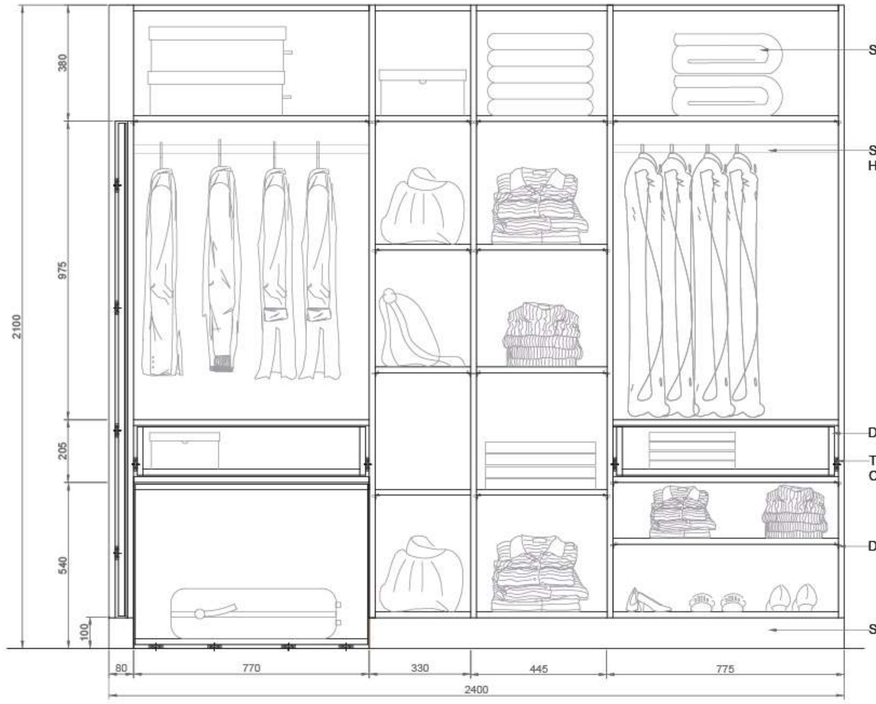
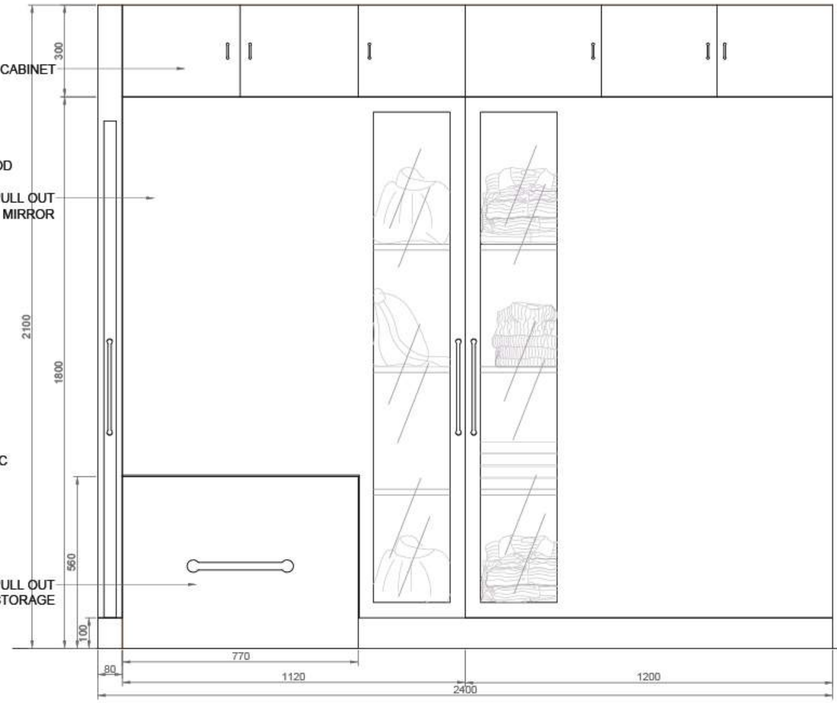


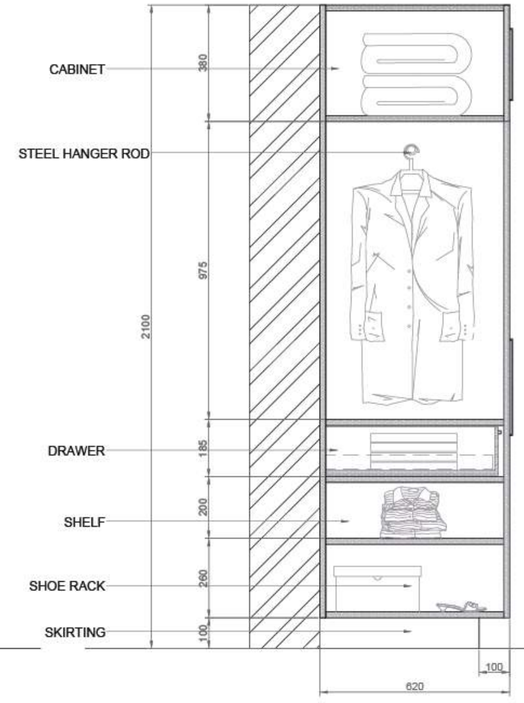
ELEVATION- INSIDE

SCALE 1:10



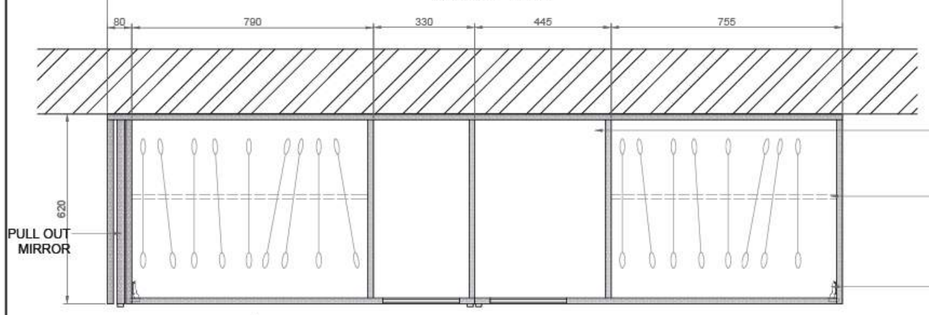
ELEVATION- OUTSIDE

SCALE 1:10



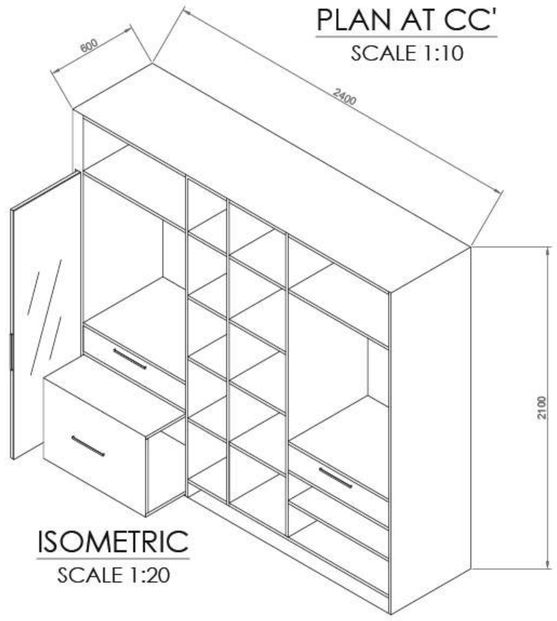
SECTION AA'

SCALE 1:10



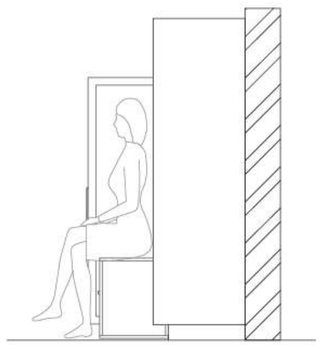
PLAN AT CC'

