their are still explorations going on, but the purpose of building such units are always fixed.

Their are flexible units but the purpose remains the same. While have a look at some prototypes been made in this chapter. The reason to pick this module is, the purpose, lightness, and they can be moved and the vehicle itself helps to generate the erection and support.



4. PORTABLE UNITS STUDY

HONG KONG TOURIST ASSOCIATION PAVILLION.

HKTA(Hong Kong Tourist Association) wanted to promot Hong Kong as a tourist destination in European cities and exhibiting to the locals the tourist destination of their country and helping them with the travel packages. They were looking for a light weight structure that can be moved from place to place and could accomodate all the necessary exhibition material. The reason for them to adopt to such a module was the success of their first TBS Pavillion. Building a new complex and large pavillion that would attract more tourists was their challenge. Flexibility, Automated were some of the necessity that was required.

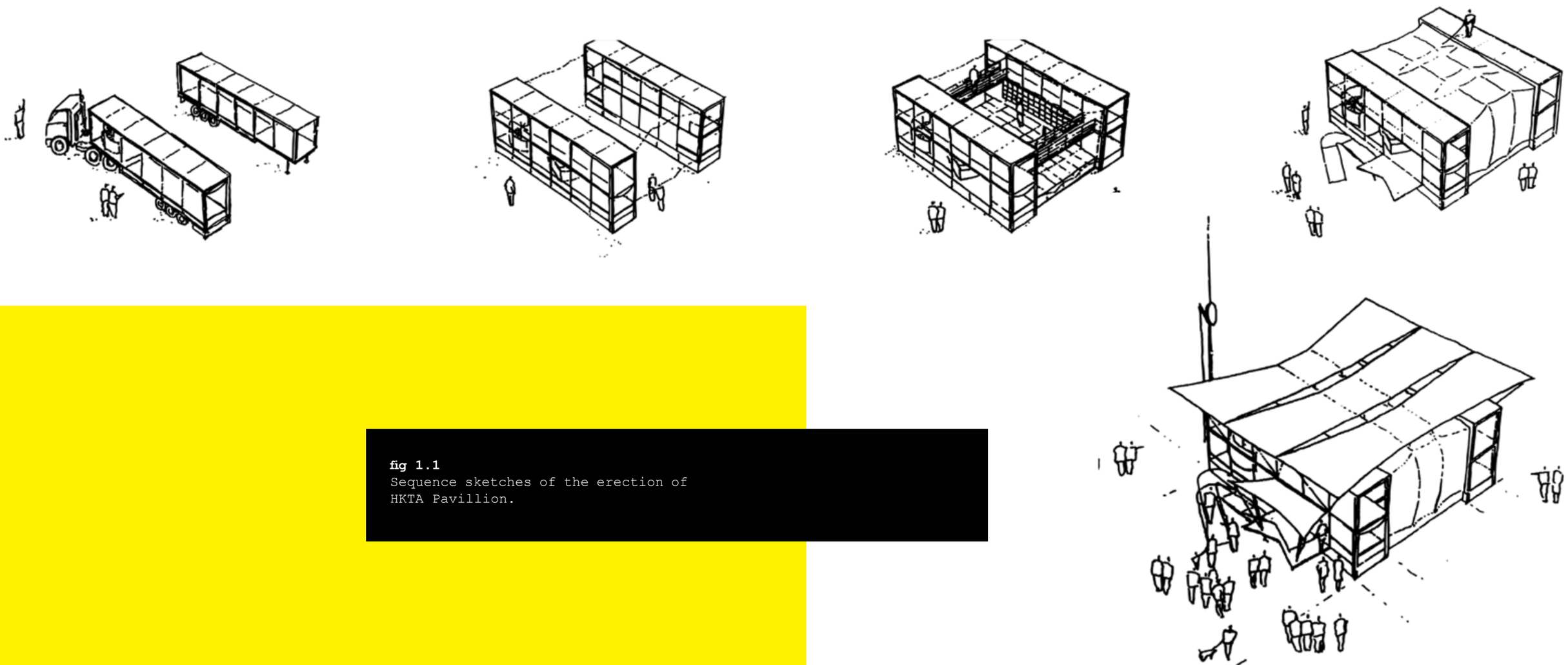


fig 1.1
Sequence sketches of the erection of HKTA Pavillion.

4. PORTABLE UNITS STUDY

The entire structure is carried by three 13.5m long regular trailers. Two of which carry the structure itself and the third consists of the air conditions plant, other parts such as the tensile material, furniture, generator and other structural components.

The first trailer is set into position and leveled using special systems that incorporates greased shoes that allow fine adjustments of lateral movement and allows positioning in relation to the second trailer

The two trailers then push the second level up using hydraulics that lock after erection. Then the trailers are attached with cables so as to allow the support system for the tensile covering.

Later the floors extrude from the trailers and are combined and the hydraulic shoes set them self to the ground for support. Two aluminum trusses also extrude and combine the trailers and give them the structural support entirely which are used as circulation on the first level.

The tensile material is then raped and tightened to the trusses that are supported by the trailers. They have ventilators between them, to help the inbuilt environment to be comfortable during summers.

fig 1.1
HTKA Pavillion, entrance elevation.

4. PORTABLE UNITS STUDY

The tensile material was later redesigned due to water vapor condensation on it during winters. A double layer skin was then used with hot air pumped into it continuously to heat the upper level. Keeping the entire inbuilt condition comfortable and a third layer over it to avoid direct sun to heat the inner layers during summers.

The structure could be expanded if necessary by adding up other components to it or even add up the trailers to expand. As it used modular system in the structural components

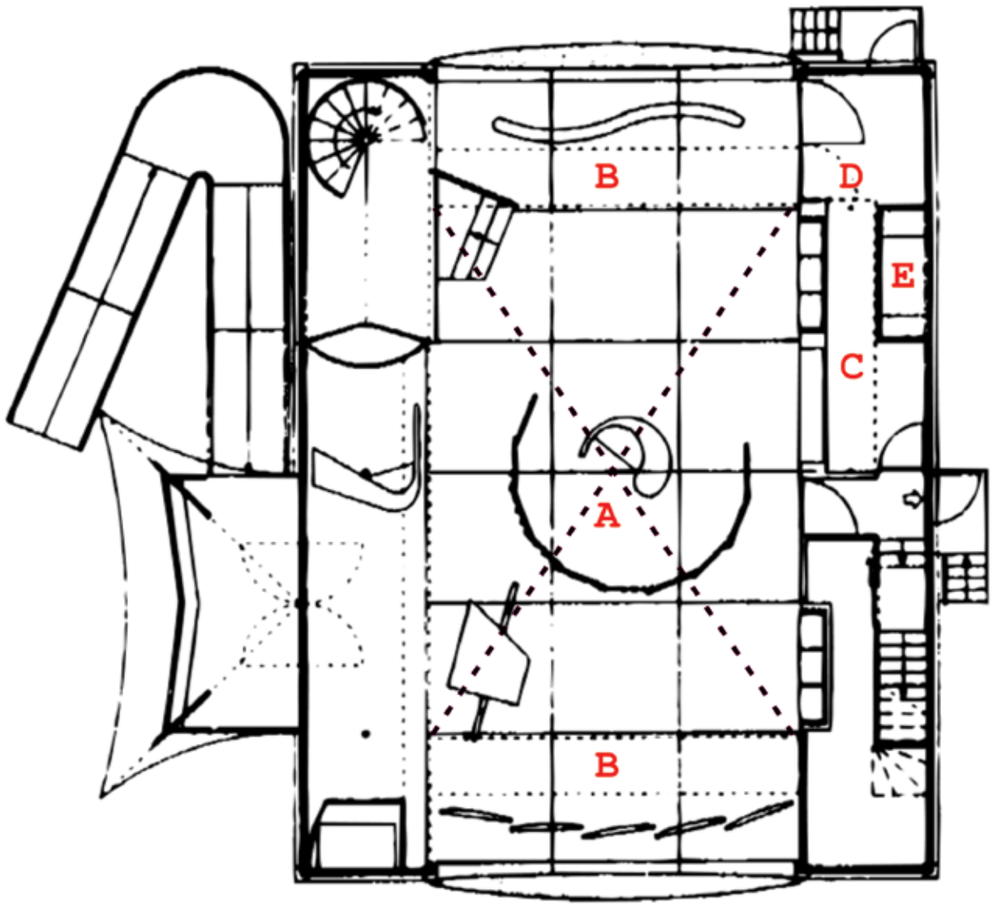
It takes 24 hours to erect with the help of six members. They don't have to do much work as its mostly automated. They just have to work for the tensile structure and the arranging the furniture as well as wiring.

The entire Structure is a two level building with two connecting stair case, and two connecters between the two trailers, Creating a double heighted center consisting of the exhibition area. One trailor consists of the services such as wash room, pantry, shower and changing area where as the other trailor has the entrance ramp connected to it that unfoldes when setted up.

The second level has meeting tables where interested clients will have their further talks and preparation of travel documents and visa preparation. It also has a small room were some storage can be available. The entire structure has three entry and exit. One for the visitors and two for the staff. Where one is connected to the staicase and the other to the pantry area. The area between the trailors is entirely ment for exhibition.

fig 1.1
Interior view of the second level

4. PORTABLE UNITS STUDY



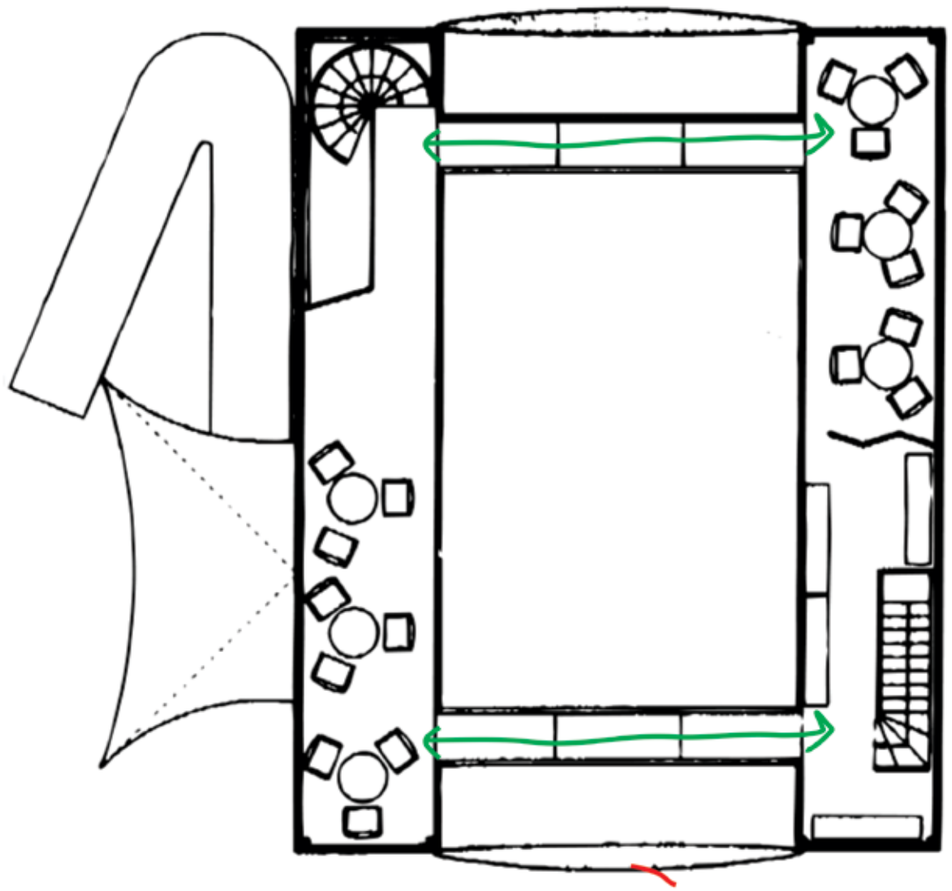


fig 1.1
left plan at level 1, right plan at level 2

Areas at level 1

Reception	A
Exhibition area	B
Changing room	C
Pantry	D
Washroom	E

Areas at level 2

Discussion area

Area transformation of the units

90 m2 = 250 m2
300 m3 = 1000m3

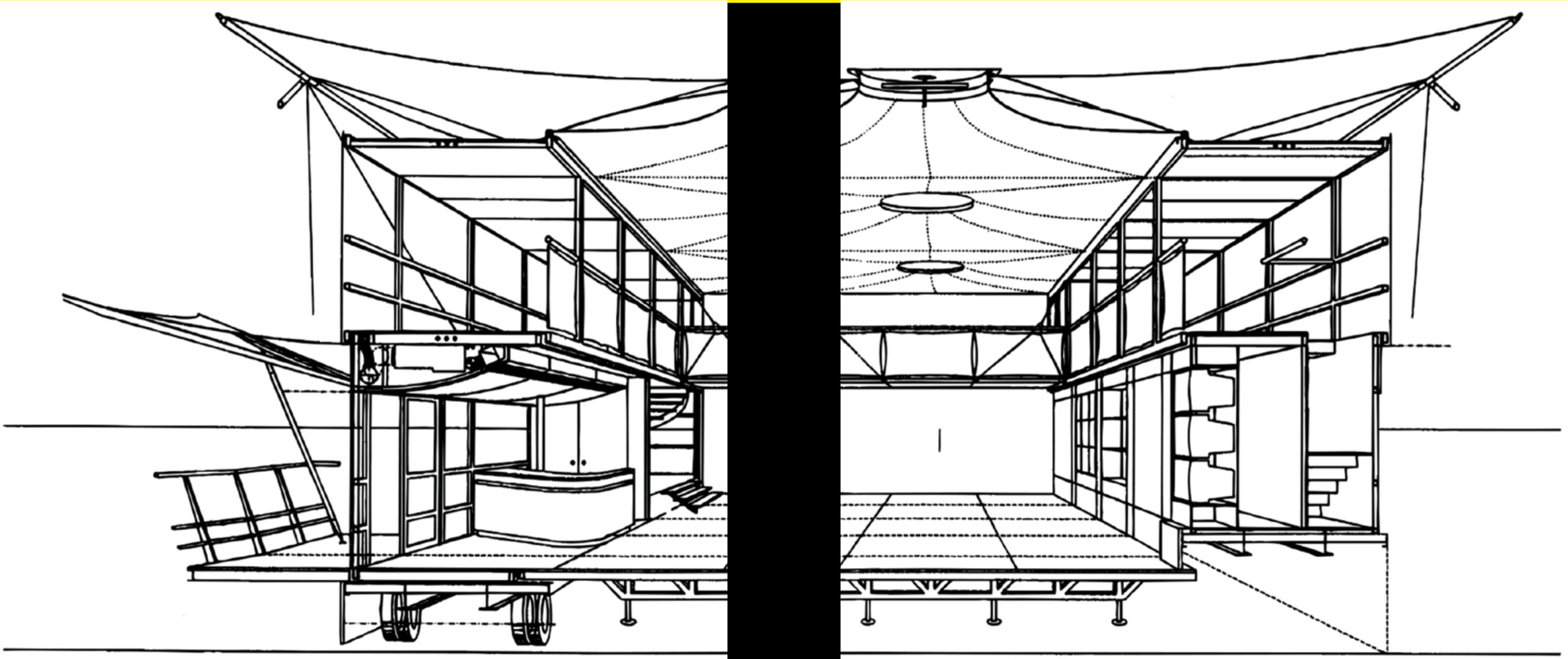


fig 1.1
Cross-section of the HKTA paviol-loion.

4. PORTABLE UNITS STUDY

PORTABLE HOUSING UNIT, VENICE, USA.

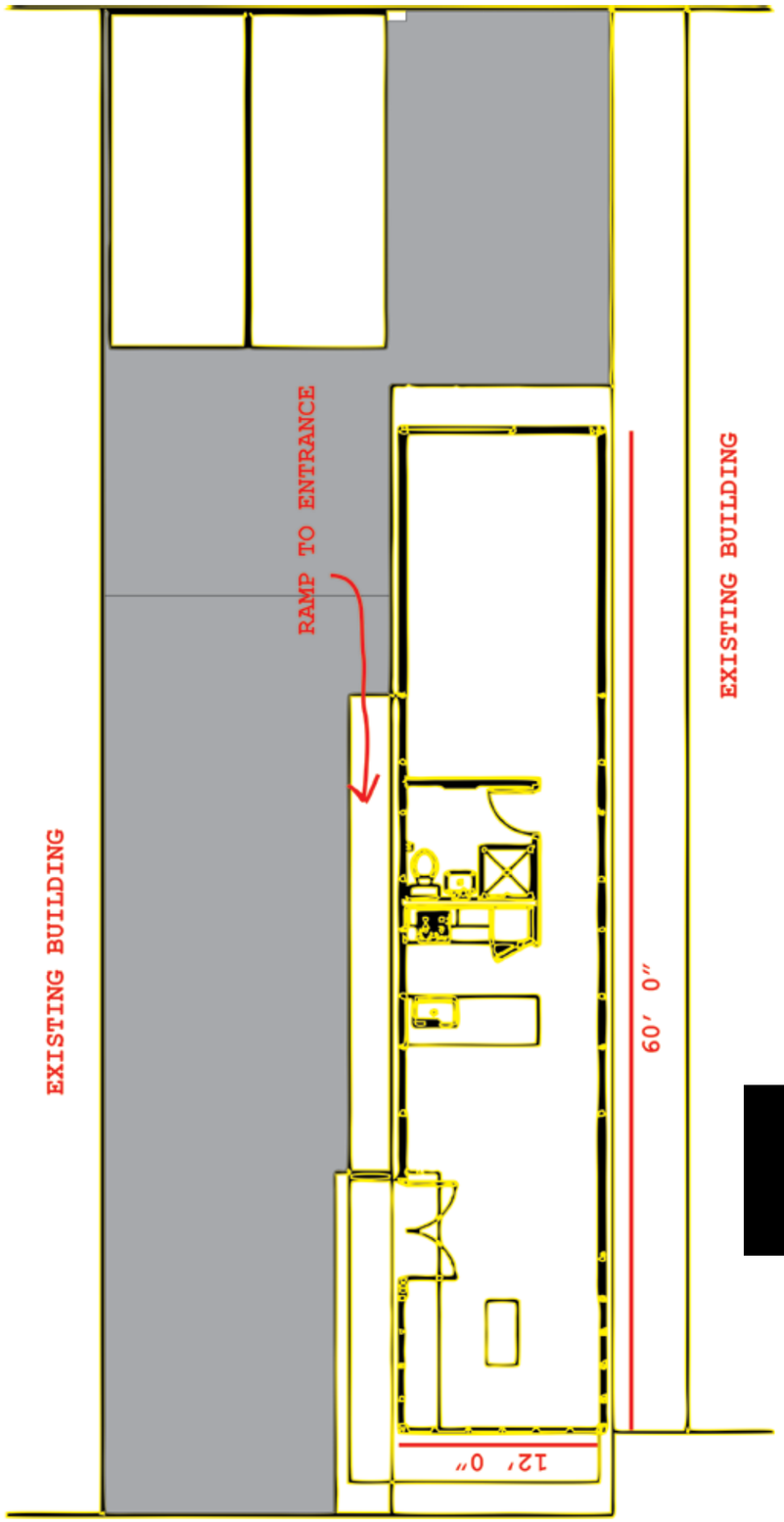
Built for almost a quarter of the North American new housing. Costs less then prefabricated structures and are of the same quality. The module is more of a do-it-yourself, self-helped approach in creating the module. Were the design is open and does not have much in the interior apart from the services such as kitchen module and shower/W.c module. It's a redesign of a typical mobile house of the Americans but a rather more permanent building then temporary. Workable in all climate conditions due to the conventional material used.

The basic module is a 3.5m by 18m long steel frame structure. Secondary framing is made of timber from renewable resources. External cladding with metal sliding and translucent polycarbonate panels internally with sustainable floor and wall materials. durapalm a non-wood flooring material made from Asian coconut palms; plyboo, a bamboo flooring system; wheat sheet, made of recycled wheat fibre and used in walls as an alternative to particle board and medium density fibreboard (MDF)

Even thou the module is a 3.5 x 18, it can be expanded using the same module to double or triple depending on the user. The module is manufactured in the factory then taken to site and assembled. It takes about four to eight weeks to manufacture depending on the user. it costs 15% less then convention building even after transportation and assembling on site. And takes about 2hours to install on site if it's a one story custom module. Before installation the foundation is done on site while manufacturing is going on to save on time.

fig 1.1
HTKA Pavillion, entrance elevation.