SCALE 1:10



ISOMETRIC

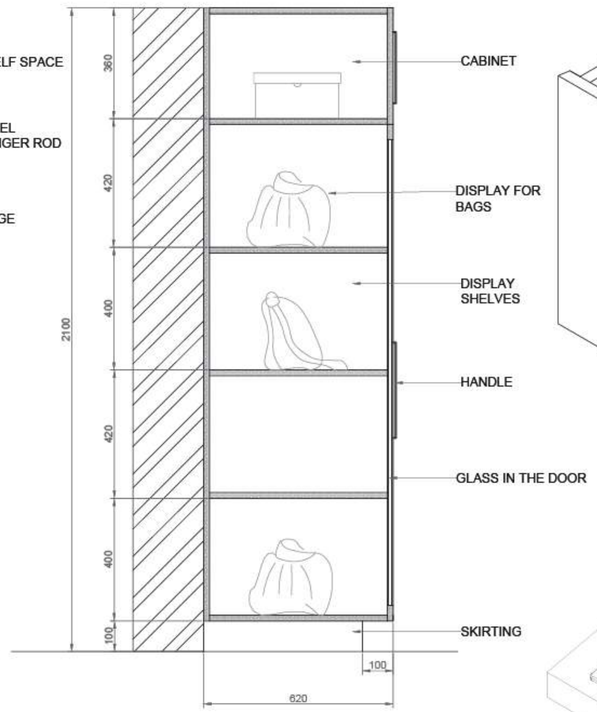
SCALE 1:20



ELEVATION D

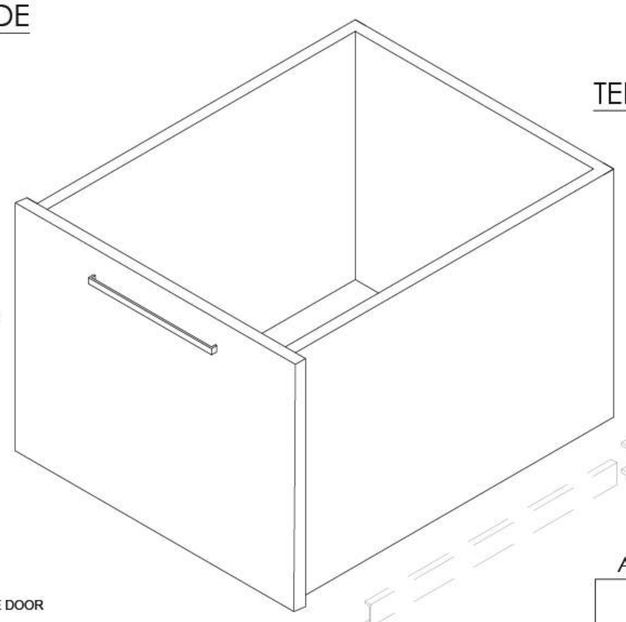
TO SHOW HOW THE PULL OOUT MIRROR AND SEAT WORK

SCALE 1:20



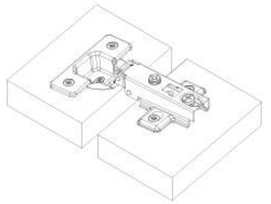
SECTION BB'

SCALE 1:10



DRAWER DETAIL

SCALE 1:5

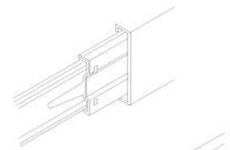


SHELF SUPPORT DETAIL

SCALE 1:1

TELESCOPIC CHANNEL

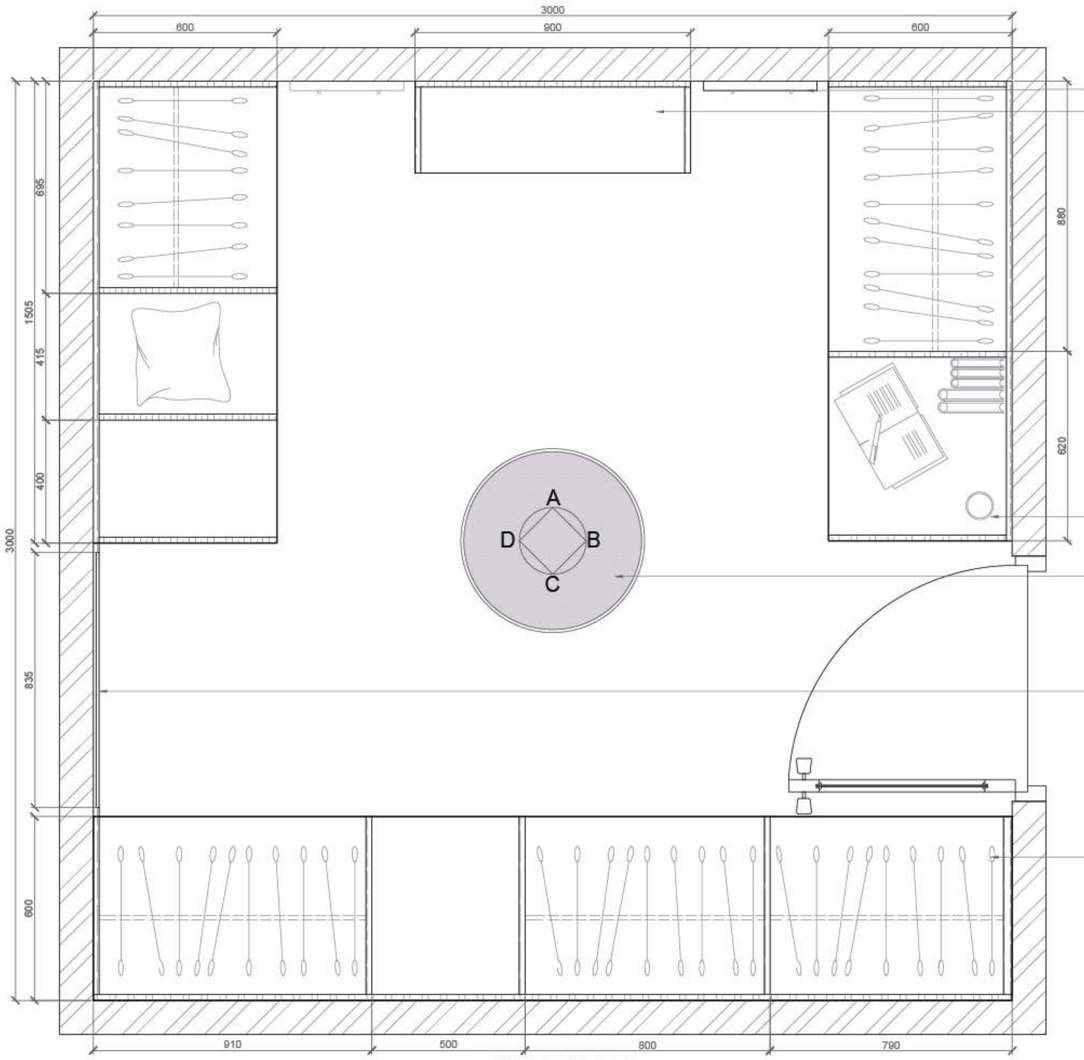
SCALE 1:1



ALL MEASUREMENTS ARE IN MM

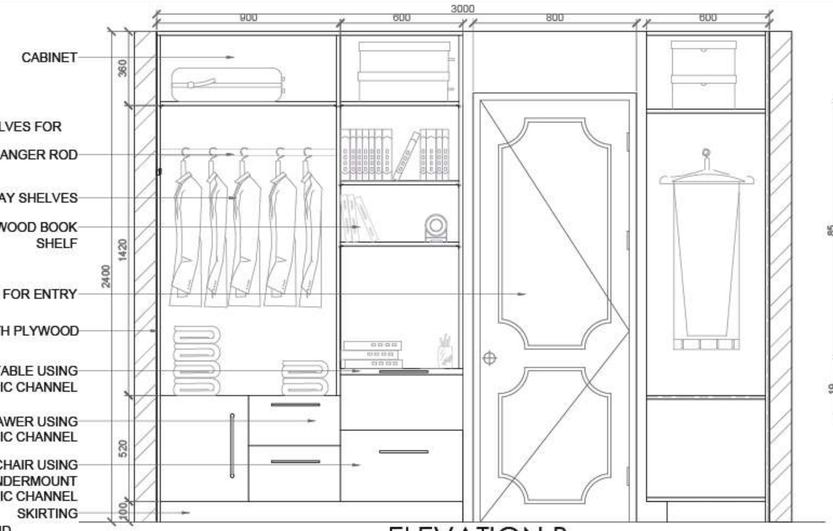
WARDROBE

A wardrobe or armoire or almirah is a standing closet used for storing clothes.