4. PORTABLE UNITS STUDY



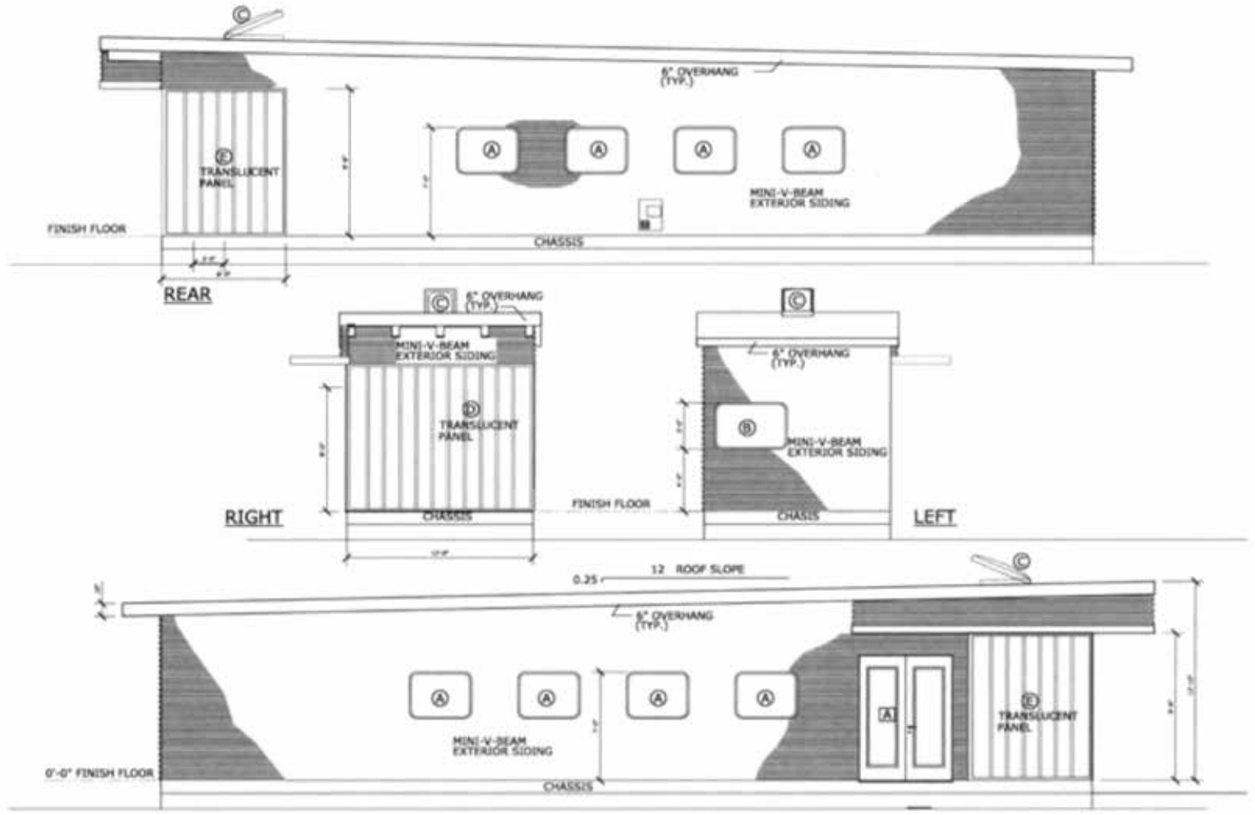
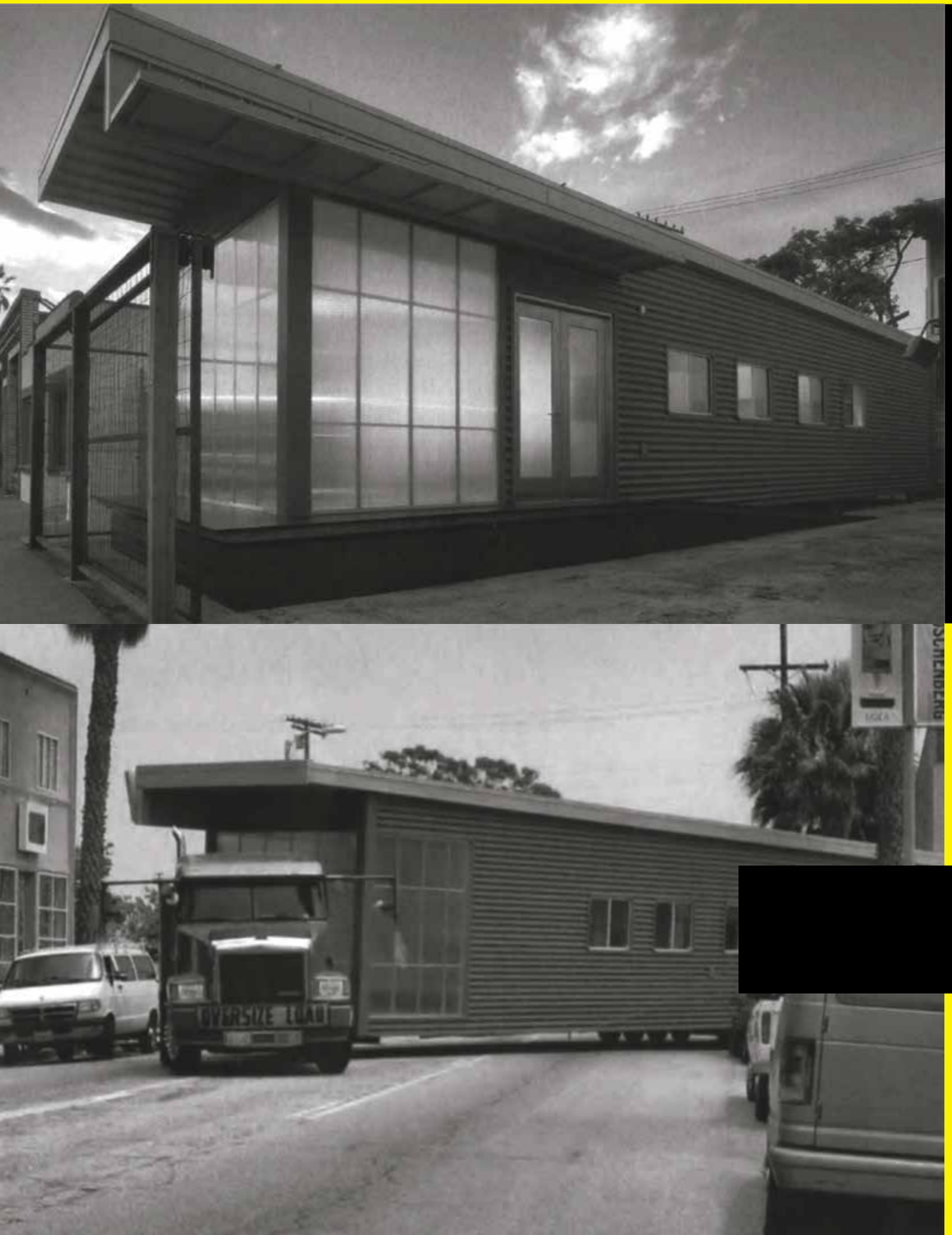


fig 1.1
left a typical one module plan and above are the four different elevations

4. PORTABLE UNITS STUDY



- Modules can be towed by a trailer.
- light weight
- customized to be used as other function such as class-room or site office.
- easy to resite if it's a single module building, al-though its also possible for double or more but its complex.
- wiring and connections are done once installed.
- multiple of 70m square.
- Conventional building construction technics.
- essily moved around highways, but hectic in tight urban context.

fig 1.1
left, A module been transported in the urban fabric, top an installed module on site.

5. CONCEPTUAL

IDEAS AND THOUGHT FOR THE DESIGN TO ACCOMPLISH THE DESIGN AIMS

5. CONCEPTUAL

ALIEN GEOMETRY ILUUSTRATION BY CROTALIDAE

Geometries can be simple and at the same time can create complex geometries within itself. A simple box attached to other boxes and stacket, rotated at different angles gives complexity and beauty to that simple box.

The image below can be seen with a use of three differnt elements can create amazing comploexity and spaces.

SPACE FRAME STRUCTURES

We can see around as, the use of space frame structure has solved lots of issues such as span, lightness, strength, flexibility and may more issues. They are been used from a small frame building to space shuttles. Using this ideology to help me design the prototype will be very necessary.

ADVANTAGES

Loads are distributed more evenly to the supports. This can reduce the cost of the supporting structures especially when heavy moving loads may be applied

Deflections are reduced compared to plane structures of equivalent span, depth and applied loading, assuming that the structural elements are of similar size.

The statical redundancy of space grids means that, in general, failure of one or a limited number of elements, for instance, the buckling of a compression member, does not lead to overall collapse of the structure. There have been exceptions to this, notably, the collapse of the Hartford Civic Centre, Coliseum, space truss roof in January 1978. It depends which members fail and whether an adequate alternative load path exists.

Space grid structures are resistant to damage caused by fire, explosion or seismic activity. Unless critical elements (e.g. those adjacent to individual column supports) are removed or weakened by explosion or fire collapse is unlikely for the same reason as above.

Modular space grids are usually factory fabricated (thus producing accurate components) easily transportable and simple to assemble on site.

fig 1.1
Cross-section of the HKTA paviolloion.

DISADVANTAGES

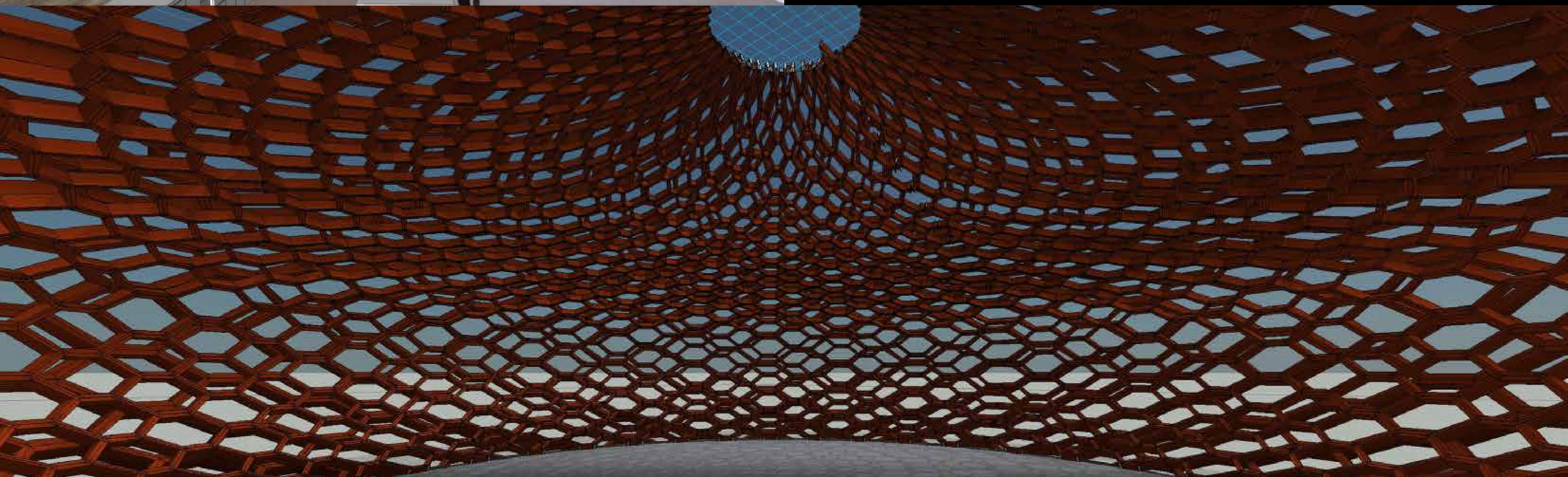
When space grids are used to support floors some form of fire protection may be required. This is difficult to achieve economically due to the high number and relatively large surface area of the space grid elements.

The standardised modular nature of most space grids can impose a geometric discipline of their own. This sometimes makes difficult the use of irregular plan shapes and imposes control on the location of supports.

The number and complexity of joints can lead to longer erection times on site. This is obviously very dependent on the system being used and the grid module chosen.

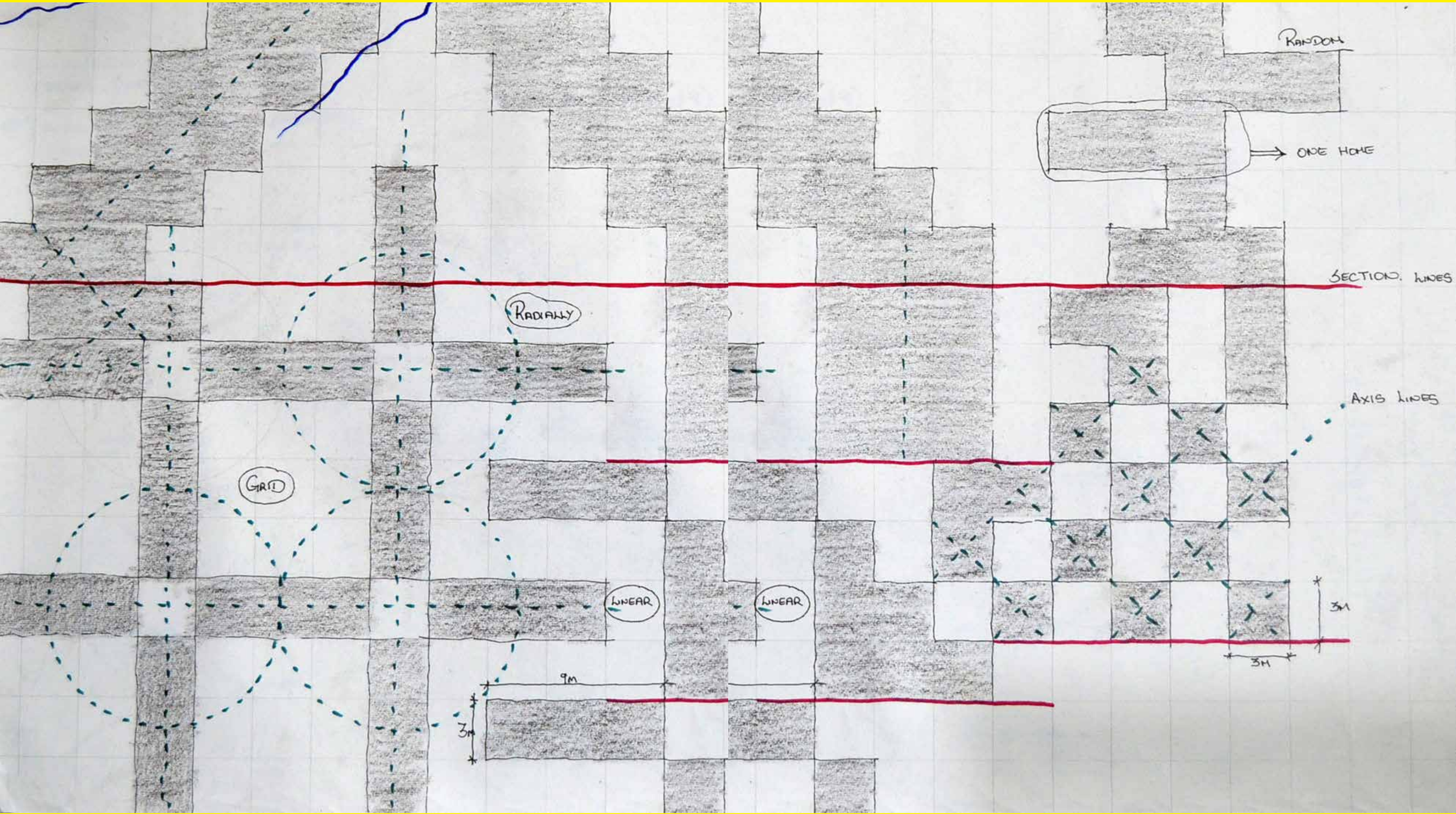
The main criticism of space grids is their cost, which can be high when compared with alternative structural systems. This is particularly true when space grids are used for short spans. The definition of a short span is very dependent on the system under consideration but less than 20 to 30m can probably be considered short.

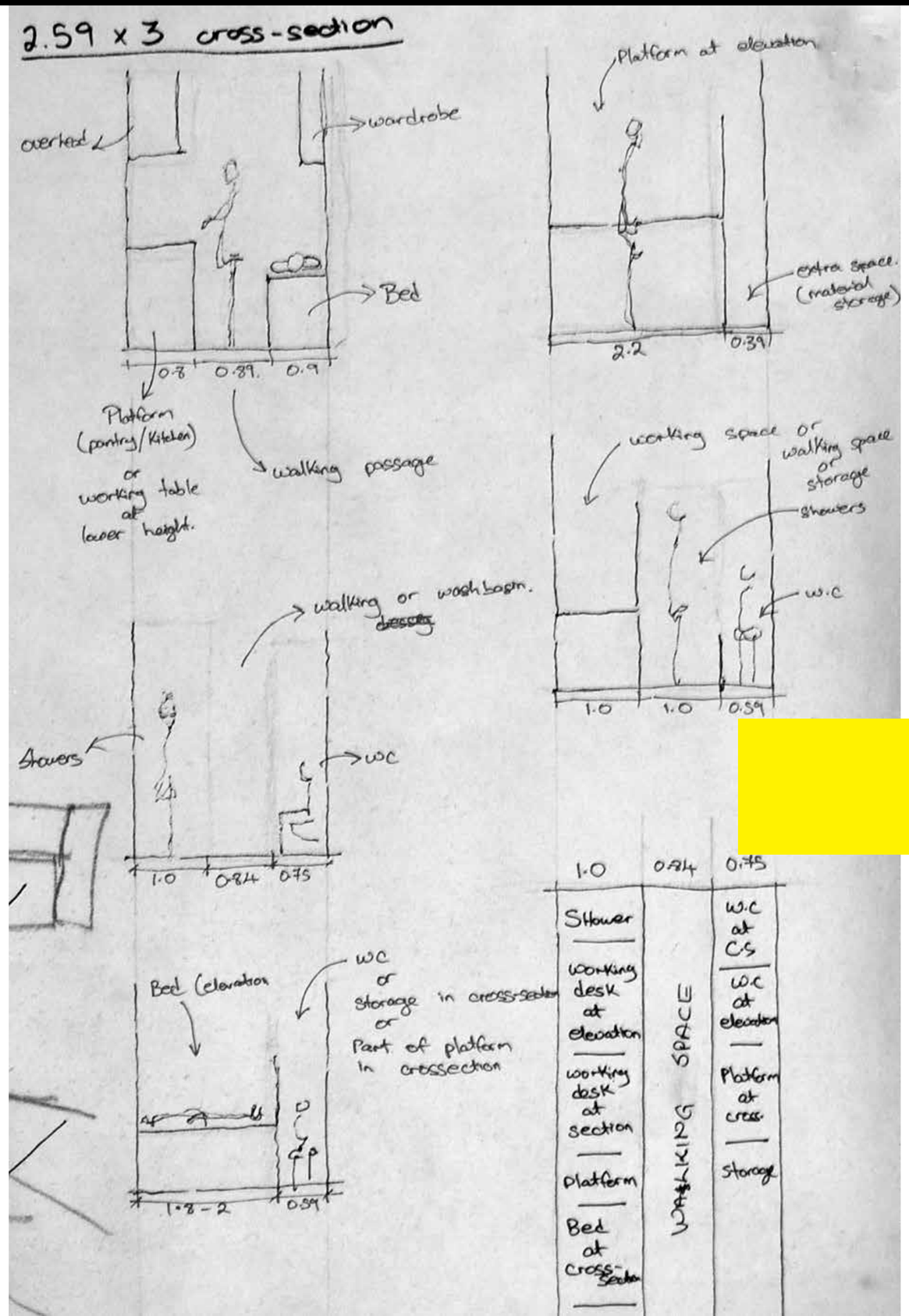
fig 1.1
Cross-section of the HKTA paviol-loion.



5. CONCEPTUAL

SIMPLE SPACE FRAME GEOMETRIES USED IN CONVENTIONAL HOUSING. CREATING COMPLEX VISUALS AND SPACES. ITS ALL ABOUT PLAYING WITH THE GEOMETRIES AND COMPONENTS.





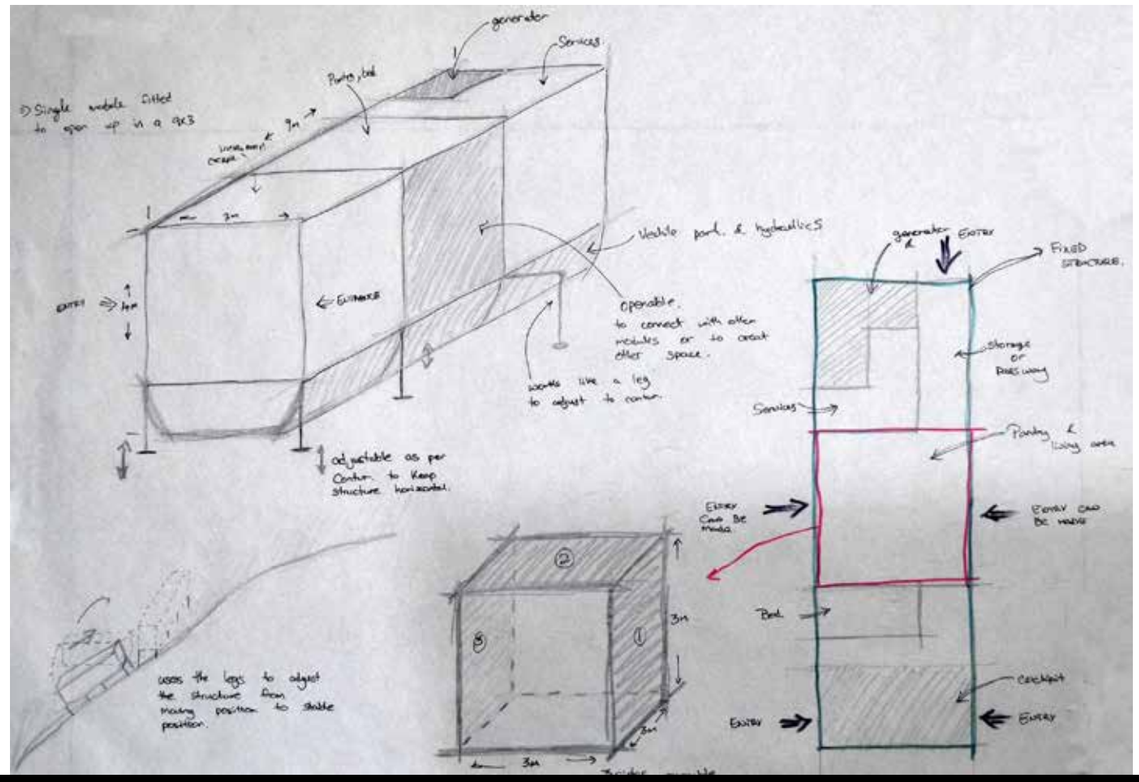
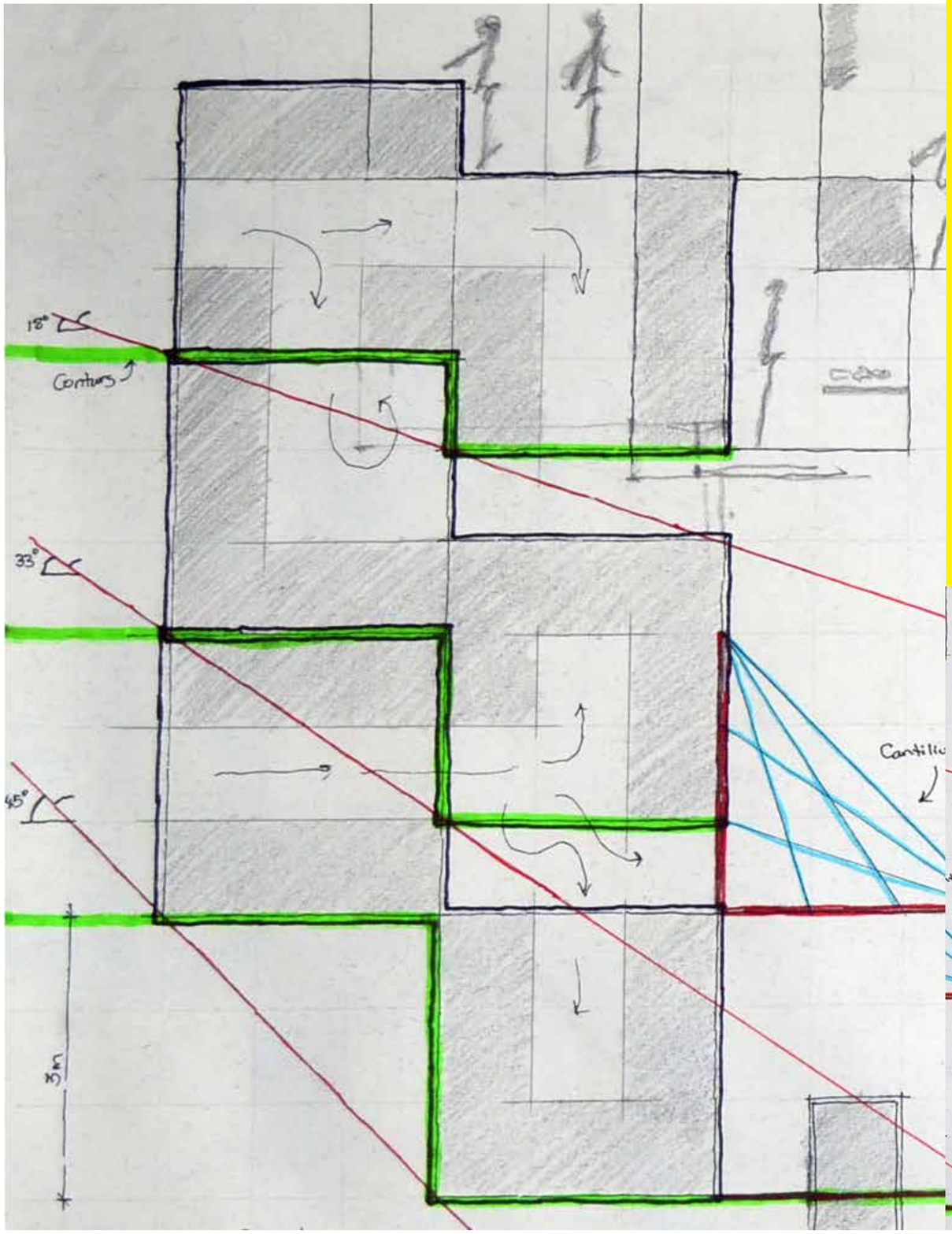
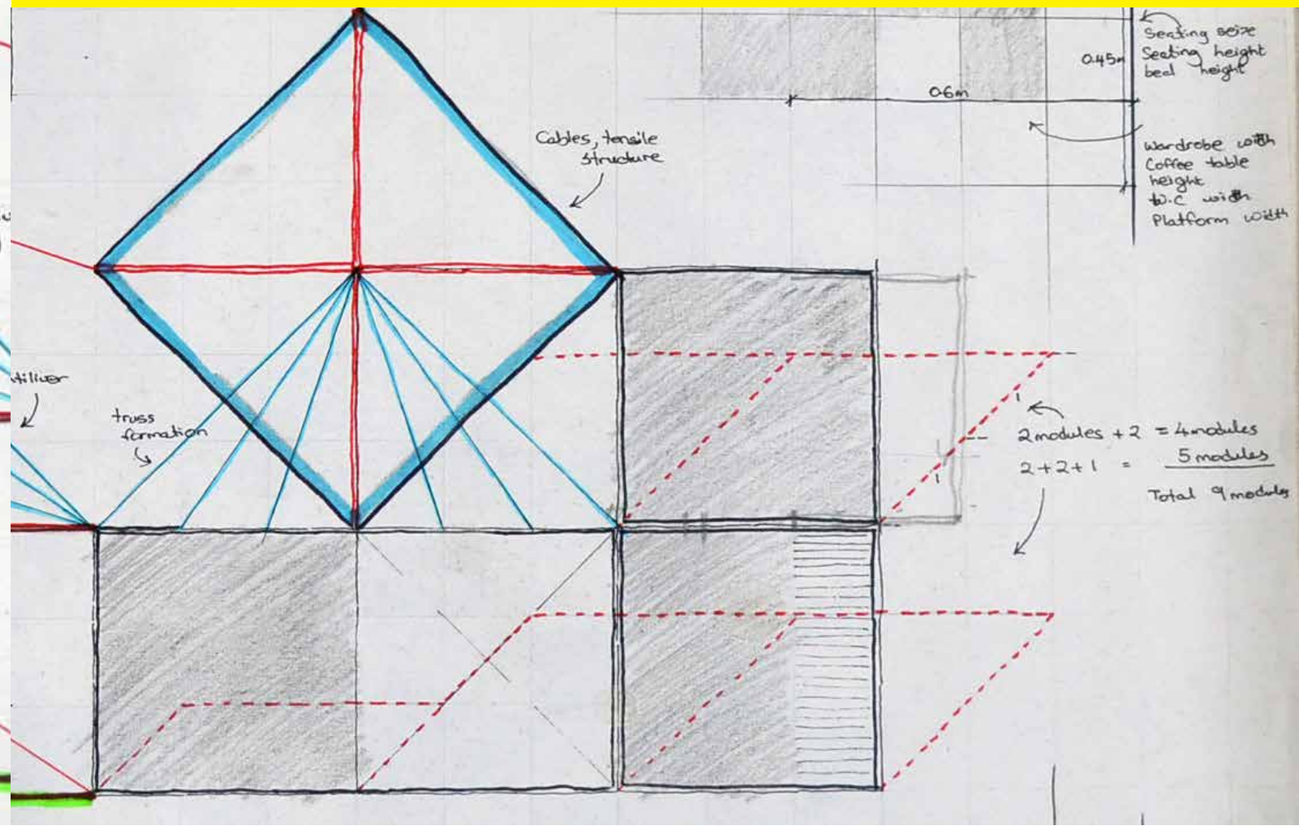


fig 1.1
Understanding human anthro and dimensions of a vehicle.

5. CONCEPTUAL

COMBINATION AF MODULES TO CREATE A PROTOTYPE. MODULATION OF SPACE TO GIVE THE FLEXIBILITY.





5. CONCEPTUAL

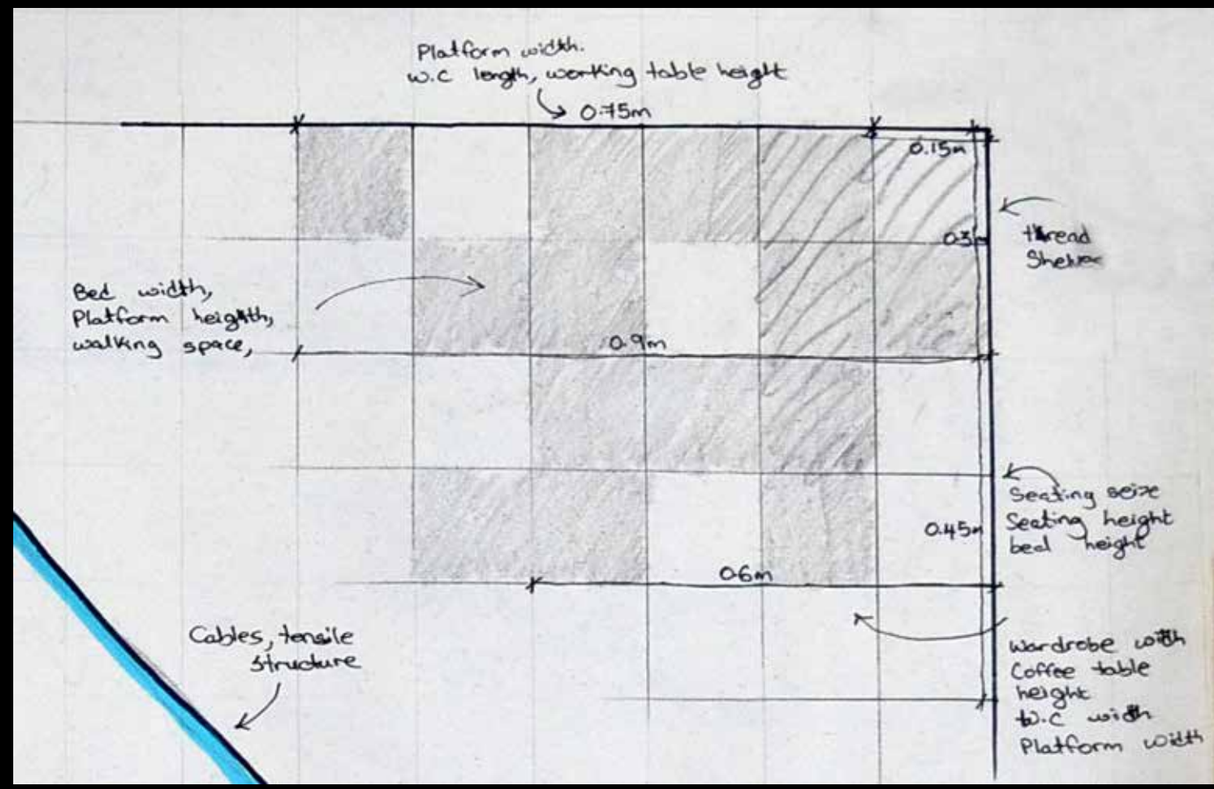
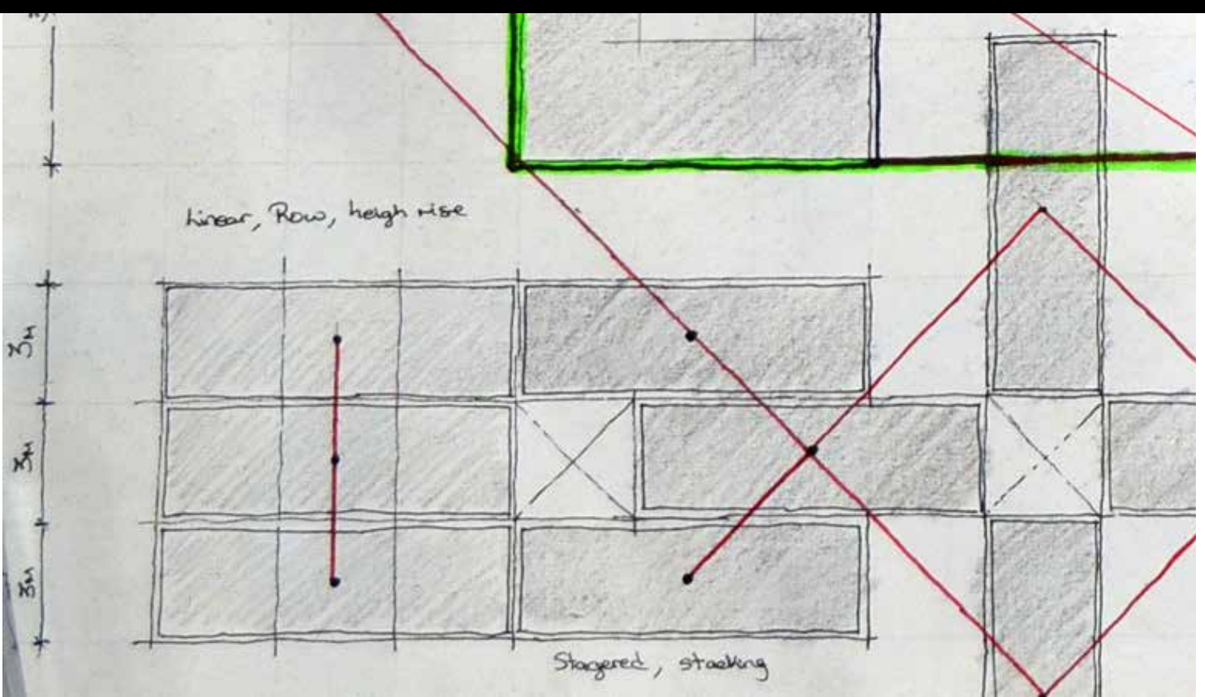
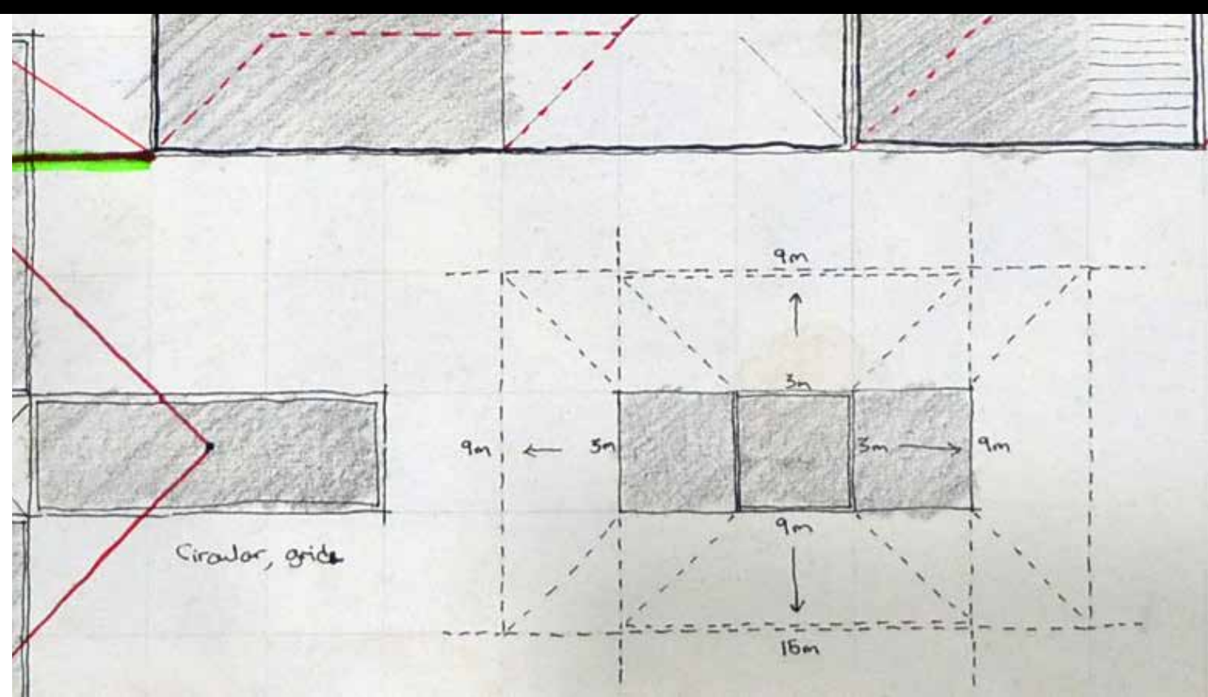


fig 1.1
above, Modulation of the components
below is the formation of settle-
ments