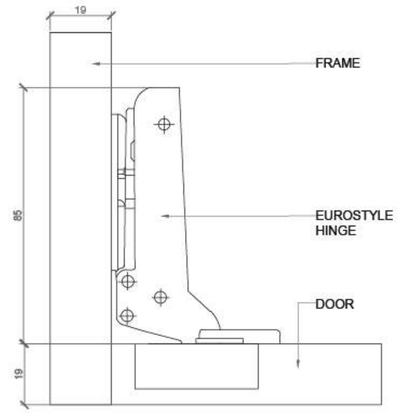
KEY PLAN

SCALE 1:10



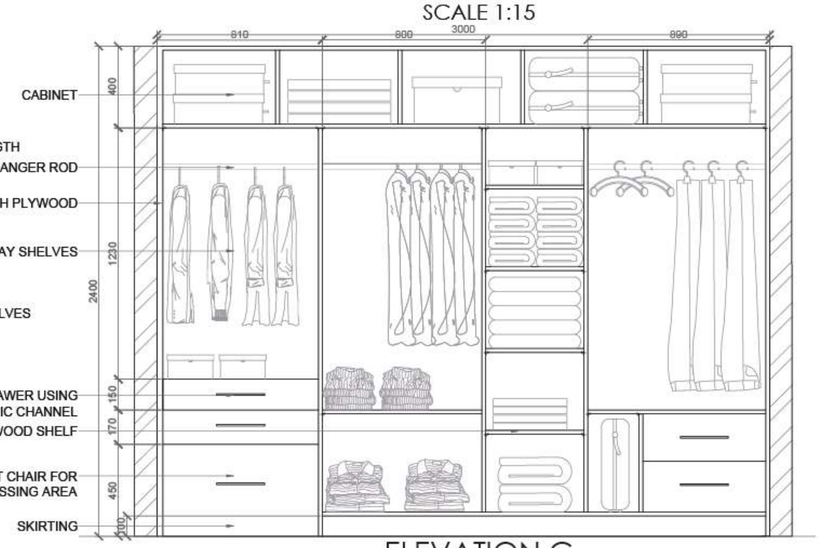
ELEVATION B

SCALE 1:15



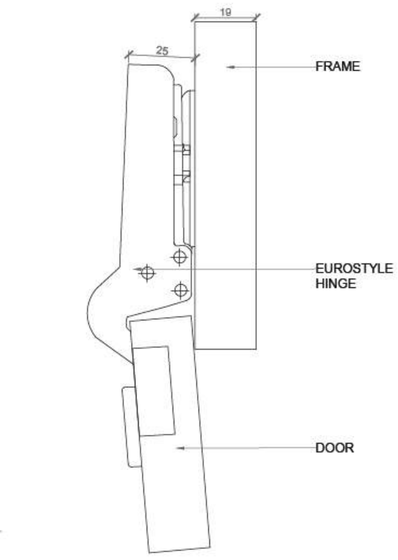
EUROSTYLE HINGE DETAIL CLOSED

SCALE 1:1



ELEVATION C

SCALE 1:15



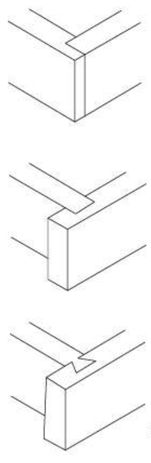
EUROSTYLE HINGE DETAIL CLOSED

SCALE 1:1

ELEVATION A

SCALE 1:15

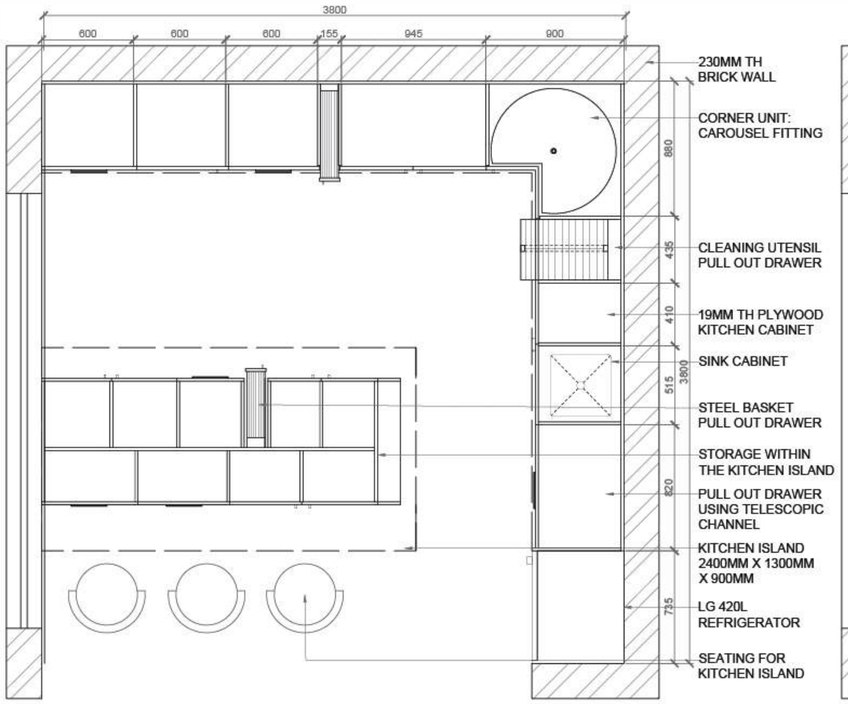
TYPES OF JOINTS



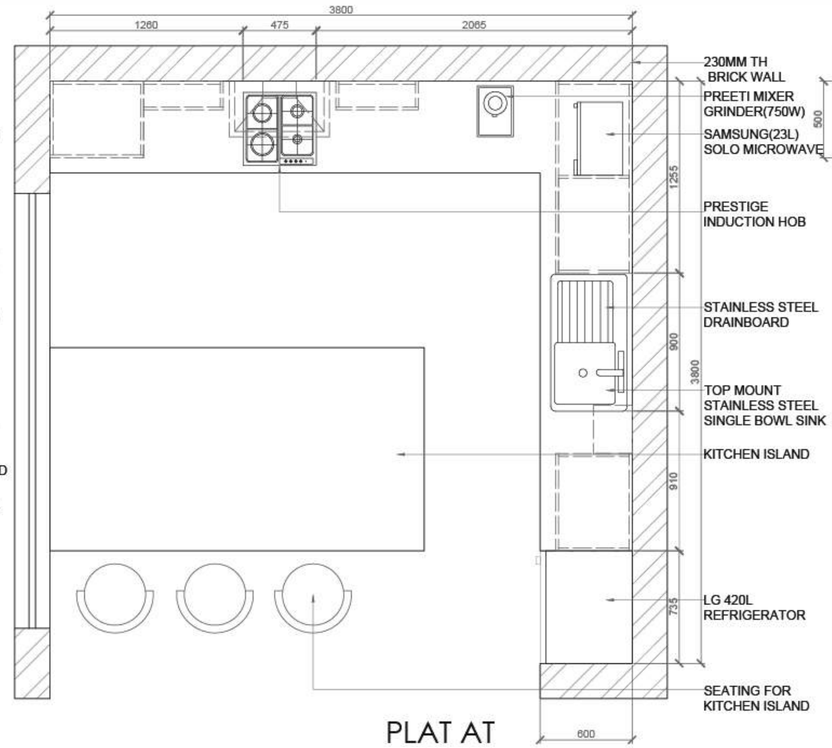
ELEVATION D

SCALE 1:15

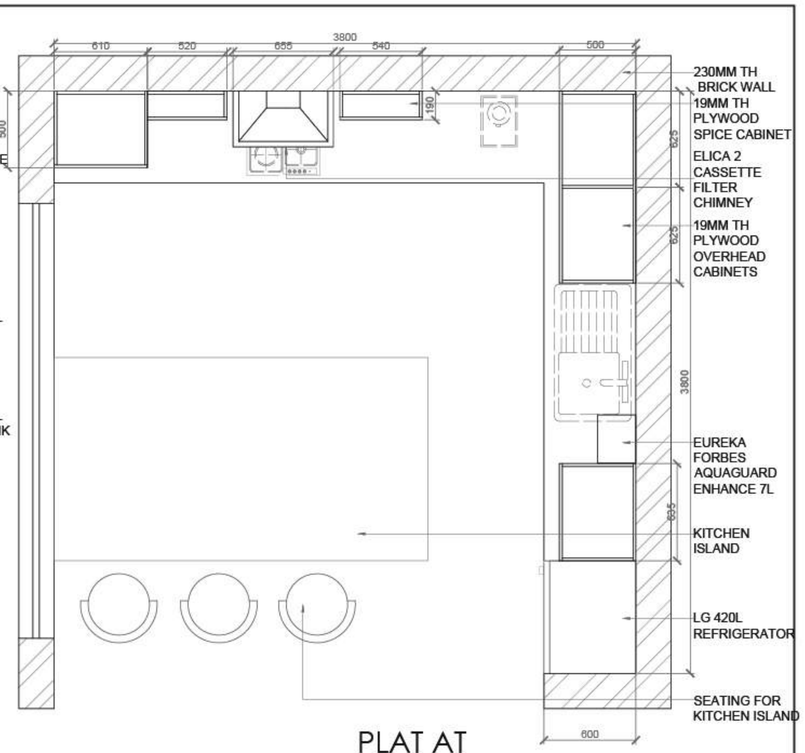
ALL MEASUREMENTS ARE IN MM



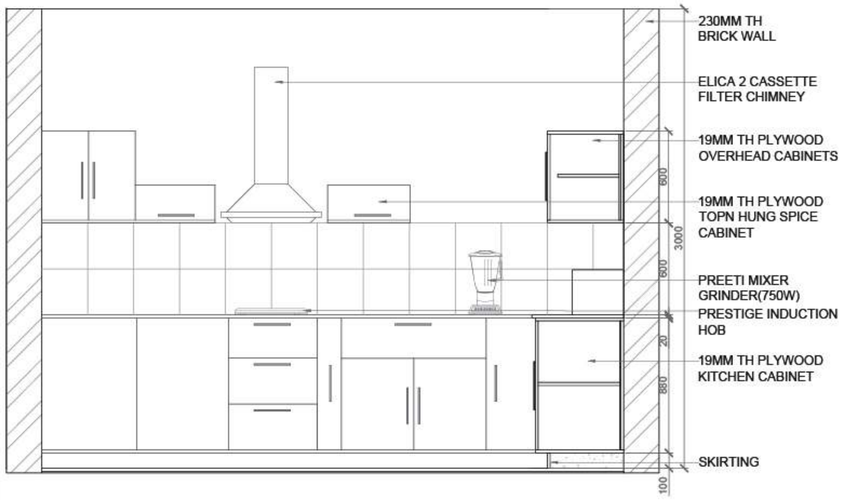
PLAT AT
LOWER CABINET LEVEL (600MM)
SCALE 1:20



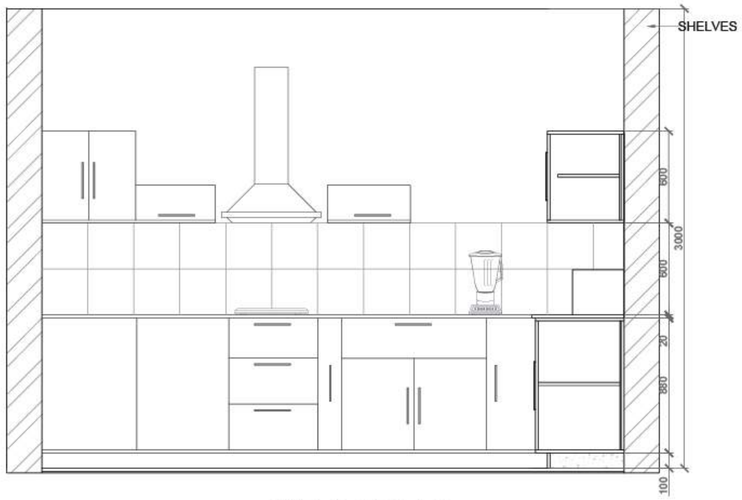
PLAT AT
CABINET LEVEL (1000MM)
SCALE 1:20



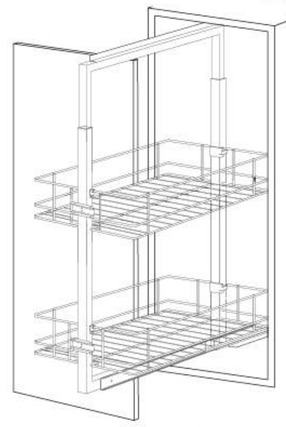
PLAT AT
UPPER CABINET LEVEL (1500MM)
SCALE 1:20