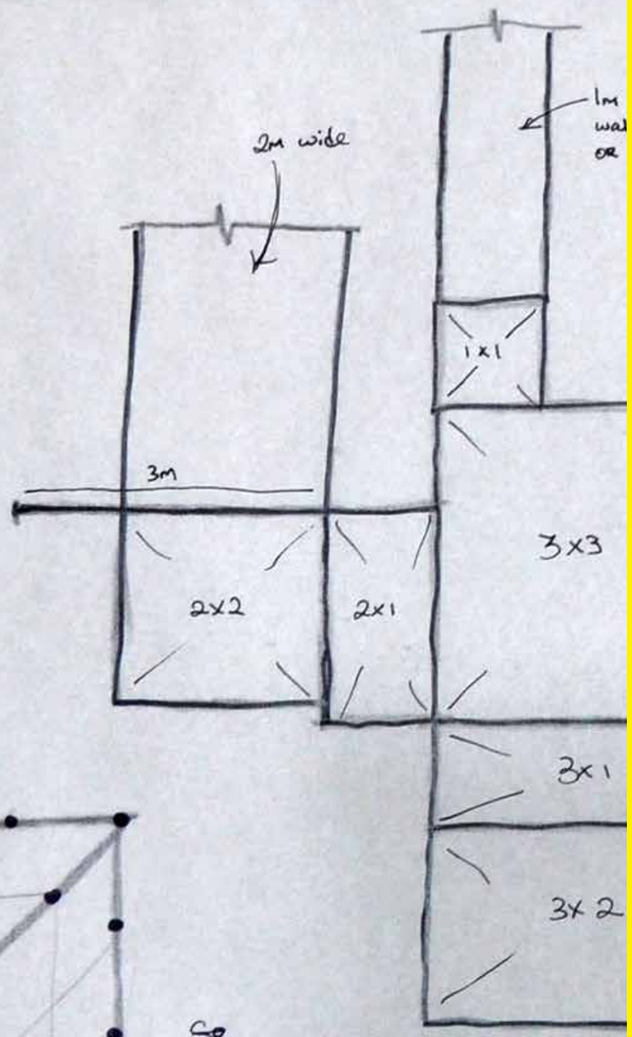


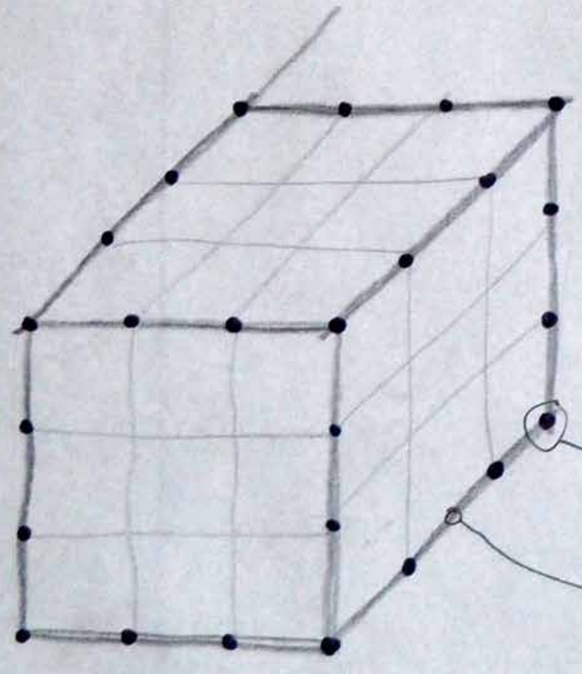
5. CONCEPTUAL

=> EXPAND OR REDUCE AS PER USER

=> USER HAS EXTRA COMPONENT

=> FLEXIBLE CLOTH OR TENSILE CLOTH

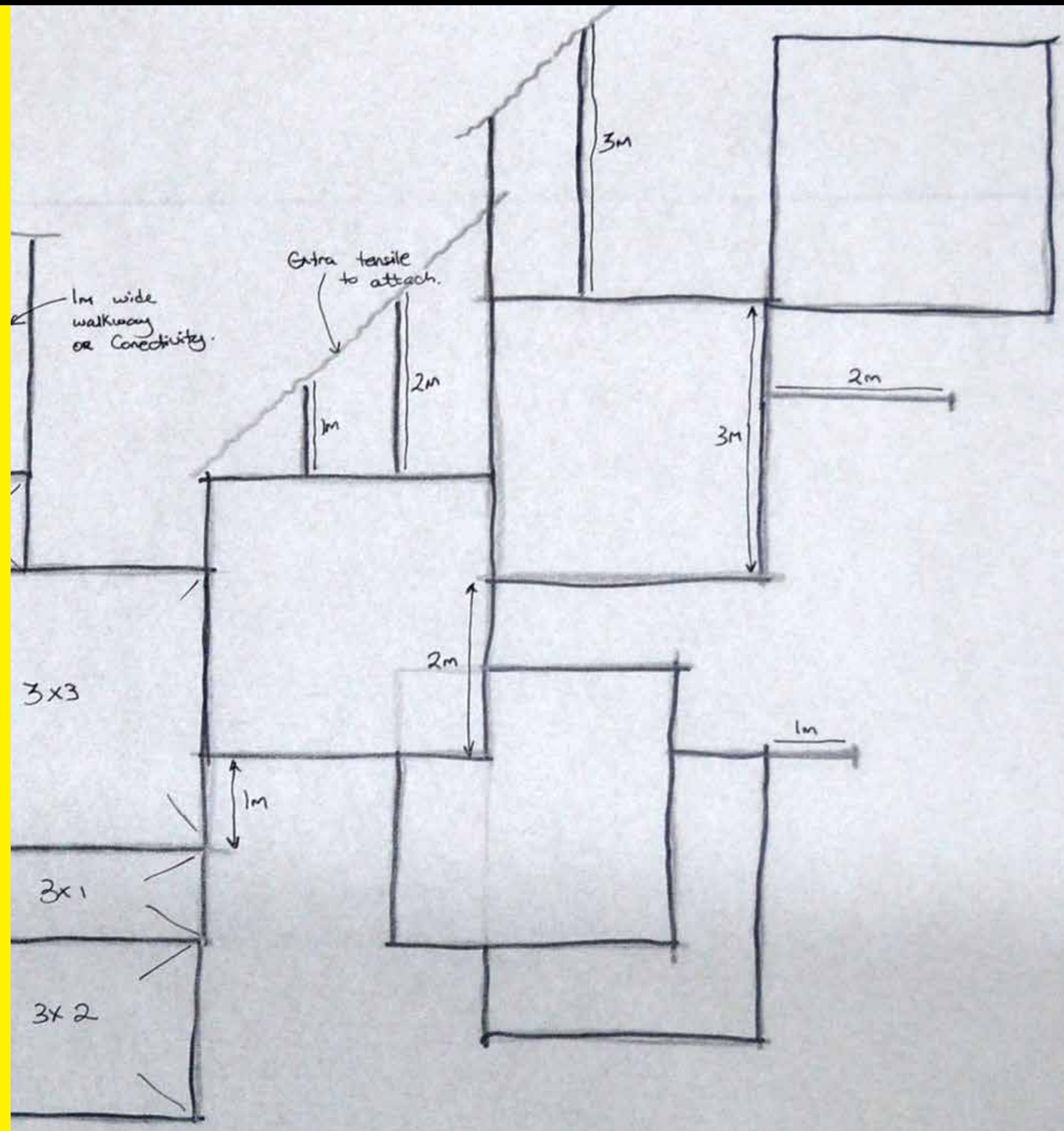




SR
STRUCTURAL system

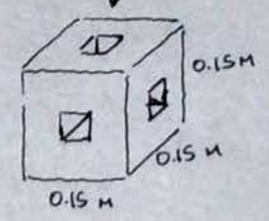
Joinery nodes.

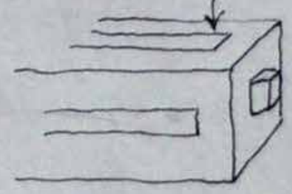
Column or Beam Rods.



Joinery nodes

Joining GROOVE on all six sides.





grooves to let
or slab Ax. all

Tongue to join
the nodes.

Size 1m, 2m or 3m.

6. FACTORS TO CONSIDER

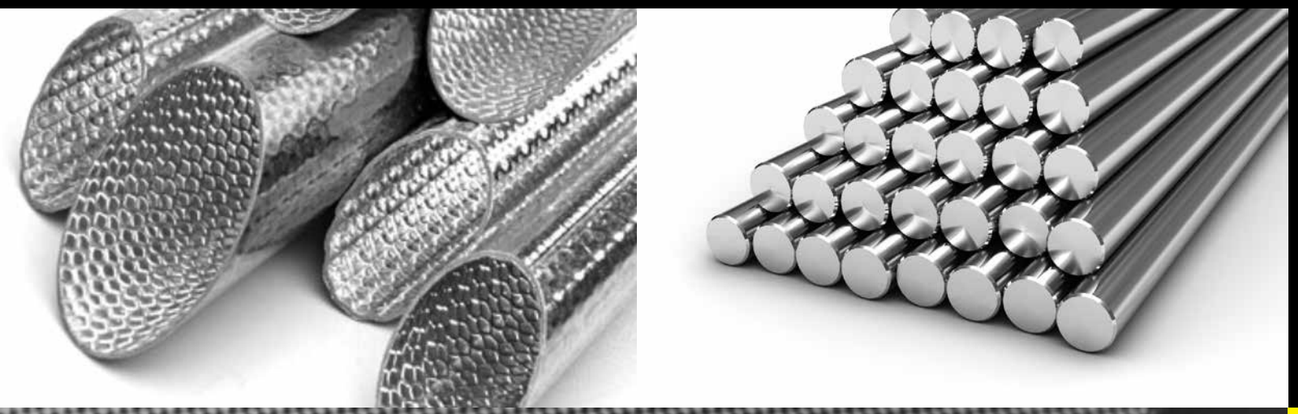
SOME FACTS NEED TO BE TAKEN CARE OF BEFORE FURTHER DEVELPING THE CONCEPT

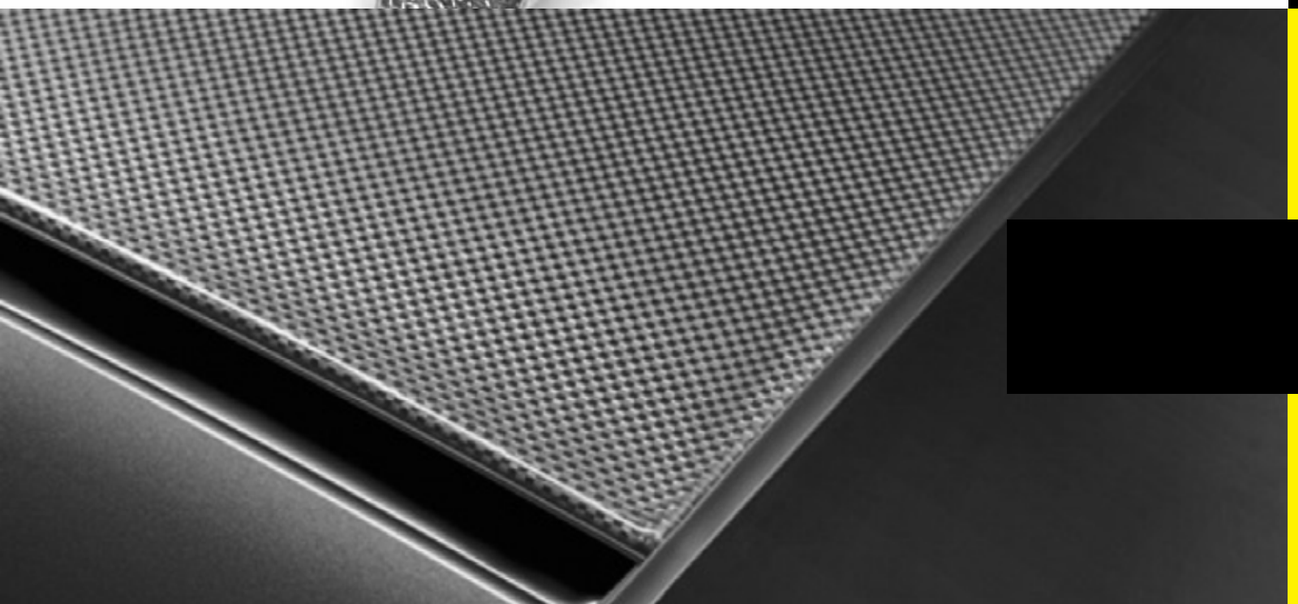
6. FACTORS TO CONSIDER

MATERIAL

Their is a wide range of material But what to use is the big challenge. New materials have been discovered to help accomplish the materials been used in Portable Industry. To help me desire about this prototype, I need materials that are light, strong as steel or even harder, floatable, mouldable in any form desired.

They are new materials available but the production is limited up to date. Researchers are still on the move of creating large quantities. The Design is more of a futuristic approach, But to make it more feasible the materials present needs to be used. We will have a look at some of the properties of the Material that will be used in the prototype.





METALS AND ELEMENTS USEFULL FOR STRUCTURAL COMPONENTS

Steel and Titanium

- Steel has an excellent forming properties, heat resistant, high corrosion resistant, tensile strength.
- On the other hand titanium is also similar to steel but has higher strength properties and has a low density comparatively.
- Titanium is been used in areospace industries to manufacture components that are strong and light.
- Titanium can be alloyed with iron, aluminium, vanadium, molybdenum.

Aluminum

- Light and strong though not as strong as steel and iron.
- Poor conductor of electricity and thermal and doesn't corrode as well.

Carbon Fiber

- Strong as steel and very light compared to it.
- High tensile strength, high chemical resistant, high temperature resistance and has low thermal expansion.
- This properties will help give the strength and lightness needed to board on water.

fig 1.1
Left top, aluminum rods, right, steel rods, and bottom, carbon fiber sheet

6. FACTORS TO CONSIDER

PLASTIC AND ELEMENTS USEFULL FOR IMPACT ABSORBTION

ABS (Acrylonitrile Butadiene Styrene)

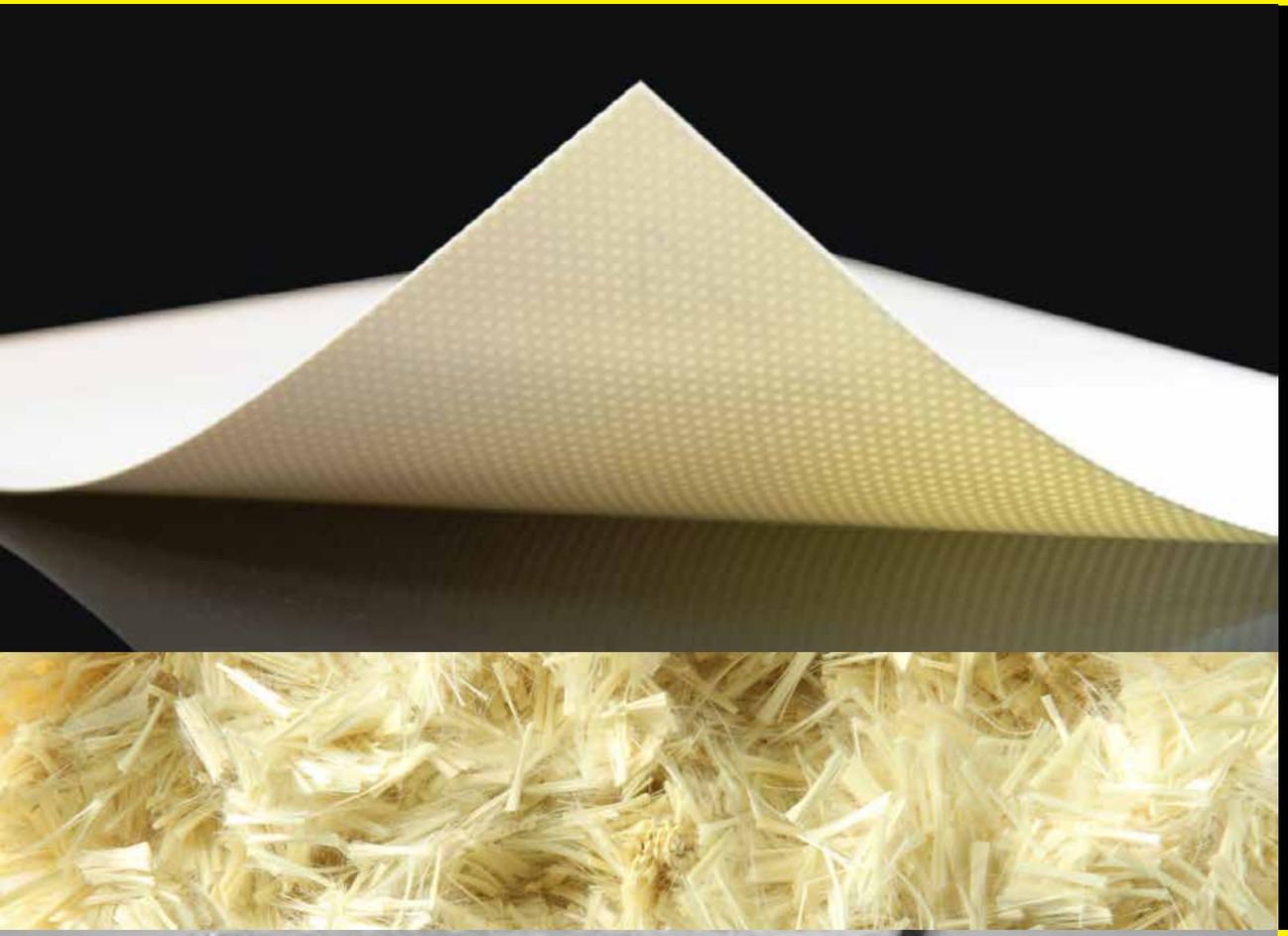
- High impact resistance and toughness.
- Chemical resistant and can be made with different variations by changing the polymers and preparation methods.
- Very useful material for coating and shock absorber.

Sorbothane

- It absorbs more than 90% of shock energy and more than 50% of vibration energy.
- It performs in temperatures ranging from -20° to 160° Fahrenheit (-29° to 72° Celsius)].
- It performs at frequencies ranging from 10 to 30,000 Hertz.
- It's damping ratio is 0.344 at 2.34 HZ.
- It doesn't support bacterial or fungal growth and is relatively unaffected by industrial solvents such as diesel fuel, kerosene, and hydraulic fluid.
- It has an extremely long shelf life and It has a superior damping coefficient.

fig 1.1
top, ABS sheet, bottom, Sorbothane.

6. FACTORS TO CONSIDER



OTHER USEFUL MATERIALS

Poly-carbonate, PMMA, PEEK, Polyamide, poly-phenylsulfone, ultem.

- This are some of the resins that will can to coat the overall structure due to their chemical resistance, heat resistance and good absorbers as well.

Nano tubes

- Very strong and has great tensile strength as well, stronger then steel as well with one sixth the density of steel.
- still an advance material and be produced to very limited amount.

PTFE (Poly Tetra Fluro Ethlene)

- It's a tensile material that has a life span of more then 20 years.
- Waterproof and also chemical resistant to a given chemicals.
- It can be used to create tensile structure or even be used to create covering and partitions.

fig 1.1
top, PTFE, middle, PMMA fibers, and bottom, nano tubes

6. FACTORS TO CONSIDER

WEATHER CONDITIONS

All of the above material specified, can work in a great range of temperature. Some of the shock absorbing material will work in a low range. The smallest range is between -20°c to 80°c. At this range all the other materials can work perfect. The prototype will therefore have a workable range of -20°c to 80°c before it starts to malfunction due to the material.

Therefore we can conclude that the prototype can work in cold and hot climates. Ranging from desserts to snowlands. The material are also very good thermal resistance as well as thermal expandtion. So the interiors will be well protected from the sorrounding climate.

TERRAINS

The vehicle used is manfactured to move in all kind of terrains apart from the rocky, high steep and moody terrains. As the vehicle has all axel drive, so moving on snow, sand, minimal rocks, muddy to some extent is possible. The vechile is designed in a way that it can travel on water as well. So going in lakes, Rivers, sea, ocean is possible as well. To an extent the tides are very low.

fig 1.1
left, dessert, left bottom, greenland area, bottom, snow regions.

6. FACTORS TO CONSIDER

TERRAWIND VEHICLE

The Terra Wind is a first class motor coach that is as comfortable on the lake as it is on the land with a highway speed of up to 80 mph and up to 7 knots on the water. It has a 330hp caterpiller engine, 13m long and 2.9m wide. It can modified with axel systems that can move on any terrains.

TECHNOLOGY

Technology is a great factor to consider as the world today has great invensions made. For instant we have MR (magnetorheological) fluids that are used in dumpers to help reduce high shock impacts. They are also used by building construction to increase sability of high rise buildings in earthquake pron areas.

Material are also worked upon new technology to improve their properties, such as steel can be alloyed with other material to improve the properties such as strength, conductivity, mouldability and other such properties.

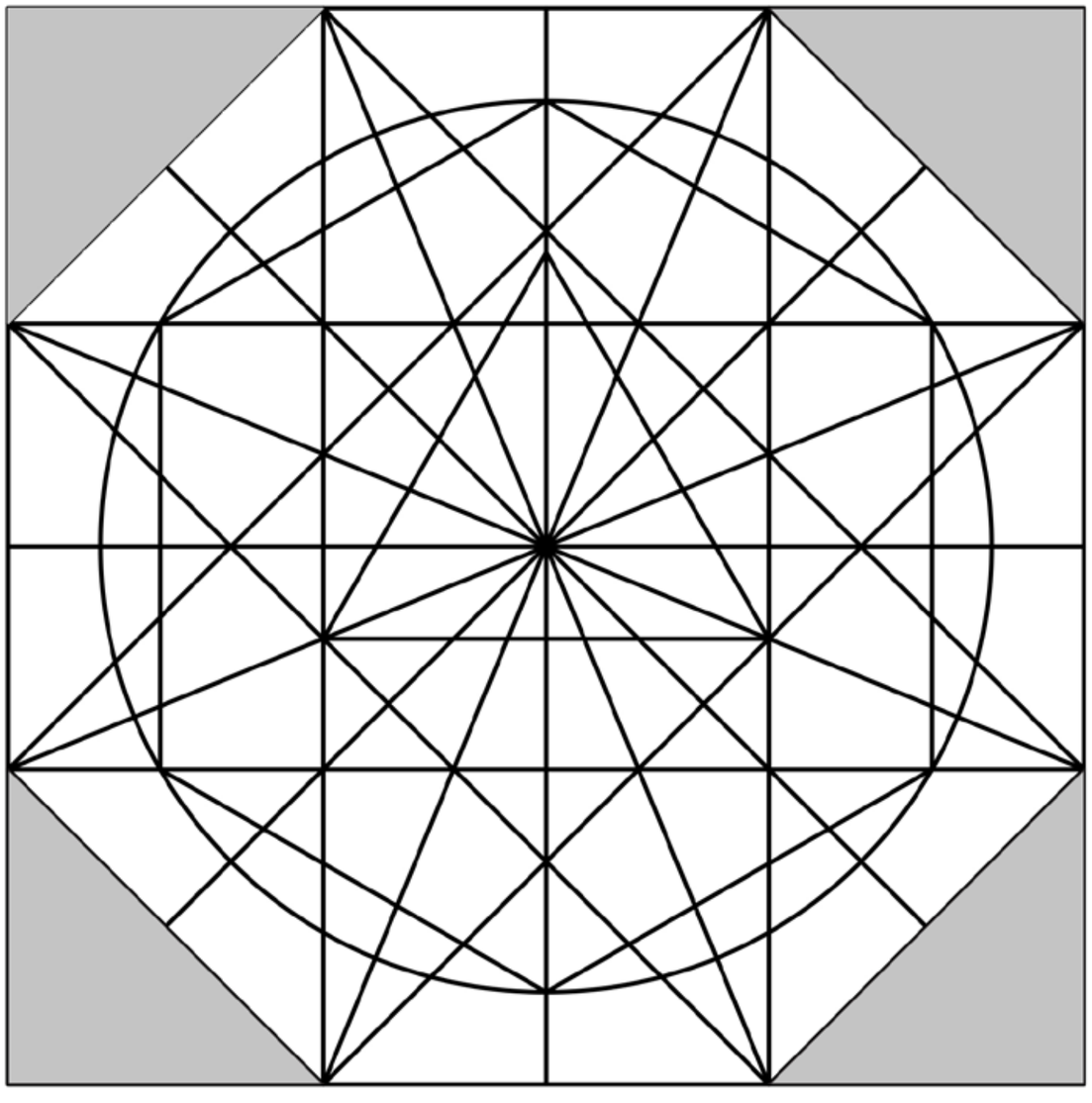
fig 1.1
Terrawind high end interior vehicle.

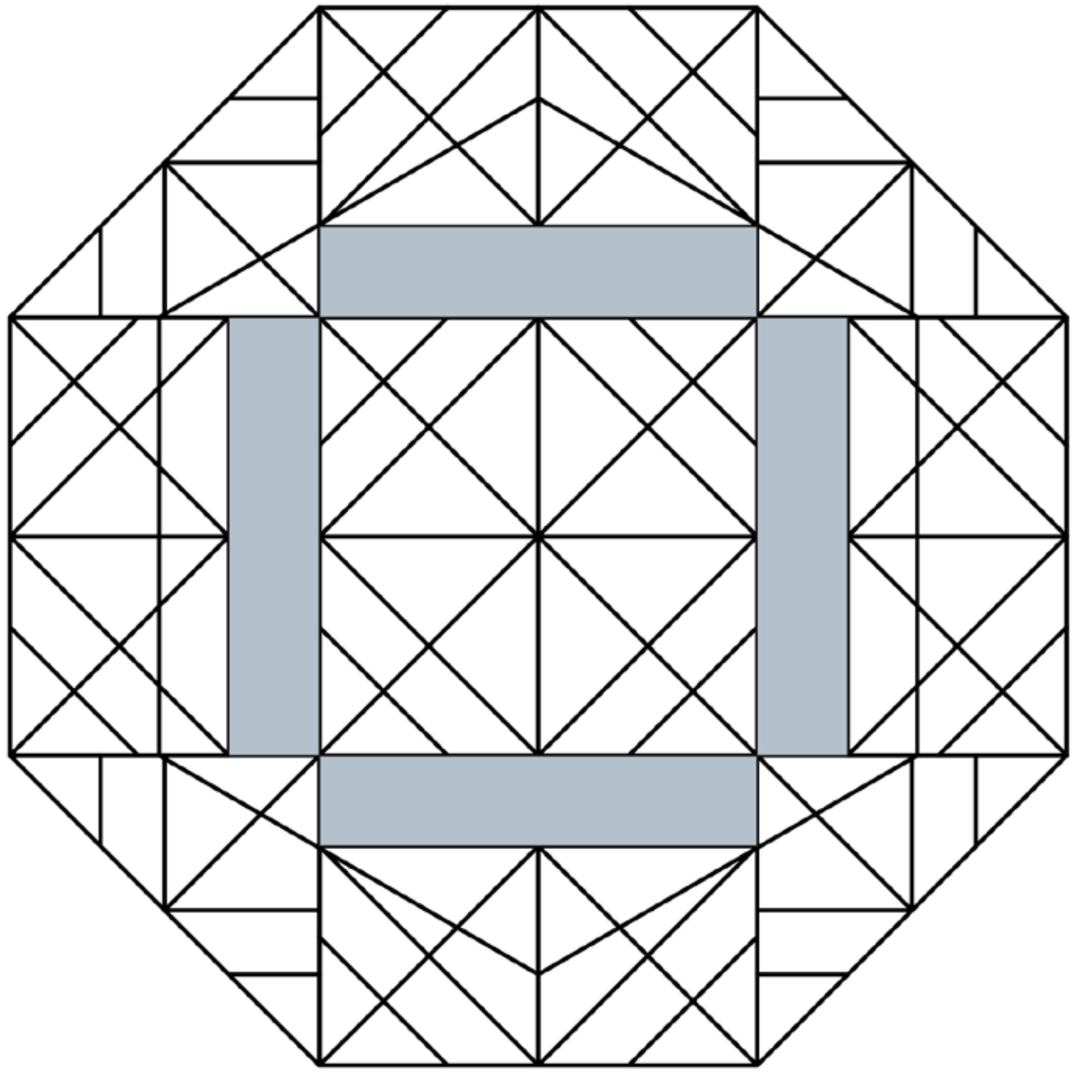
7. DESIGN DEVELOPMENT

AFTER CONSIDERING THE FACTS THE CONCEPTUAL IDEAS HAVE BEEN WORKED UPON

7. DESIGN DEVELOPMENT

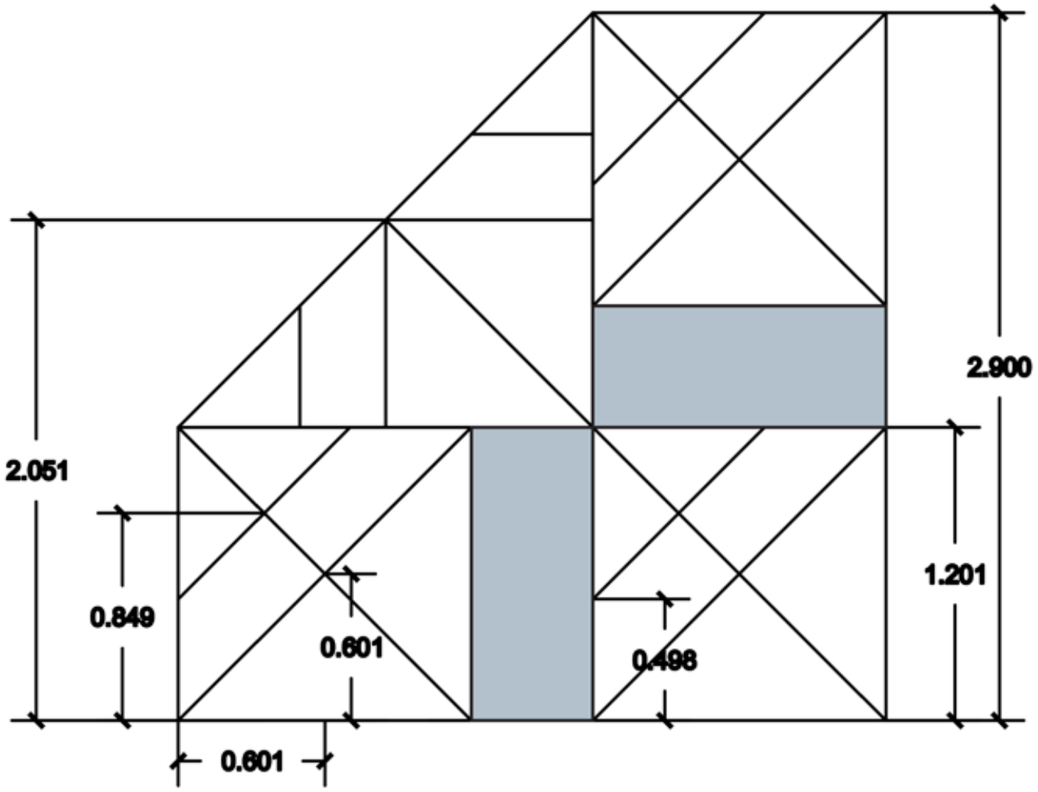
BREAKING THE CUBISM TO POLYGONS GIVING
BIRTH TO ANGULAR FORMS.

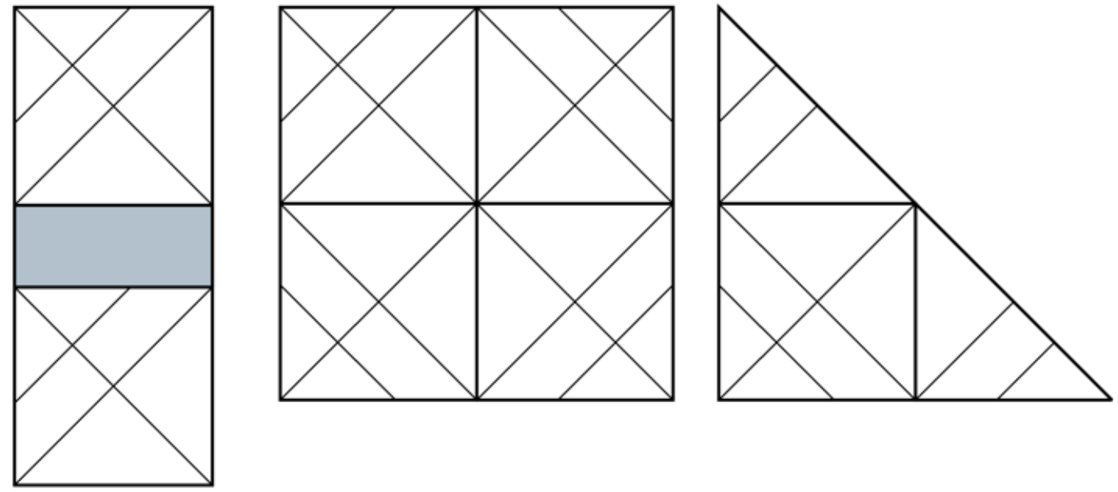




7. DESIGN DEVELOPMENT

AFTER BREAKING THE POLYGON TO GIVE COMPO-
NENTS THAT CAN HELP ME BUILT THAT POLYGON





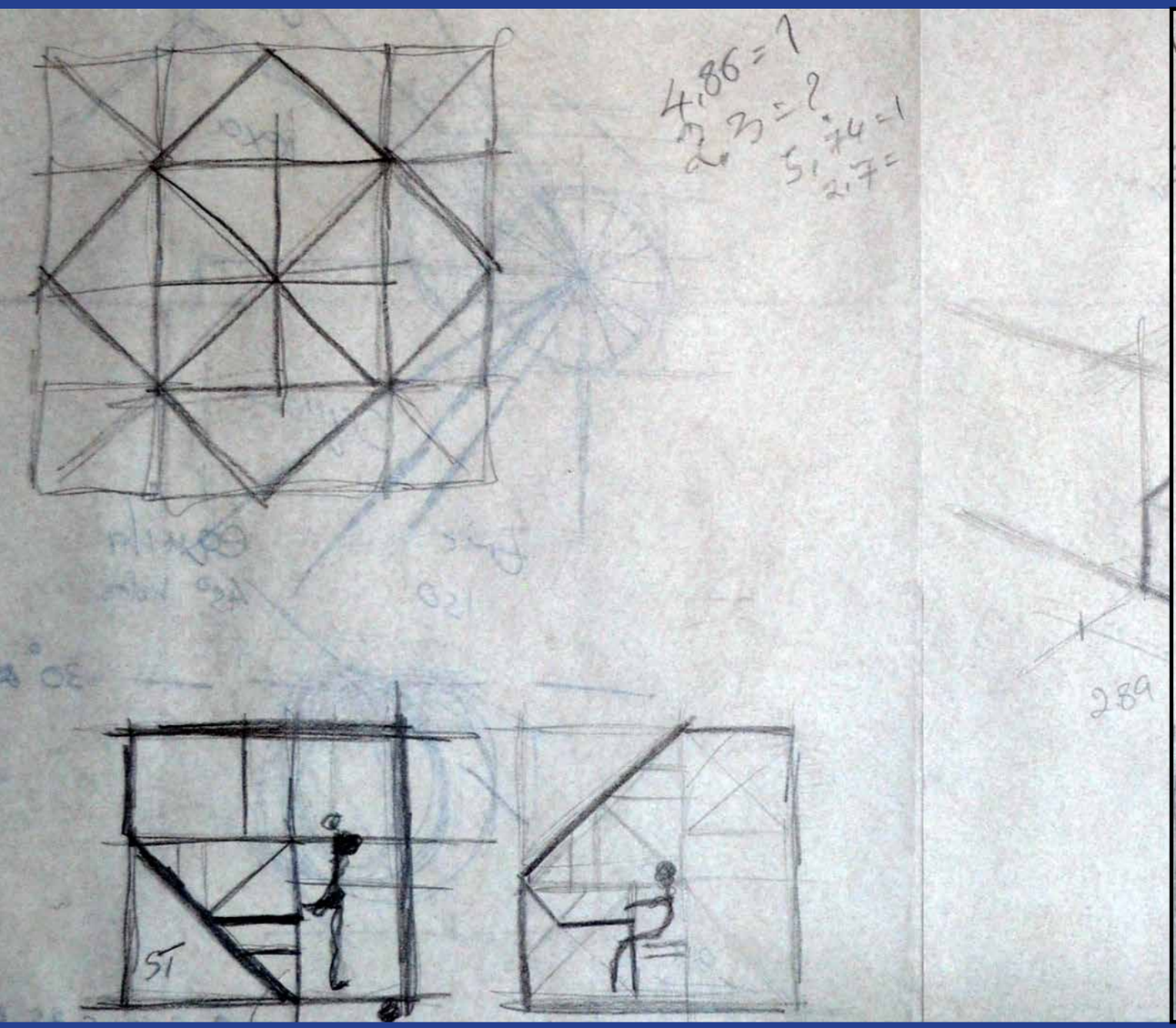
THREE COMPONENTS BREAKING FROM IT.
1.2M X 1.2M SQUARE
1.2M X 1.6M RECTANGLE THATS BROKEN DOWN TO THE SQUARE AND A RECTANGLE 0.4M X 1.2M
THE SQUARE IS DIVIDED INTO TWO THROUGH THE DIAGONALS.

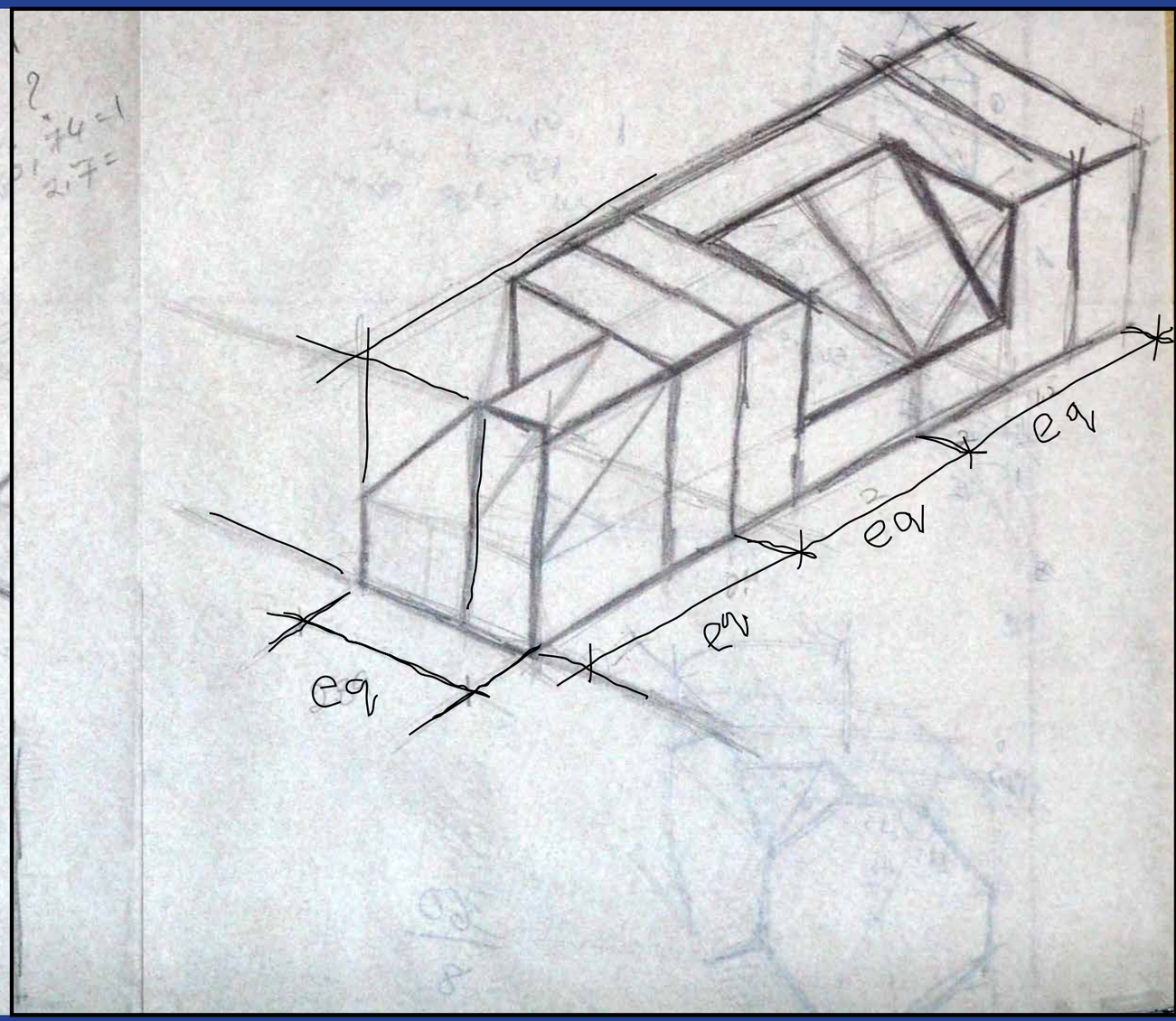
THEREFORE THREE DIFFERENT STRUCTURAL RODS.
1.2M, 1.6M, 2.4M

TAKING AN OCTAGON AND USING THE QUATRAL PART OF IT. THE COMPONENTS DIVIDED IN THIS PART CAN BE USED TO FORM THE OCTAGON, A SQUARE, A RECTANGLE, AN ISOCELES TRIANGLE, EQULATRAL PYRAMID. ALL THIS FORMS CAN BE DERIVED USING THE PARTS.