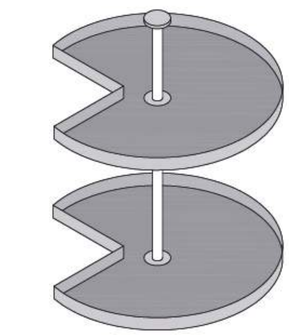
ELEVATION A
SCALE 1:20



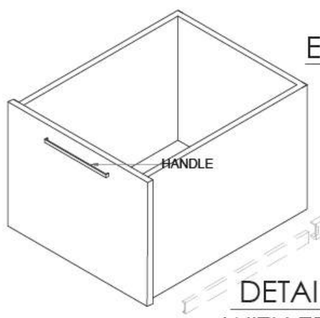
ELEVATION B
SCALE 1:20



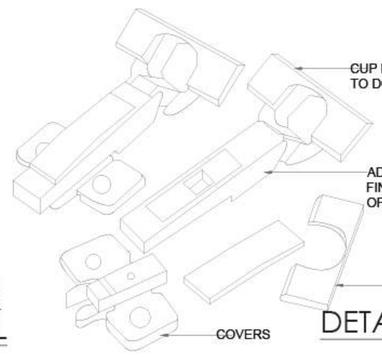
DETAIL :PULL OUT DRAWER
WITH STEEL BASKET
SCALE 1:10

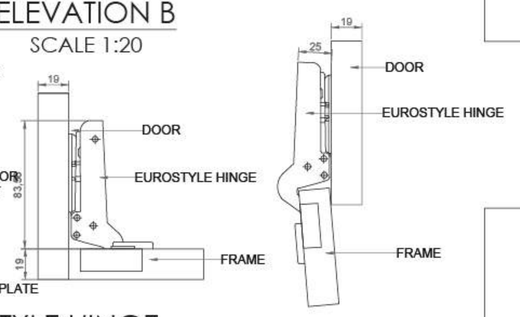


DETAIL :CORNER UNIT:
CAROUSEL FITTING
SCALE 1:5

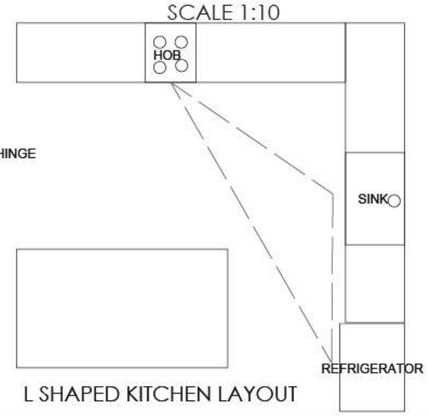


DETAIL: PULL OUT DRAWER
WITH TELESCOPIC CHANNEL
SCALE 1:10



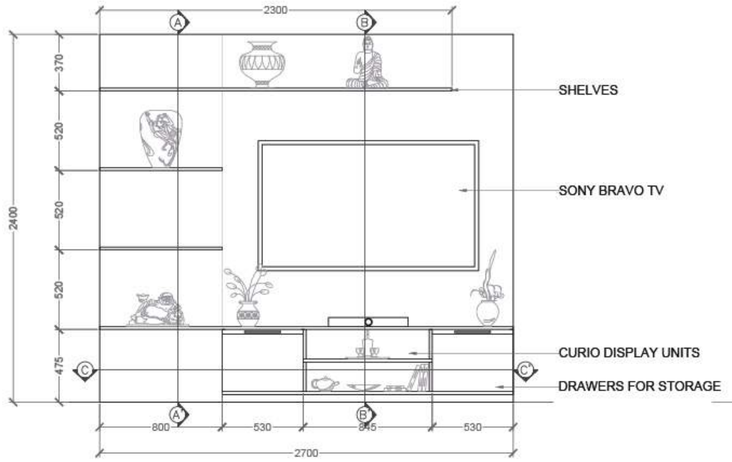


DETAIL :EUROSTYLE HINGE
SCALE 1:2



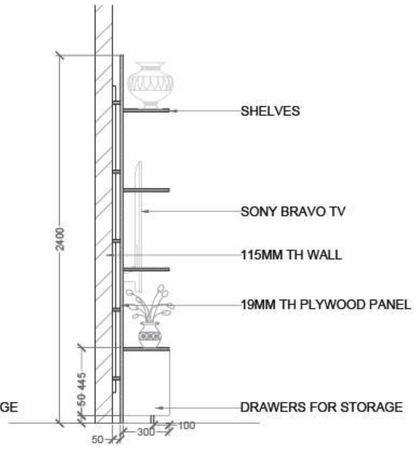
L SHAPED KITCHEN LAYOUT

LIVING UNIT: TV UNIT



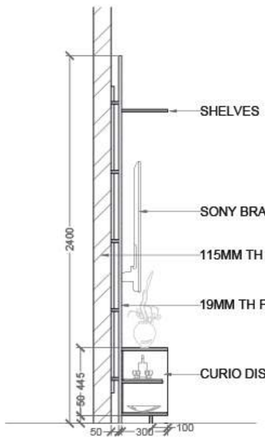
TV UNIT- ELEVATION

SCALE 1:20



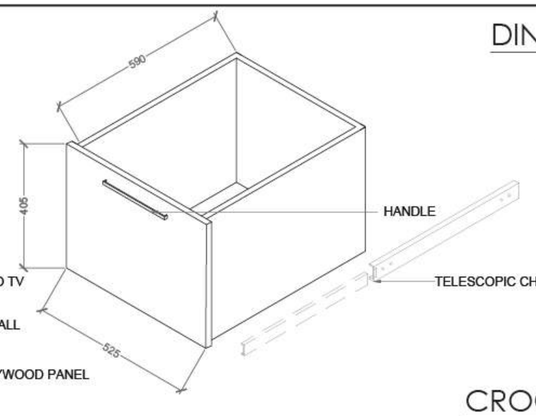
TV UNIT- SECTION AA'

SCALE 1:20



TV UNIT- SECTION BB'

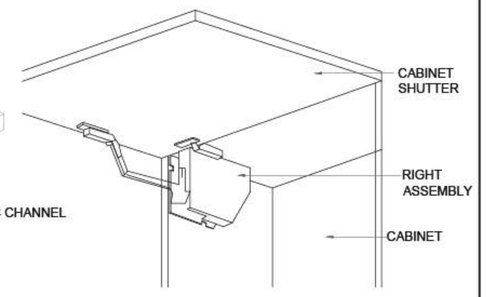
SCALE 1:20



TV UNIT- DRAWER DETAIL

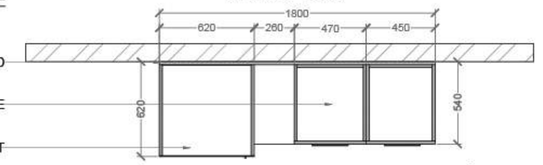
SCALE 1:10

DINING UNIT: CROCKERY UNIT



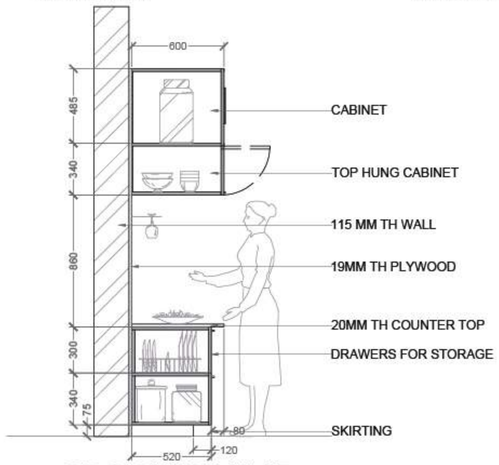
CROCKERY UNIT- STORAGE DETAIL

SCALE 1:20



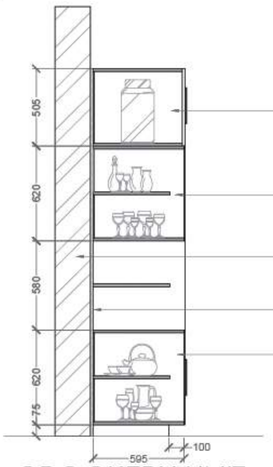
TV UNIT- PLAN CC'

SCALE 1:20



CROCKERY UNIT- SECTION DD'

SCALE 1:20

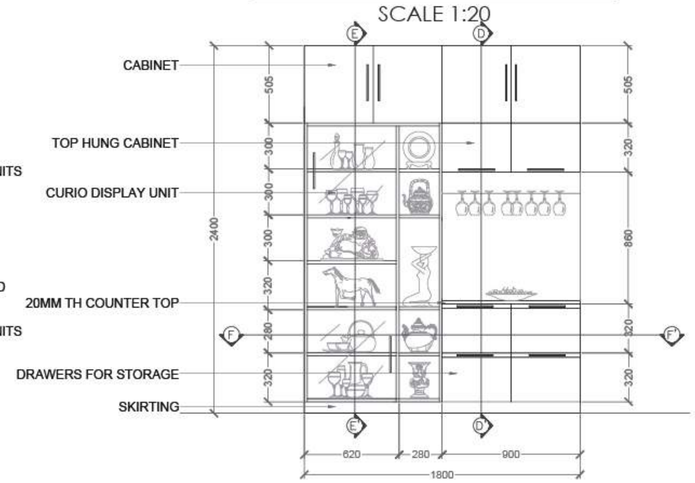


CROCKERY UNIT- SECTION EE'

SCALE 1:20

CROCKERY UNIT- PLAN FF'

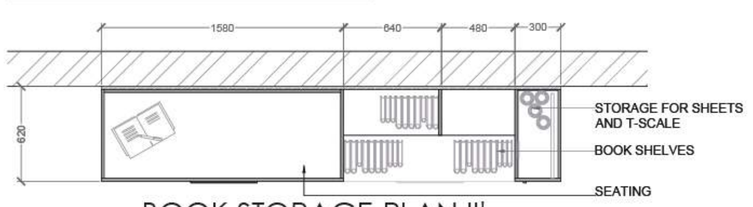
SCALE 1:20



CROCKERY UNIT- ELEVATION

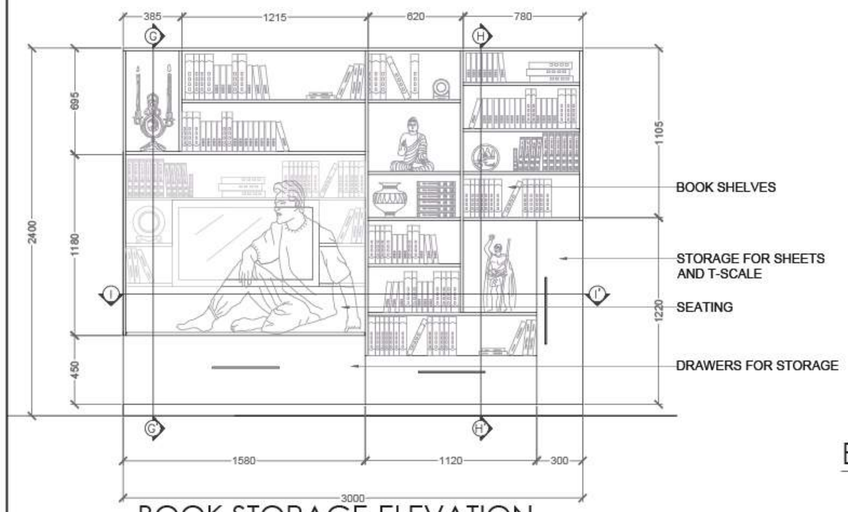
SCALE 1:20

LIBRARY/ BOOK STORAGE



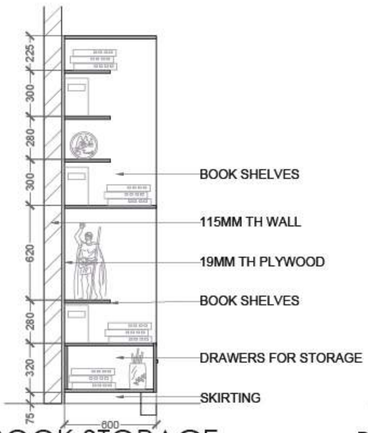
BOOK STORAGE-PLAN II'

SCALE 1:20



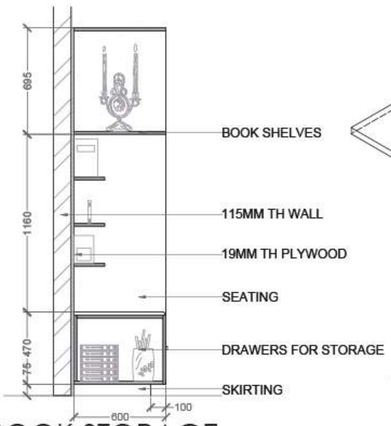
BOOK STORAGE-ELEVATION

SCALE 1:20



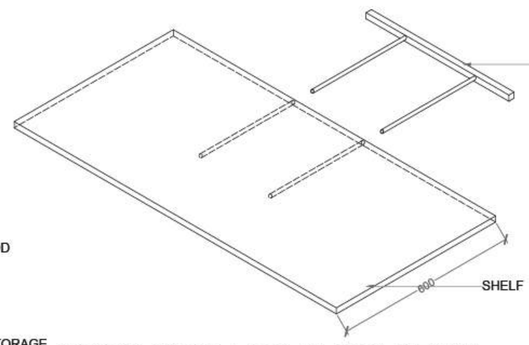
BOOK STORAGE- SECTION HH'

SCALE 1:20



BOOK STORAGE- SECTION GG'