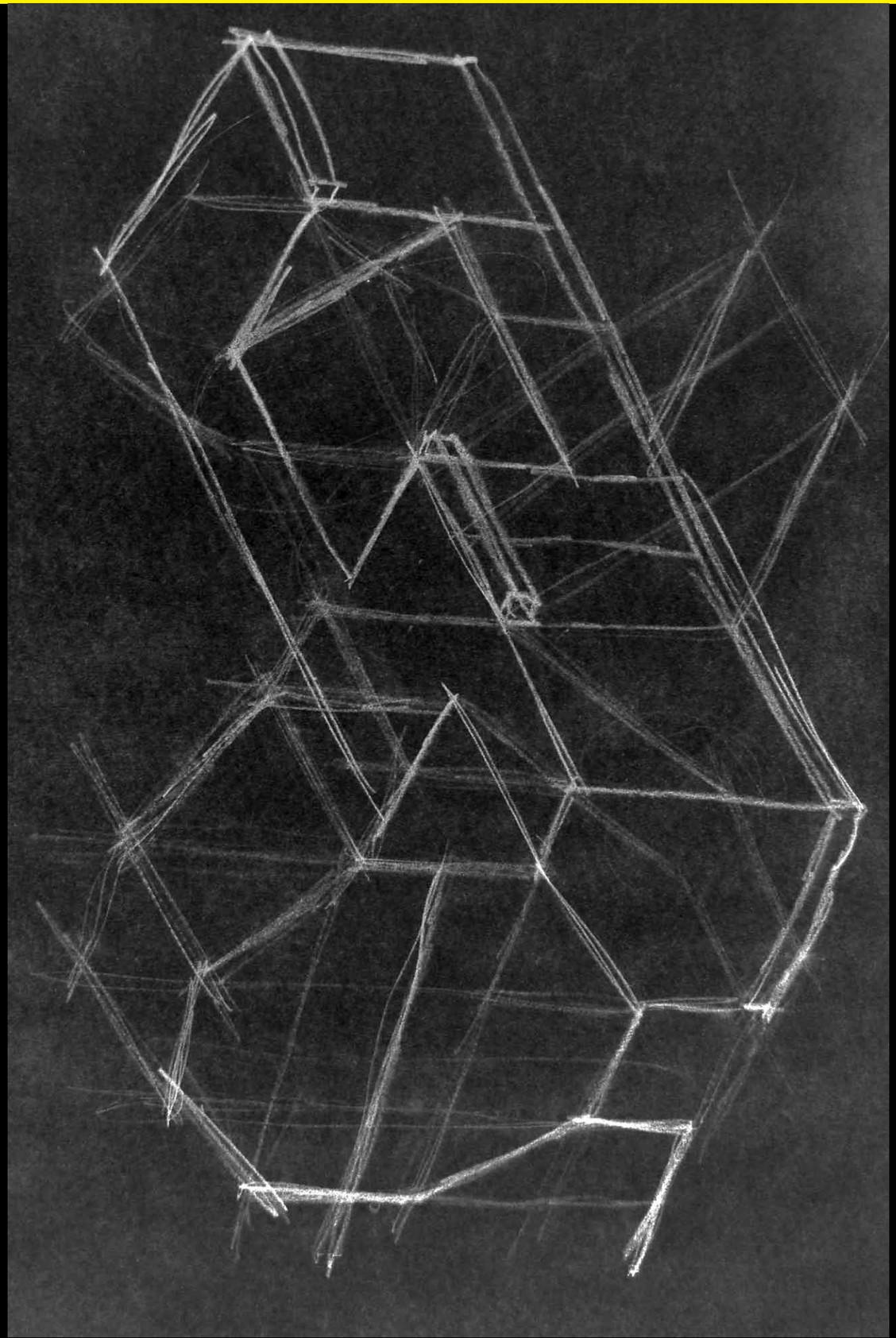
7. DESIGN DEVELOPMENT

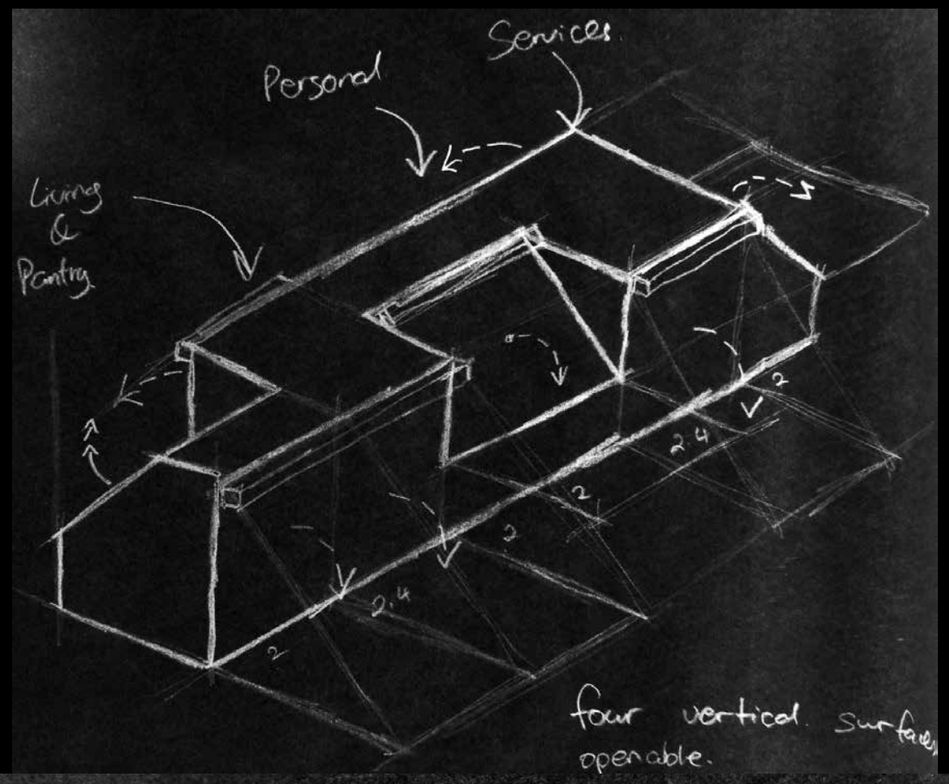
DEVELOPMENT OF THE VEHICLE USING THIS COMPONENTS.

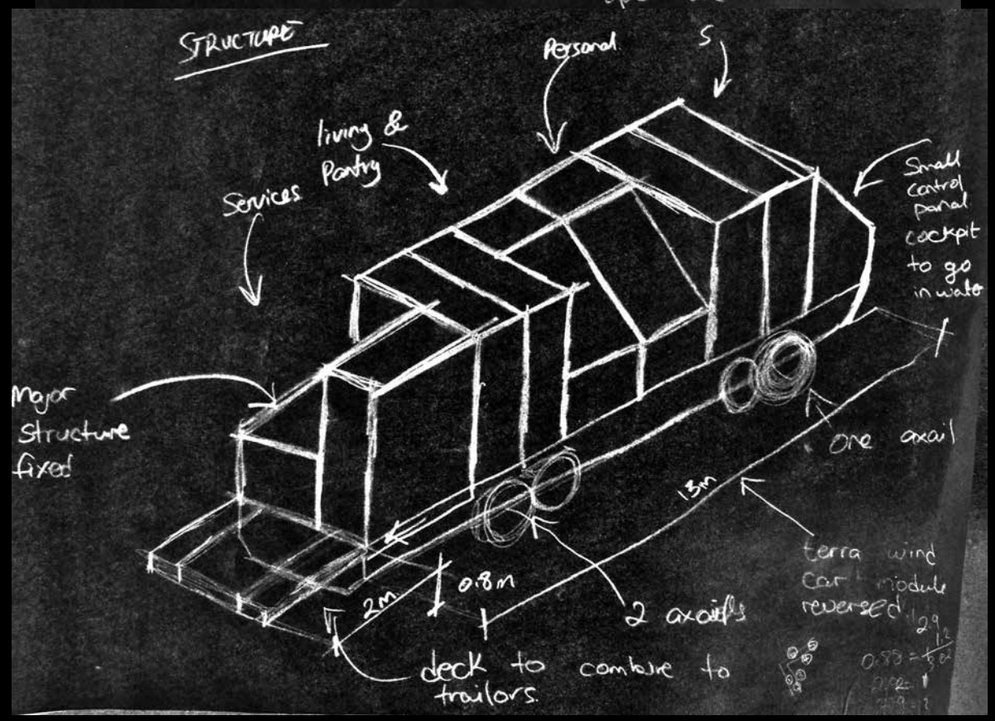




7. DESIGN DEVELOPMENT



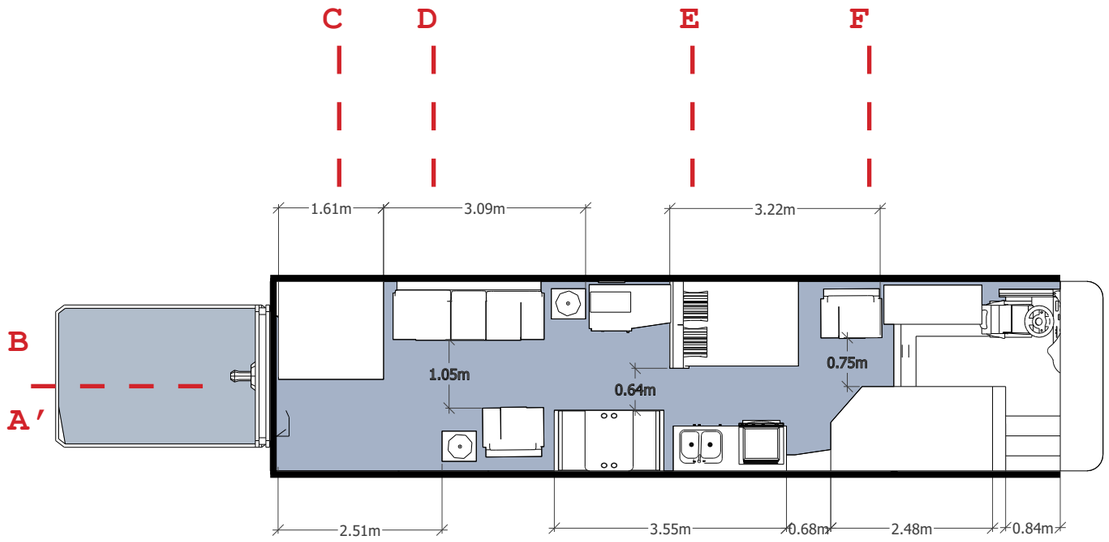




8. CONCLUSION

A VIEW OF THE FINAL OUTCOME OF THE DEVELOPMENT AND THE DETAILS ON HOW IT WORKS AND IS EXPLORED

8. CONCLUSION



LIVING AREA APPROXIMATELY
3M X 2.9M

SERVICES : GENERATOR AND BATTERY COMPONENTS.
1.6M X 1.6M

DINING AND PANTRY
2.75M X 2.9M

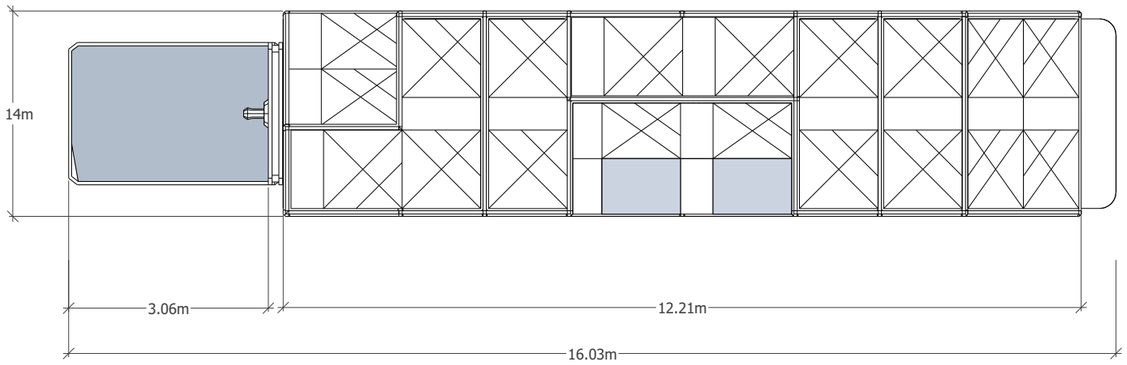
BEDROOM, TOILET AND SHOWERS
3.2M X 2.9M

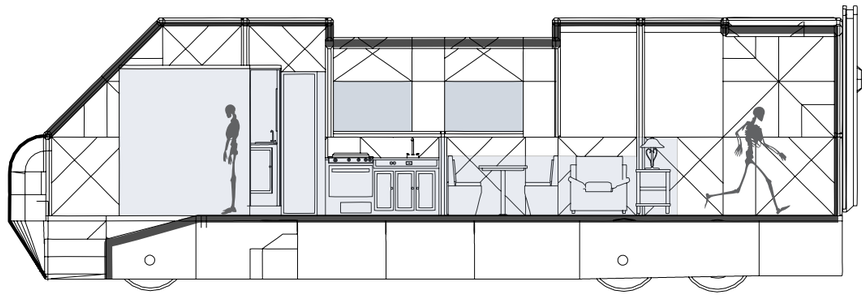
WATER STORAGE ABOVE THE SHOWER CUBICAL.

WASTE WATER STORED BELOW THE SHOWER AND KITCHEN AREA

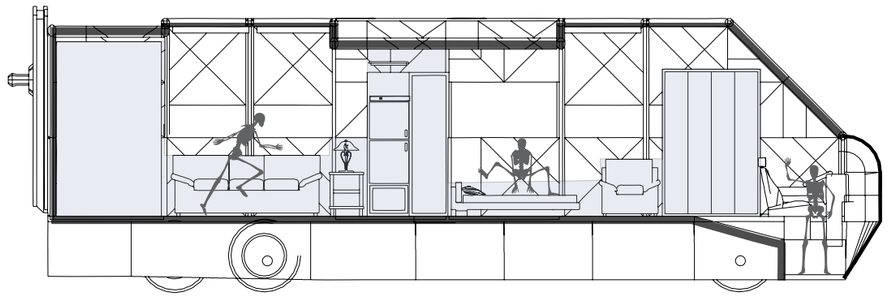
THE TURBINES ARE BELOW THE LIVING ROOM

THE REST OF THE SPACE BELOW IS USED AS STORAGE OF COMPONENTS





SECTION AA'



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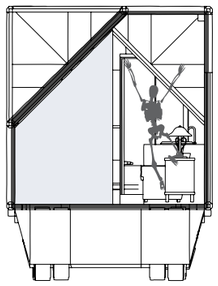

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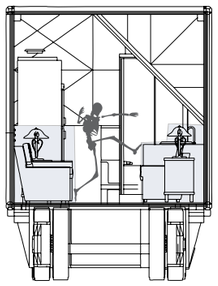

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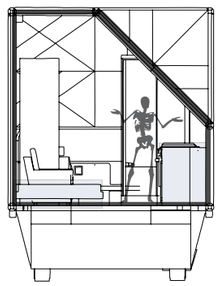

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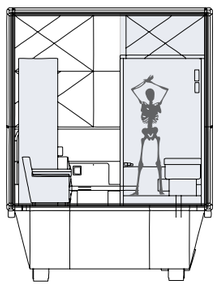
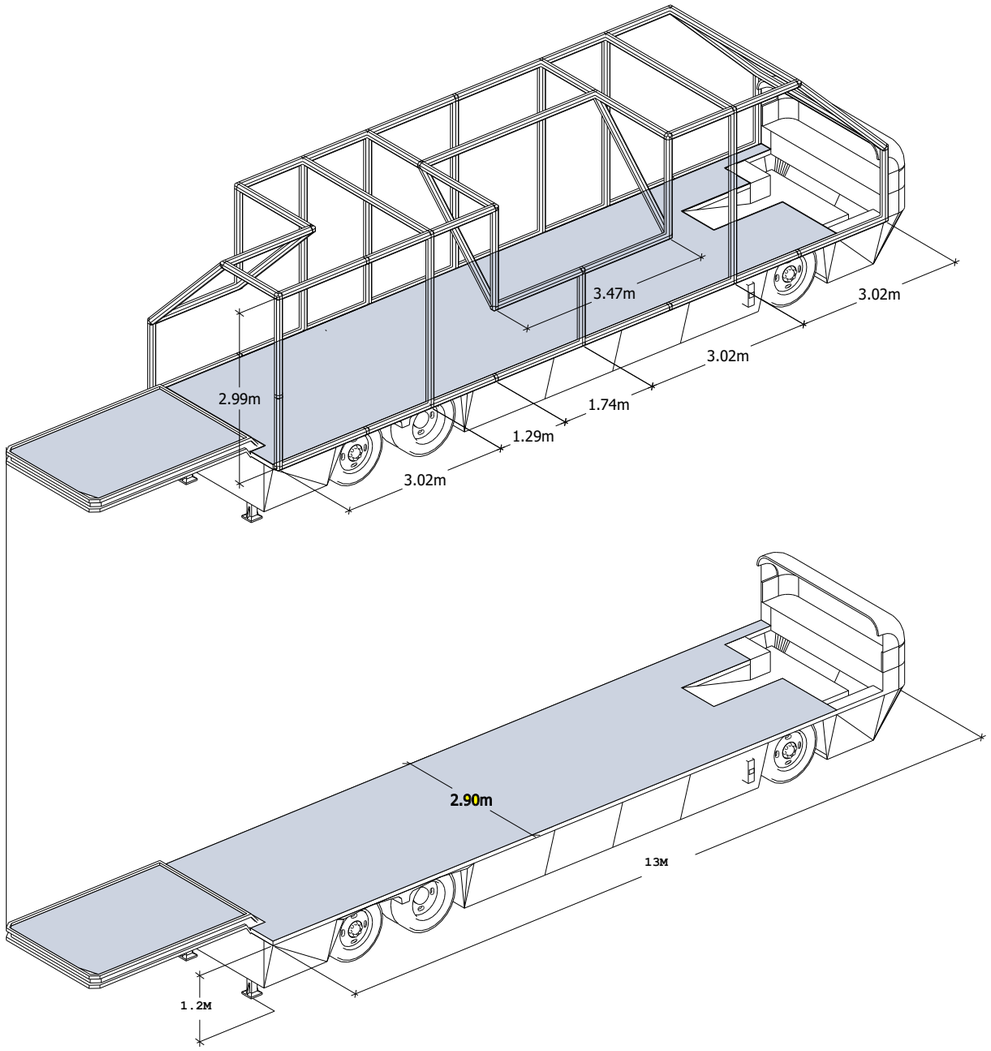
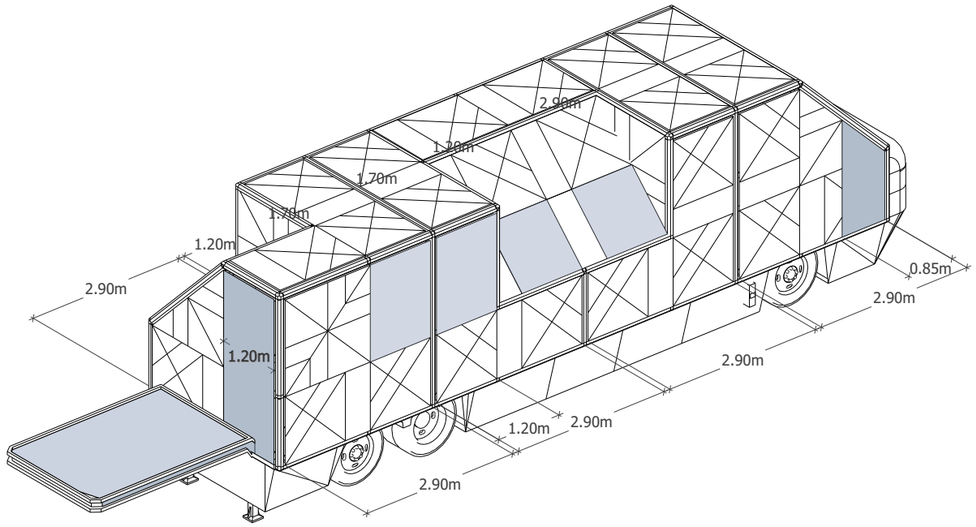


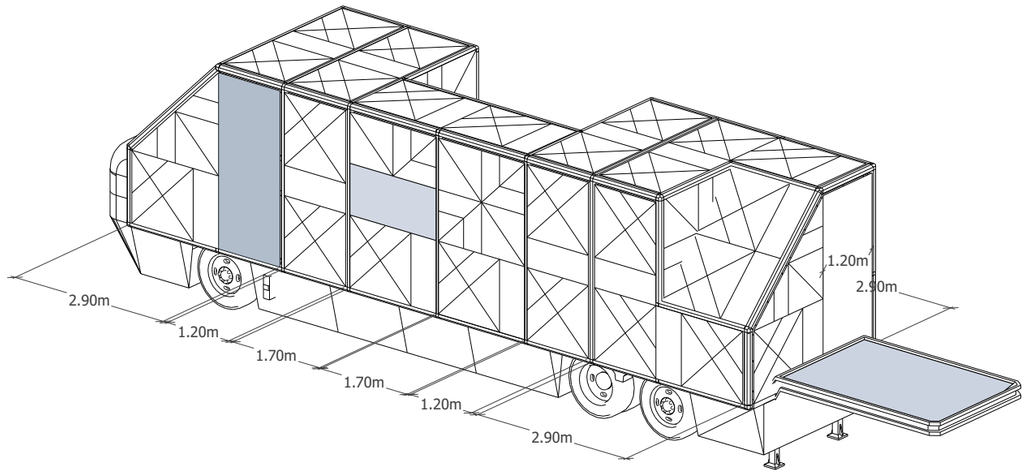
SECTION FF'

PLAN OF ONE OF THE PROTOTYPE
A high end prototype used by an individu-
al including all the modern furniture.