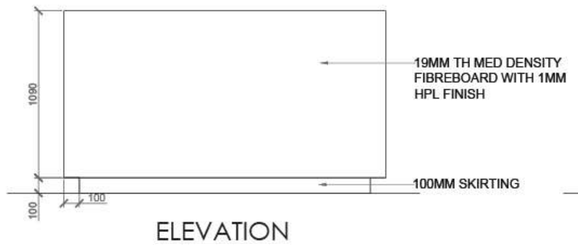
SCALE 1:20



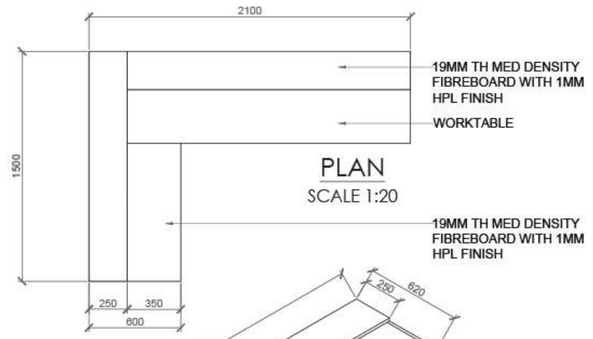
BOOK STORAGE- SHELF DETAIL

SCALE 1:10

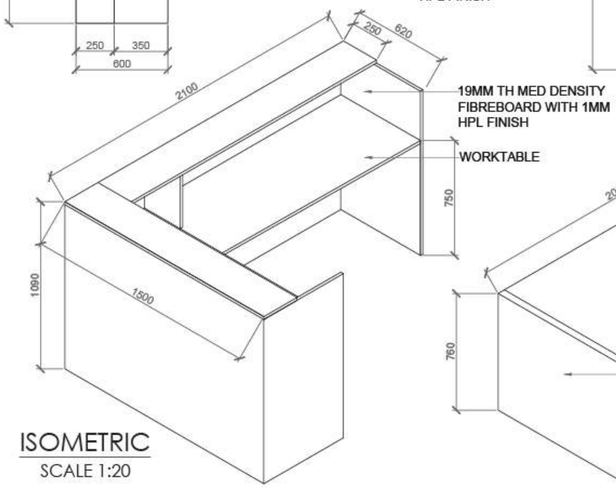
RECEPTION TABLE



ELEVATION
SCALE 1:20

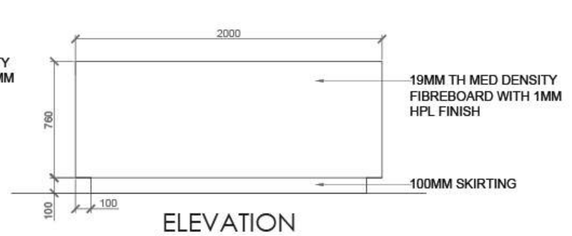


PLAN
SCALE 1:20

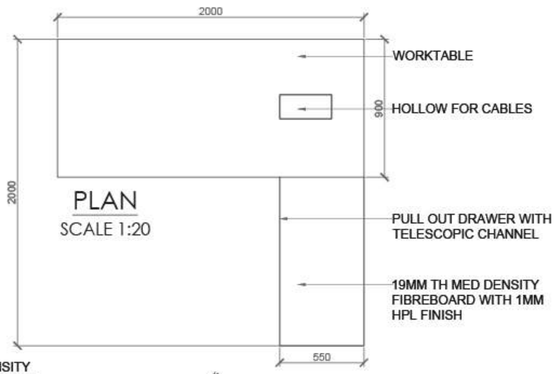


ISOMETRIC
SCALE 1:20

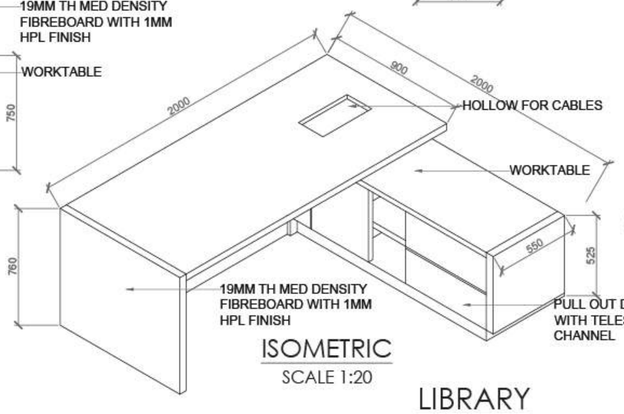
EXECUTIVE TABLE



ELEVATION
SCALE 1:20

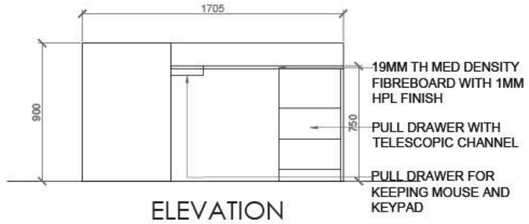


PLAN
SCALE 1:20

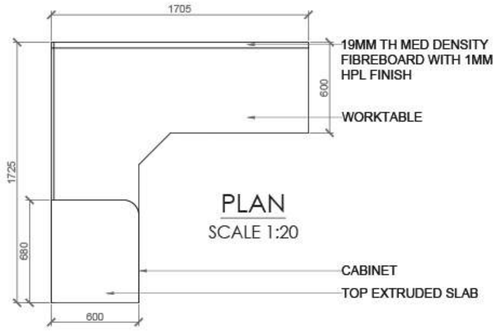


ISOMETRIC
SCALE 1:20

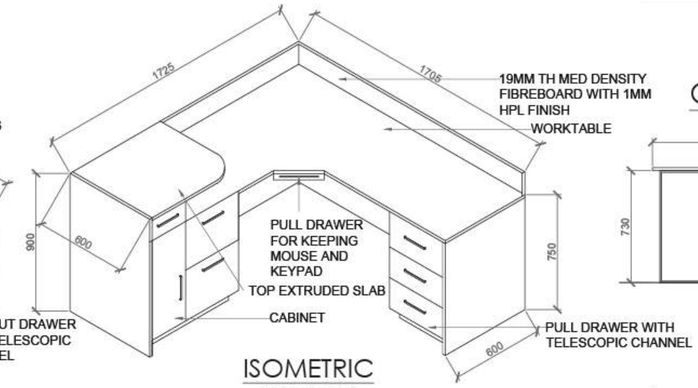
WORKSTATION



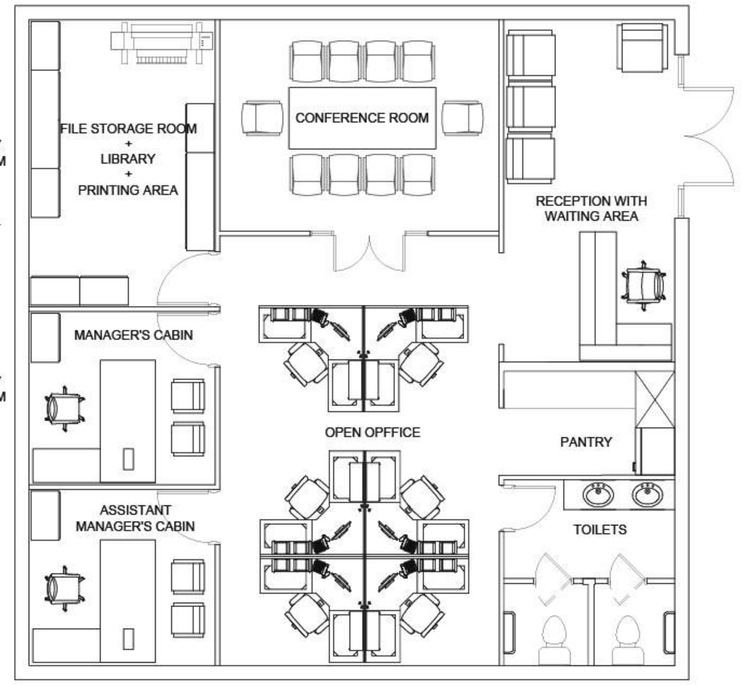
ELEVATION
SCALE 1:20



PLAN
SCALE 1:20

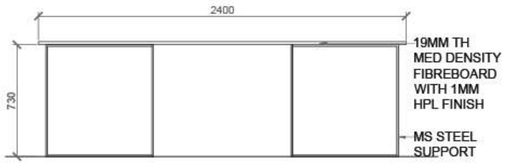


ISOMETRIC
SCALE 1:20

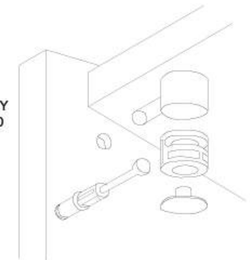


KEY PLAN
SCALE 1:50

CONFERENCE TABLE

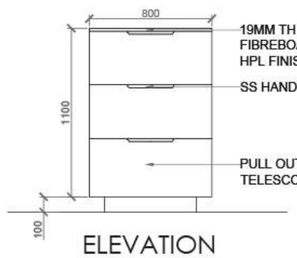


ELEVATION
SCALE 1:20

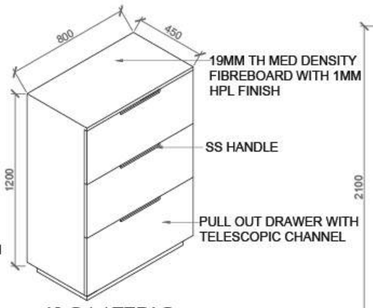


DETAIL OF CAM NUTS AND SCREWS