8. CONCLUSION

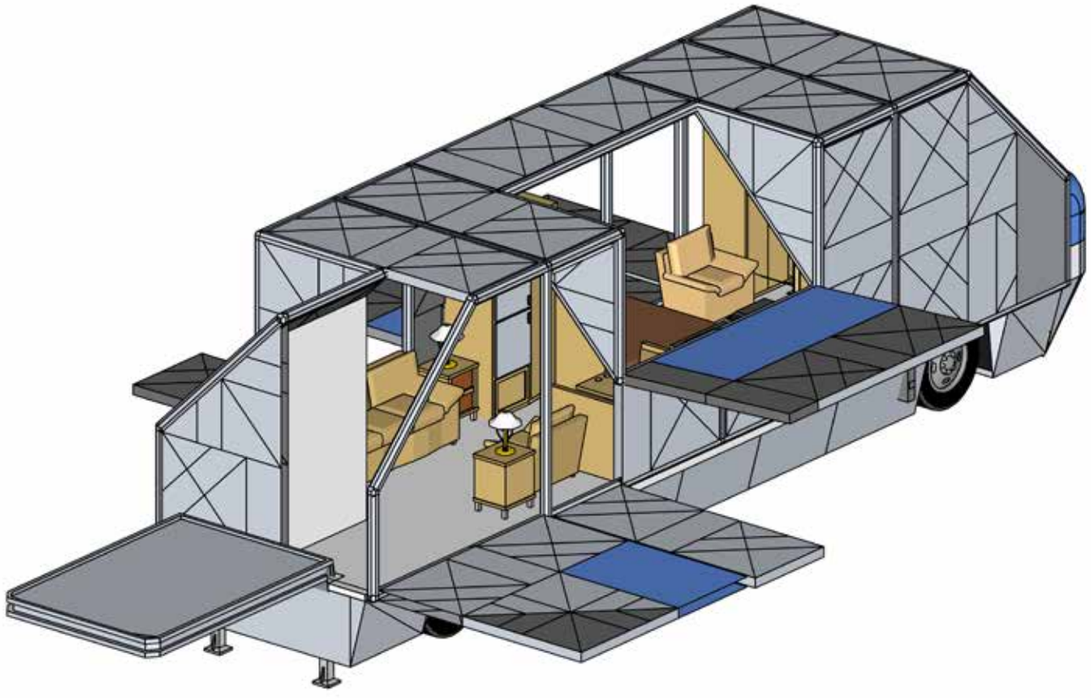




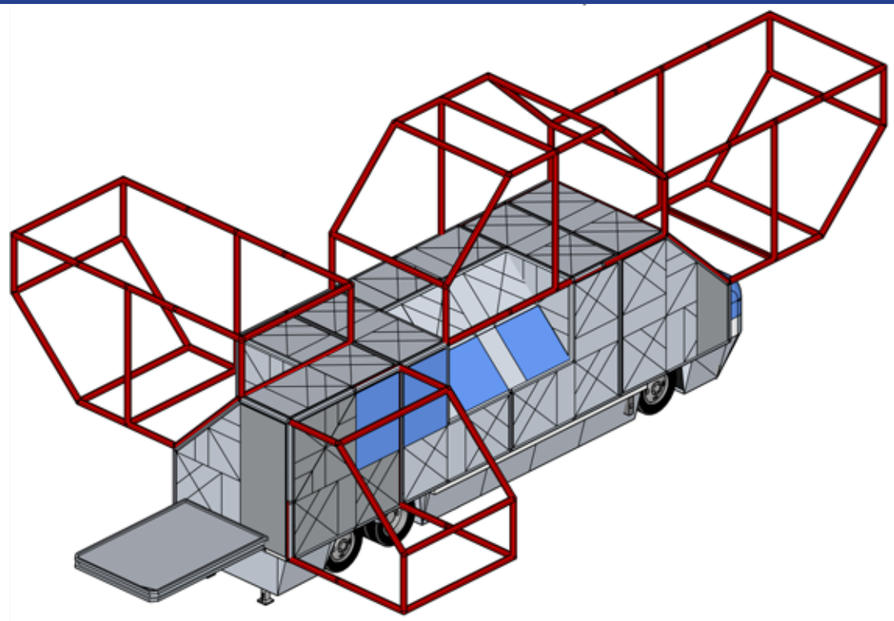


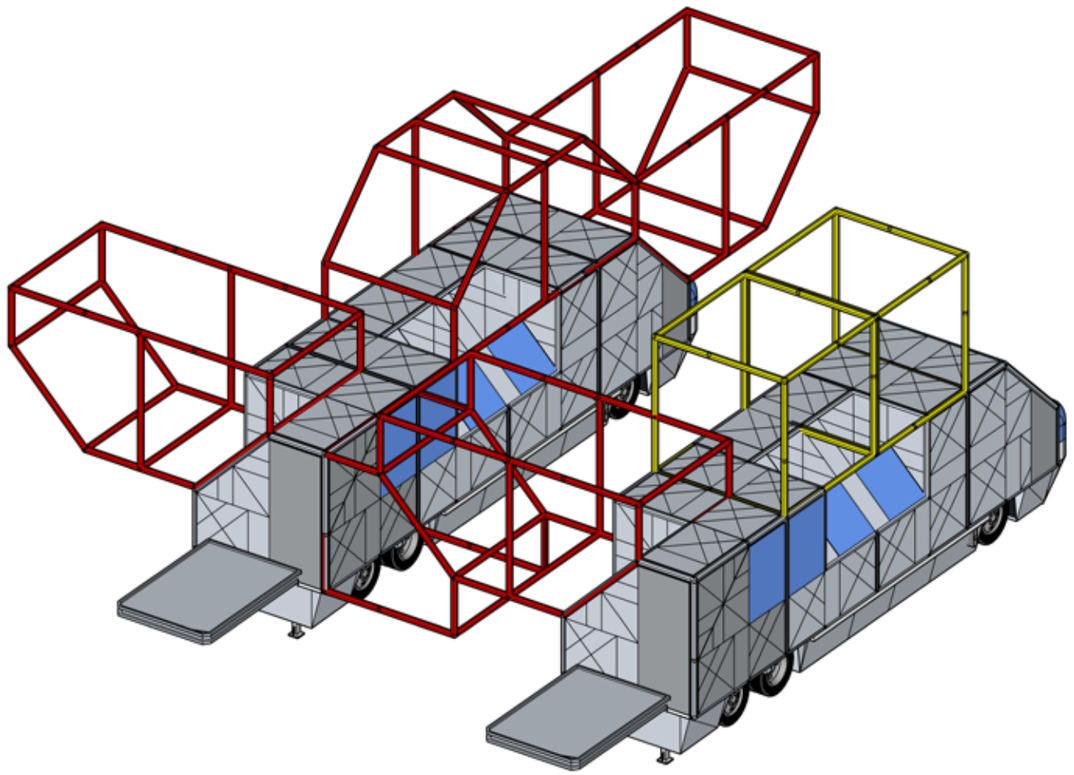
STRUCTURAL SYSTEM

8. CONCLUSION



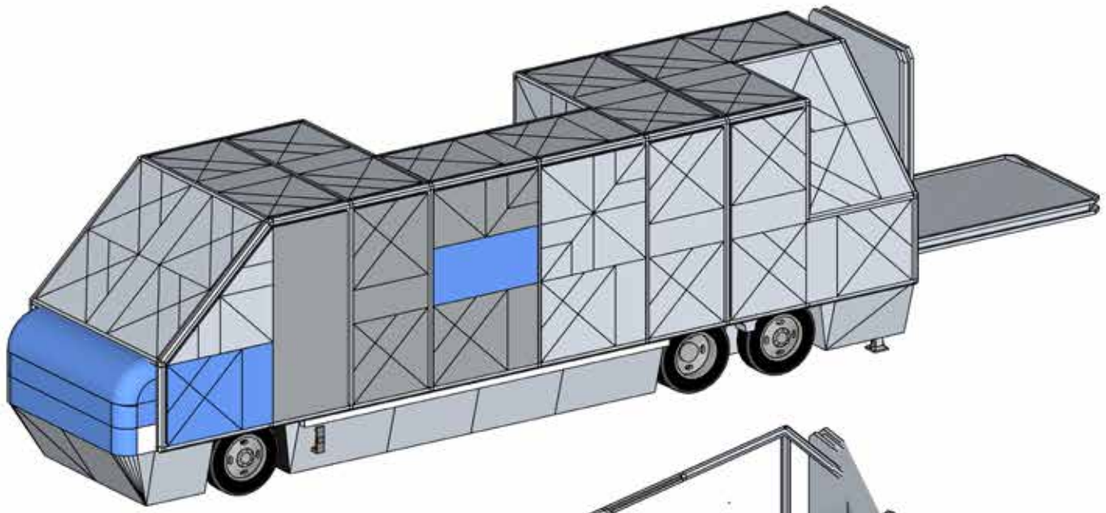
EXTERIOR VIEWS WITH OPEN PANELS

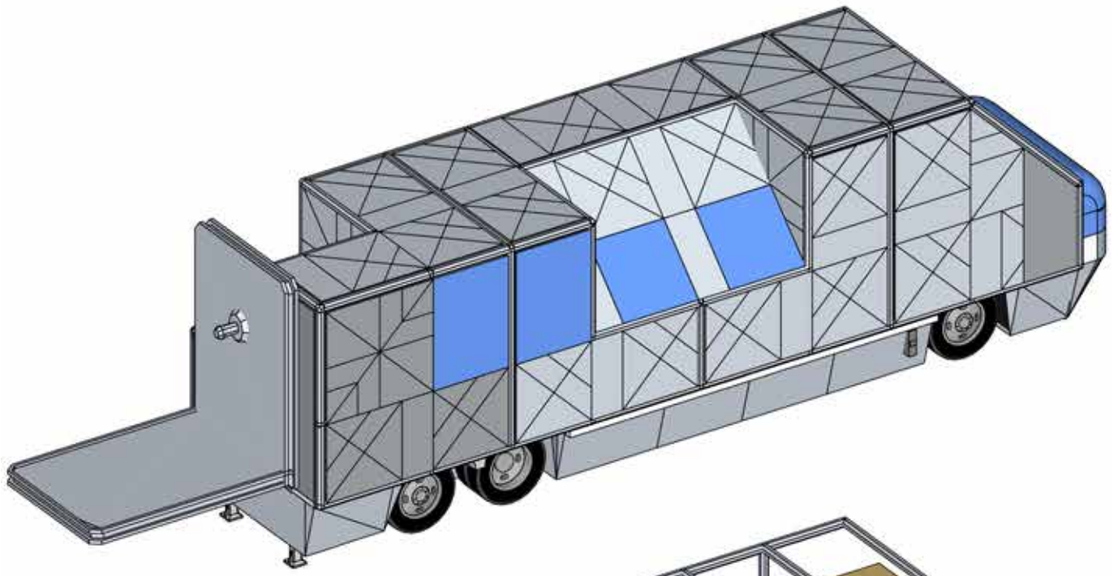


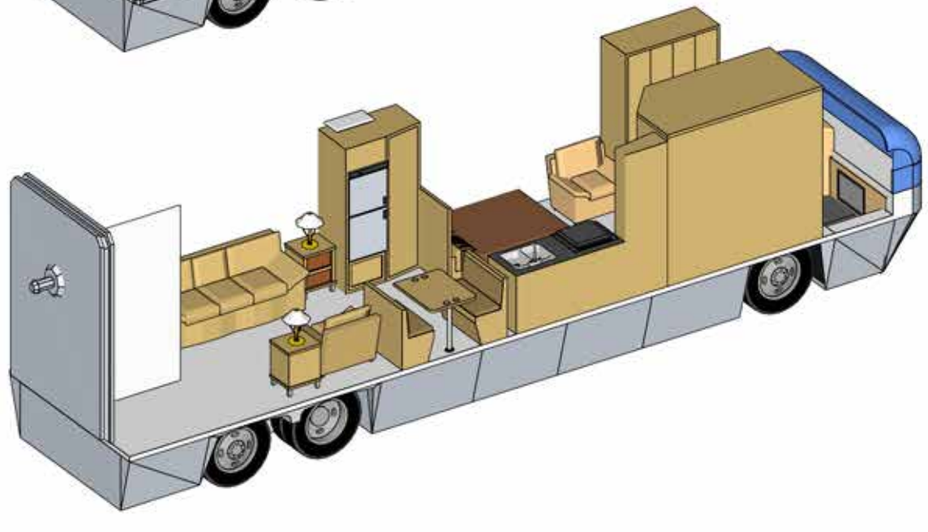


GROWTH PATTERN. CAN VARRY FROM USER TO USERS

8. CONCLUSION

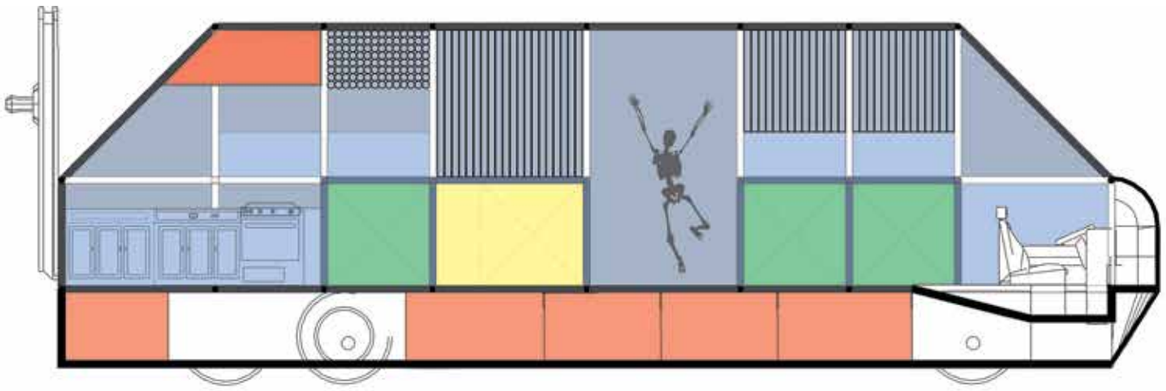




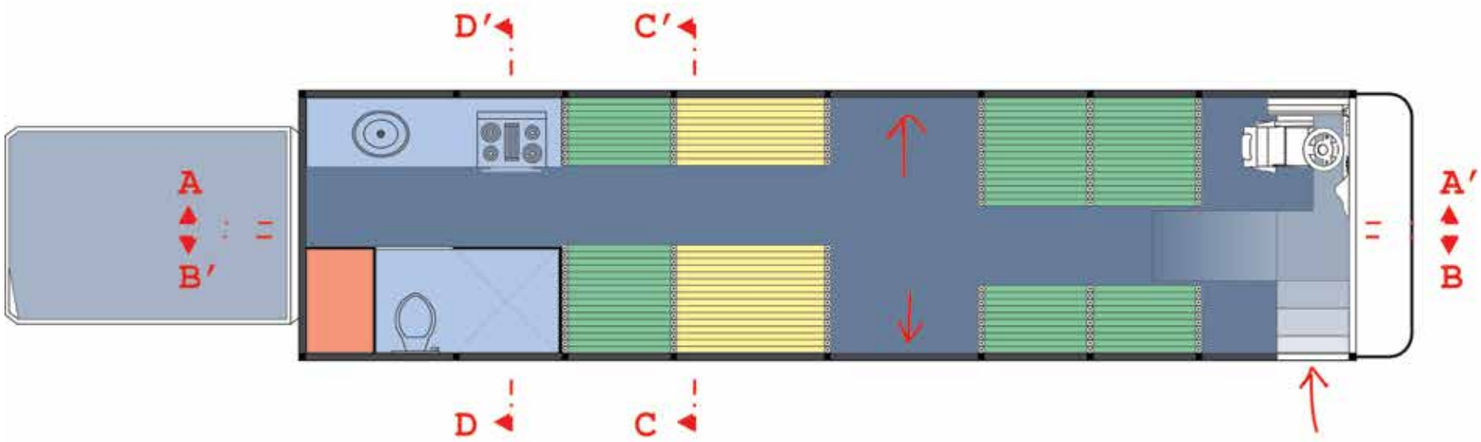


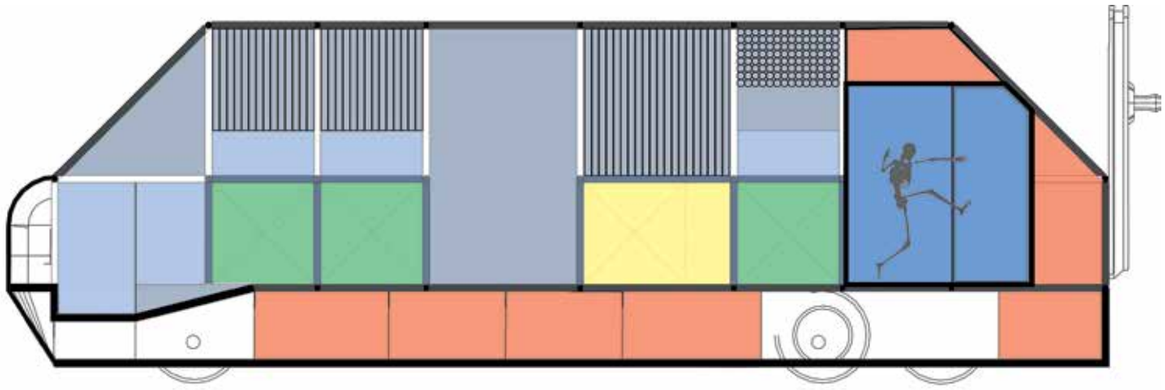
8. CONCLUSION

AN EXAMPLE OF THE PROTOTYPE USED BY RESEARCHERS, EXCAVATORS OR EXPLORERS



SECTION AA′





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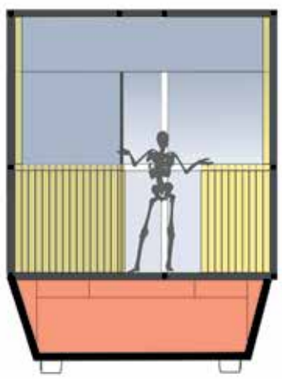