SCALE 1:2

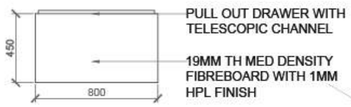
FILING CABINET



ELEVATION
SCALE 1:20



ISOMETRIC
SCALE 1:20



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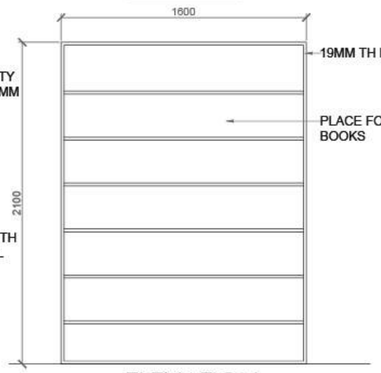
LIBRARY



ELEVATION
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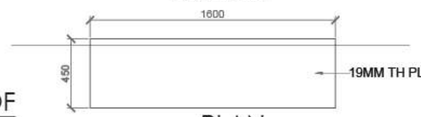

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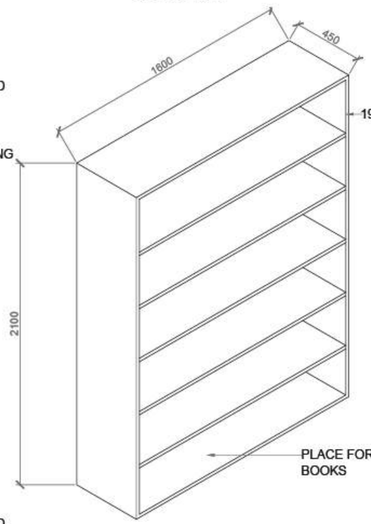

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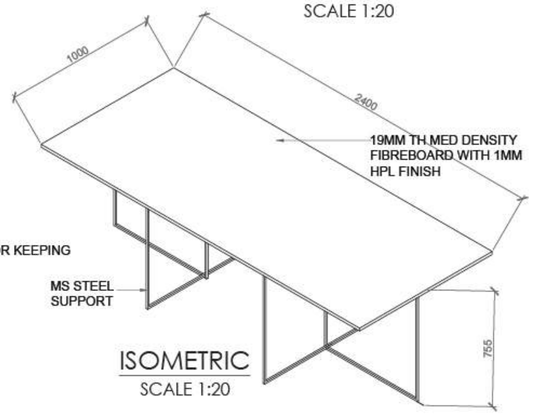
DETAIL OF DOVETAIL DADO
SCALE 1:2

PLAN
SCALE 1:20



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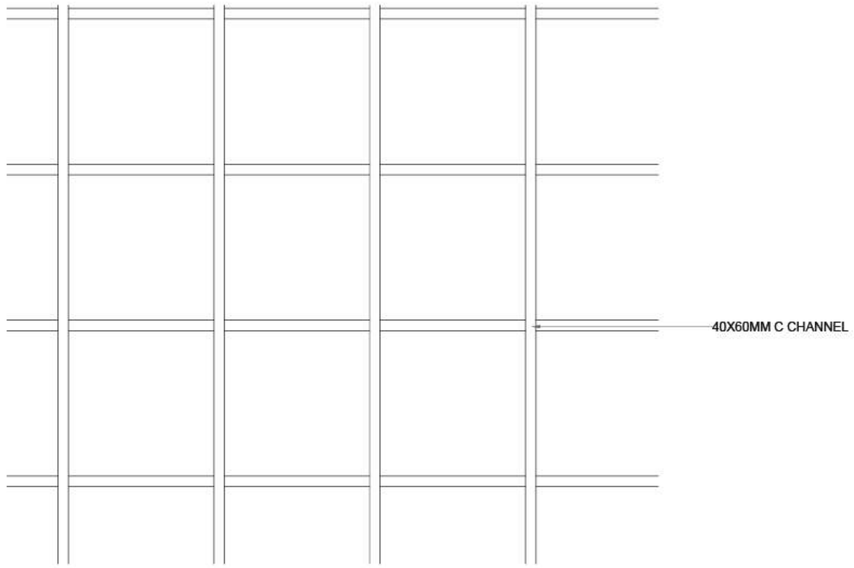
GYPSUM PARTITION



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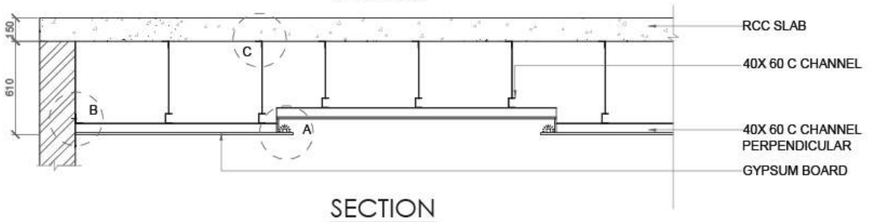

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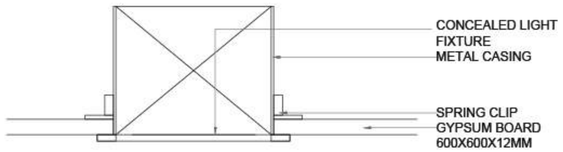
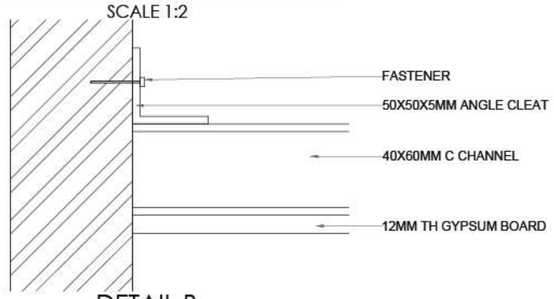
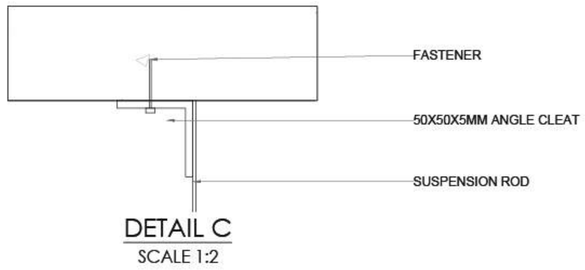
SCALE 1:20