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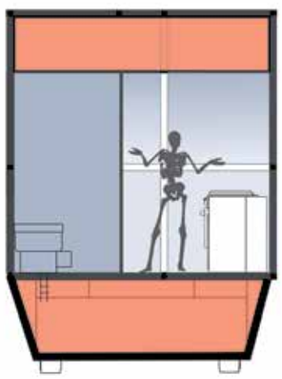
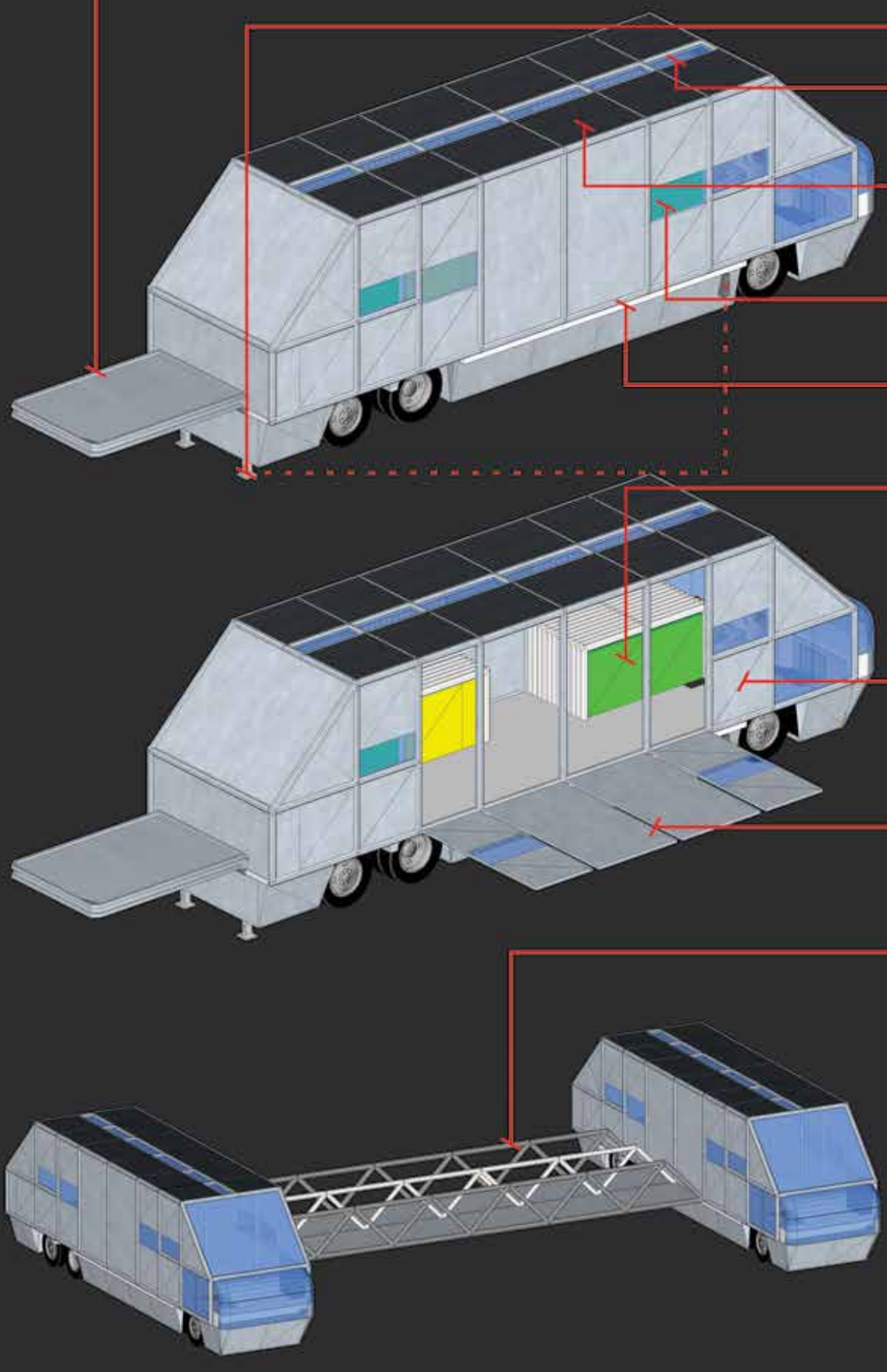


SECTION DD′

8. CONCLUSION

DETAILS AND COMPONENTS



TRUCK CONNECTOR - CAN BE PULLED BY A TRUCK ALONG WITH OTHER USEFUL MACHINERIES.

HYDRAULICS ATTACHED TO GIVE STABILITY ON UNEVEN TERRAINS

SKY LIGHT - THIS PANELS CAN BE USED ELSE WERE OR CAN BE REMOVED ALSO TO PROVIDE AIR CIRCULATION.

FLEXIBLE SOLAR PANELS THAT CAN BE REMOVED AND ATTACHED ELSE WERE WHILE EXPANDING THE MODULE.

OPEN ABLE WINDOWS DURING THE MOVE. CAN BE REMOVED DURING EXPANSION.

FLOATERS THAT INFLATE WHEN CHANGING MODE OF TRAVEL FROM ROAD TO WATER. INBUILT IN THE VEHICLE SYSTEM

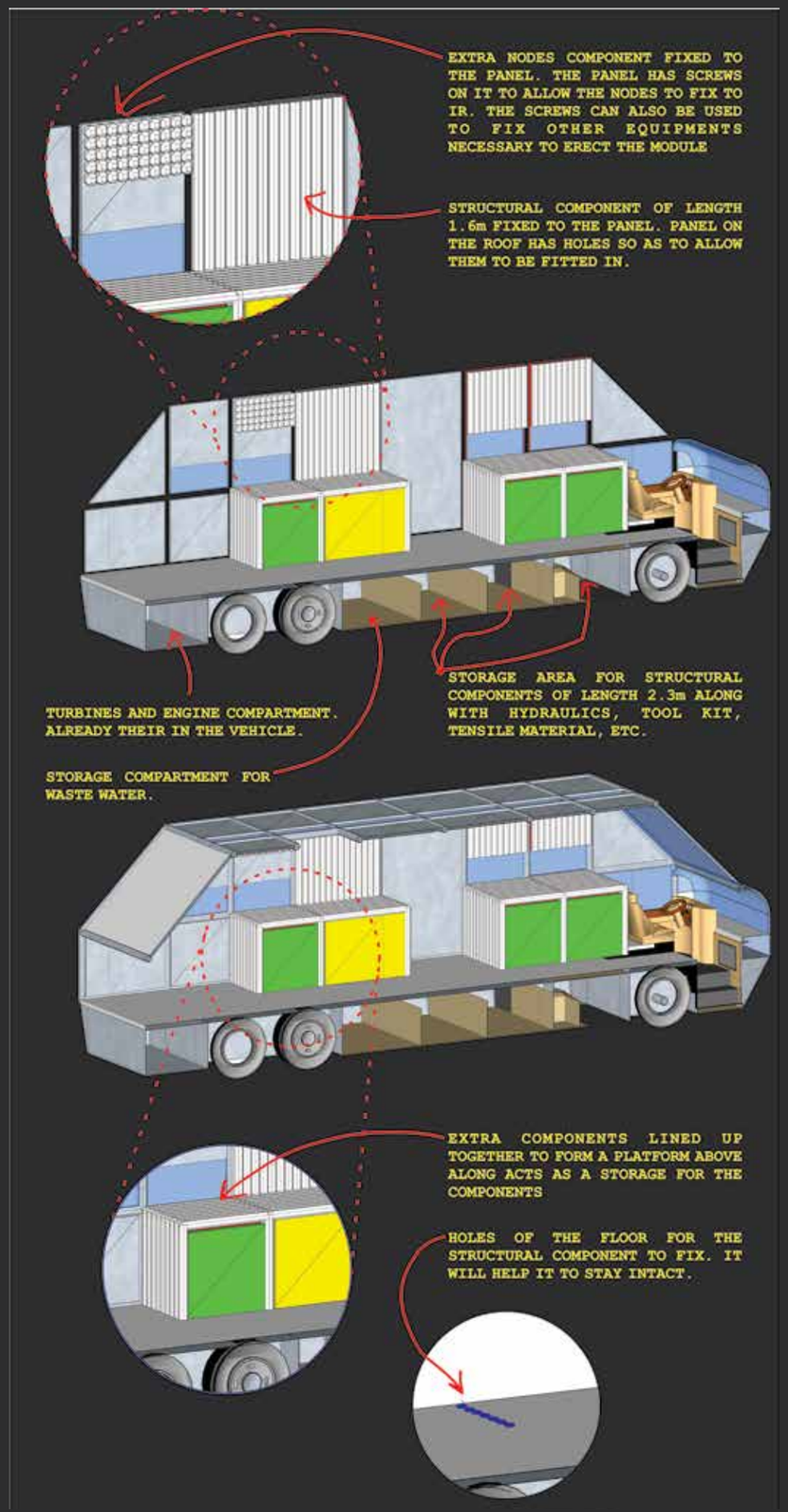
EXTRA COMPONENTS IN THE VEHICLE TO HELP EXPAND.
78 NO. 1.125 X 1.125m PANELS
26 NO. 1.125 X 1.622m PANELS
ENOUGH COMPONENTS TO CREATE OTHER 2 SHELLS OF THE VEHICLE.

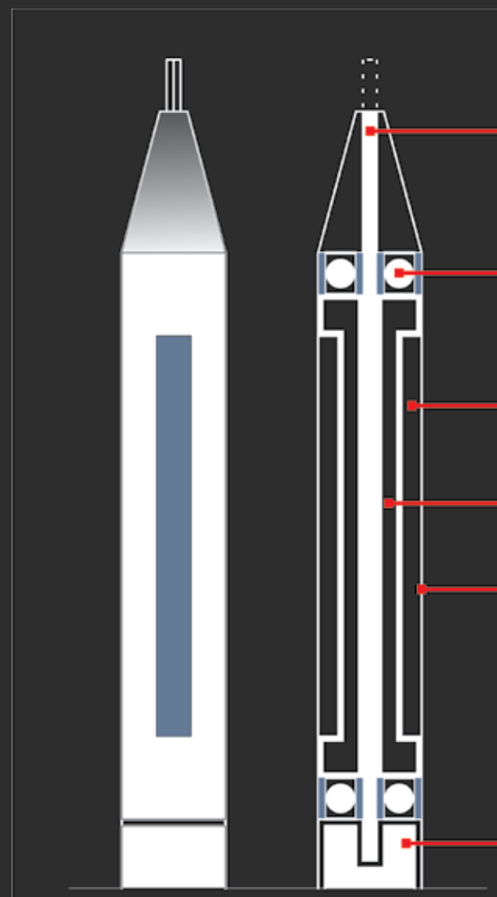
ALL WALL PANELS CAN BE REMOVED. BUT THE STRUCTURAL PARTS CAN'T BE.

FOUR OPEN ABLE HINGED WALLS. TO HELP EXPAND FROM THE INSIDE. ON BOTH SIDES OF THE VEHICLE.

THE STRUCTURAL COMPONENTS CAN HELP BUILT USEFUL CONSTRUCTION SPACE FRAMES THAT CAN BE ASSIST WHO EXCAVATE, BUILDING CONSTRUCTION, PERFORMERS, MILITARY, ETC.

8. CONCLUSION





2CM THICK MAIN CORE.
STEEL CORE AND ALUMINUM WITH TWO COPPER WIRES RUNNING THROUGH.

BALL BEARING ATTACHED TO THE OUTER SHELL AND INNER SHELL TO PROVIDE ROTATION.

SLOTS THAT HOLD THE SLIDING PARTS OF THE WALL

EMPTY SPACE THAT'S FILLED WITH INSULATING MATERIAL.

ABS COVERING THAT SLIDE AWAY WHEN WALL PARTS FIX.

CENTRAL ROD PART THAT ROTATES TO PUSH THE CORE OUTWARD. THE END OF THE CORE IS ATTACHED TO THE SHOCK ABSORBER.

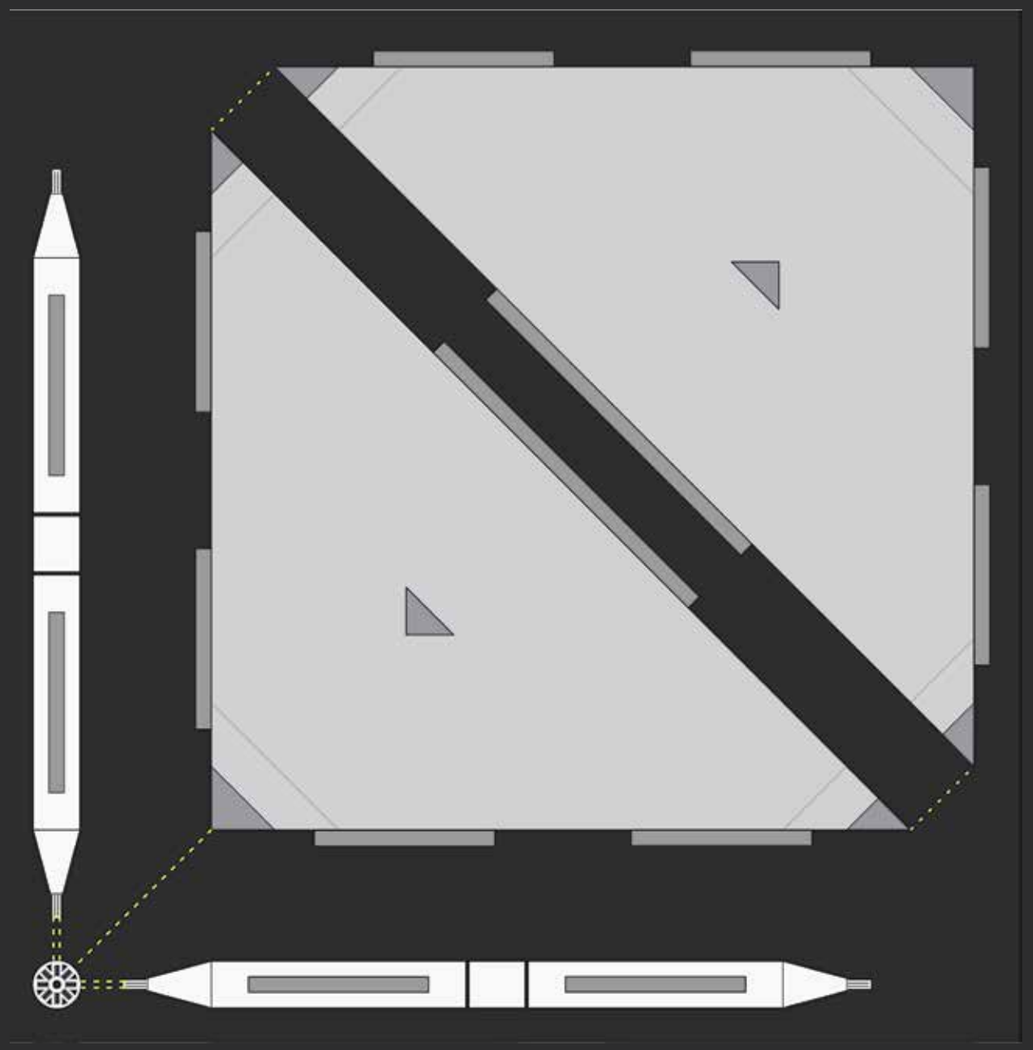
NODES

THE ROD CORE FIXES INTO THIS AREAS PUSHING THE PART INTO THE NOD AND CONNECTING THE ELECTRICAL CIRCUIT AND ALSO STRENGTHENS THE FIX.

MAIN STRUCTURE OF THE NODE. MADE OF STEEL, ALUMINUM AND CARBON FIBER

PUNCTURES AT EVERY 45o ON THE SPHERE.

8. CONCLUSION



CROSS-SECTION OF THE RODS THAT HAVE TENSILE MATERIAL FITTED IN IT. FOUR PULL OUT IN ALL FOUR DIRECTIONS AT 90o TO EACH OTHER

FOUR SLOTS FOR WALL PANELS TO FIT OR OTHER TENSILE PARTS TO FIT IN.

YOU COULD ALSO CARRY ALONG FOLDED TENSILE MATERIAL OR ROLL THEM UP IF THIS COMPONENT IS NOT NECESSARY. THE NODES HAVE SCREW HOLES OF 2CM DIAMETER AND SCREWS COMING OUT IN THE RODS, SO EVERY OTHER MATERIAL CAM BE SCREWED TO SCREWED ON.

A HOLLOW 7.5CM CONICAL CAP WITH SCREW ATTACHED TO THE TIP. THIS COMPONENTS CAN BE USED FOR DIFFERENT MATERIAL TO BE FIXED TO IT AND LATER ON FIXED TO THE NODES FOR LENGTH VARIATION. AND LOCAL AVAILABLE MATERIAL CAN ALSO BE USED SUCH AS WOOD, BAMBOO, METAL, PLASTIC ETC.

AN ADJUSTABLE ROD OF 2.4M LONG THAT CAN EXPAND UP TO 4.5M

HOW A WALL PLATE AND THE STRUCTURAL COMPONENTS COMBINE.

EXTRA COMPONENTS THAT ARE HELPFULL INCASE THE NECESSARY COMPONENTS ARE NOT ENOUGH TO GIVE THE FLEXIBILTY NEEDED BY THE USER

8. CONCLUSION

Wall panels

Two different components of sizes :
1.125 X 1.125M panels
1.125 X 1.622M panels (consists of one 1.125 X 1.125 And 1.125 X 0.497)

The 1.125 X 1.125M panel is divided into two from the diagonals. The edges have flexible ABS that can mold depending on the angles between the structural rods and will also stop water from entering through.

At the center of each parts their will be a switch mechanism that will help to lock to other parts and the structural rods.

The wall parts are made of three layers :
The two outer layers is for the structure of the wall panel itself. The sandwiched layer consists of the locking system that slides into other parts of the structural system.

Basic material is steel core and aluminum, which is fabricated with carbon fiber for extra strength and lightness.

Structural rods

Three different length rods :
1.125 M
1.622 M
2.325 M

Cylindrical in form of thickness 0.075M with conical form at the ends. Just before the conical form, the rod is connected to bearings that help it to hing when fixed. At the center of the rod theirs a rotating cylinder that help in fixing the rods to the structural nodes. The center rotates without rotating the entire rod. It just extrudes the screwing components out of the conical form to enable to fix into the nodes.

It has slots at every 45o for the wall panels to fix. The slots are covered with flexible abs that help absorb shocks and also help air locking system during fixing panels

The central cylinder is also fitted with a shock absorber that helps the structure to be intake during earthquakes as well as on water.

The central rod in the cross-section is also made of steel and aluminum with two copper wires at the center for electric transfer. Electricity will run through the structural rods and nods.

EXPLORING THE MODULE

Adding hydraulics to the extentions so as to support them.

Such areas can be used to provide services so as it can be cleaned from outside only.

Combining the structural system with other modules help in stabilizing the entire structure.

The staircase can be attached to help for the verticle movement. Even ladders can b used.

Such areas can be used to give skylight and also create open space right after it.

8. CONCLUSION

8. CONCLUSION

8. CONCLUSION

8. CONCLUSION

8. CONCLUSION

8. CONCLUSION

9. BIBLIOGRAPHY

BOOKS

Houses in motion by Robert Kronenburg,
Portable architecture by Robert Kronenburg,

Without this book my project would have not completed as the books gave me the best understanding of portable structures. Almost all of my research work is based on this books.

SITES

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I am sorry if i have forgeten to mention any names and sites that i have refered to. Most of my research is based on the theories and concepts of other great inventors. The design is the coclusion of all the research done.