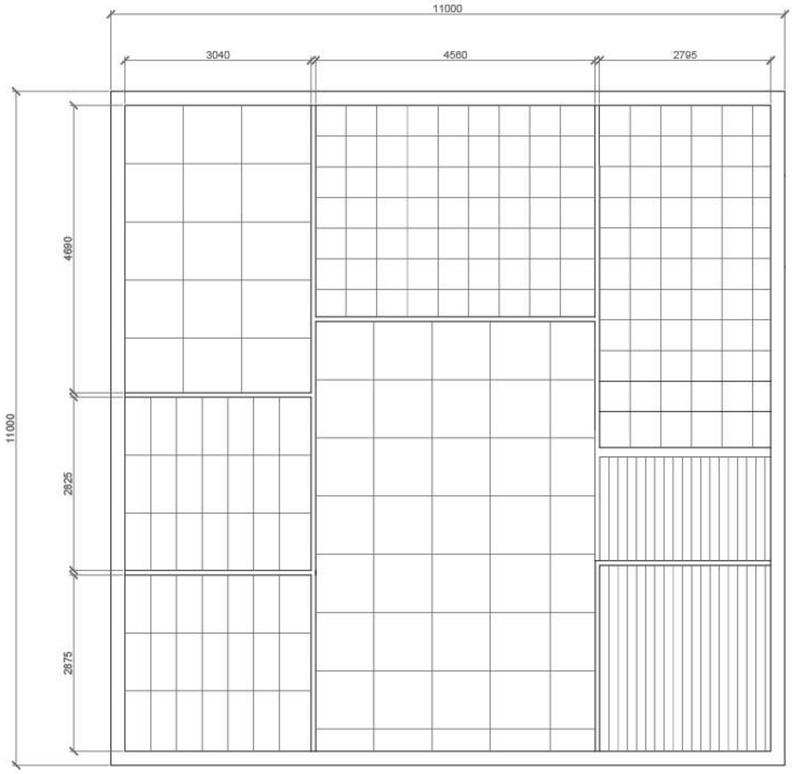
DETAIL A: LIGHT FIXTURE DETAIL
SCALE 1:2



DETAIL B
SCALE 1:2



DETAIL C
SCALE 1:2



KEY PLAN
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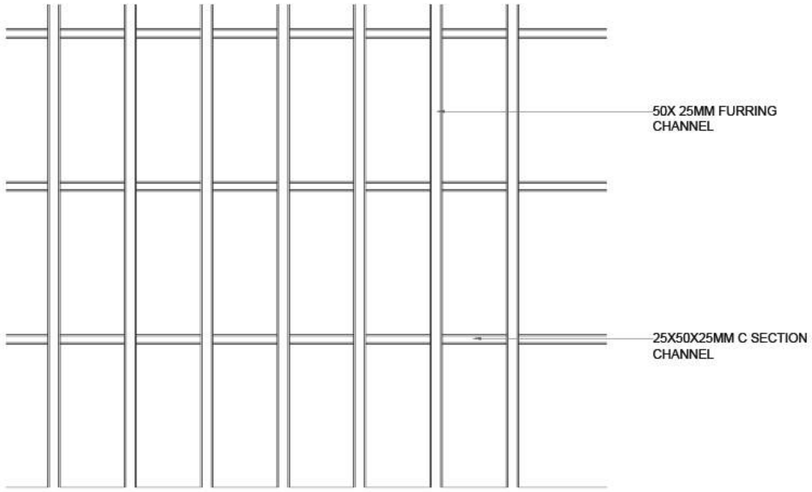
METAL PARTITION



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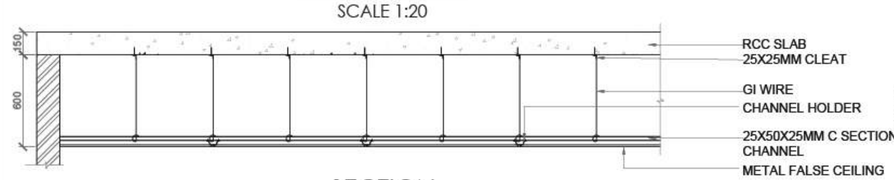
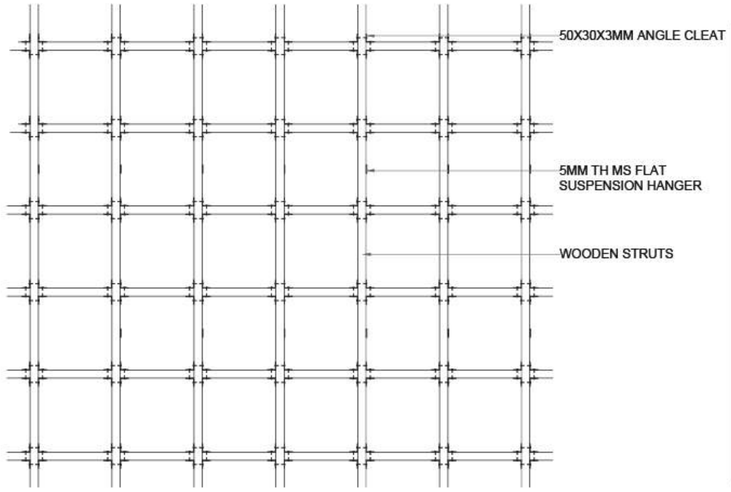


SECTION
SCALE 1:20

WOOD PARTITION



CEILING PLAN
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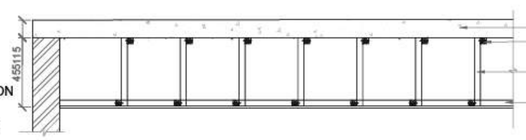
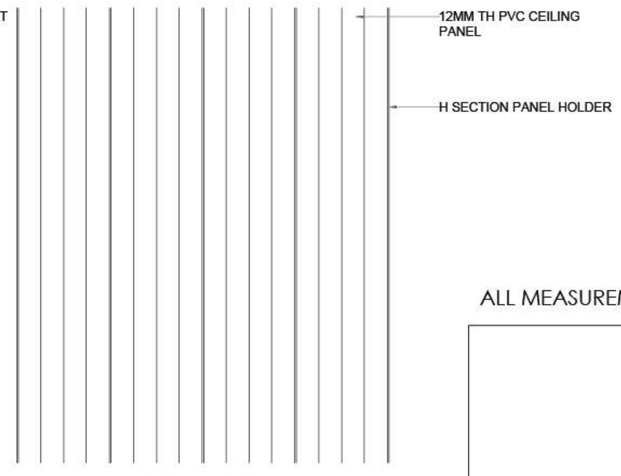


PVC PARTITION



CEILING PLAN
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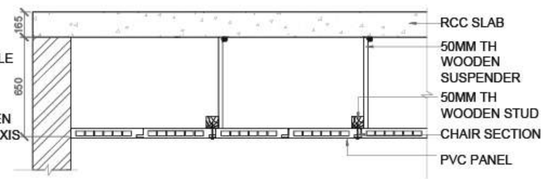


ALL MEASUREMENTS ARE IN MM

1. BRIEFLY EXPLAIN CAD CAM PROCESS IN THE CONSTRUCTION INDUSTRY? CITE SOME EXAMPLES OF CAD CAM APPLICATIONS IN ARCHITECTURE.

1. Computer Aided Design (CAD) involves creating computer models defined by geometrical parameters.

Computer-Aided Manufacturing (CAM) uses geometrical design data to control automated machinery.

Since CAD & CAM use computer-based methods for encoding geometrical data, it is possible for the processes of design & manufacture to be highly integrated.

HISTORY OF CAD IN CONSTRUCTION

→ emerged in 1960s via programs like Sketchpad, which apparently laid the foundation for modern iterations of CAD.

→ Eventually, CAD became precise enough for use in engineering applications, which is when it really took hold in the construction industry.

ADVANTAGES OF CAD/CAM

→ speed
→ cost
→ flexibility
→ competitive advantage
→ tangible design & product testing
→ quality
→ consistency
→ risk reduction
→ accessibility
→ sustainability

PHASES OF CAD/CAM IN CONSTRUCTION

→ PHASE 1 : PLANNING
- Planning, Budgeting & Permission
- concept evaluation & feasibility

→ PHASE 2: DESIGN
- Collaborative Design
- BIM Database & design Optimization.

→ PHASE 3: EVALUATION
- Design Evaluation using BIM
- cost Estimation & Transition

→ PHASE 4 : CONSTRUCTION
- construction drawings w/ accurate info. for site plans, floor plans, lighting, etc.

WHY CAD IS IMPORTANT IN CONSTRUCTION

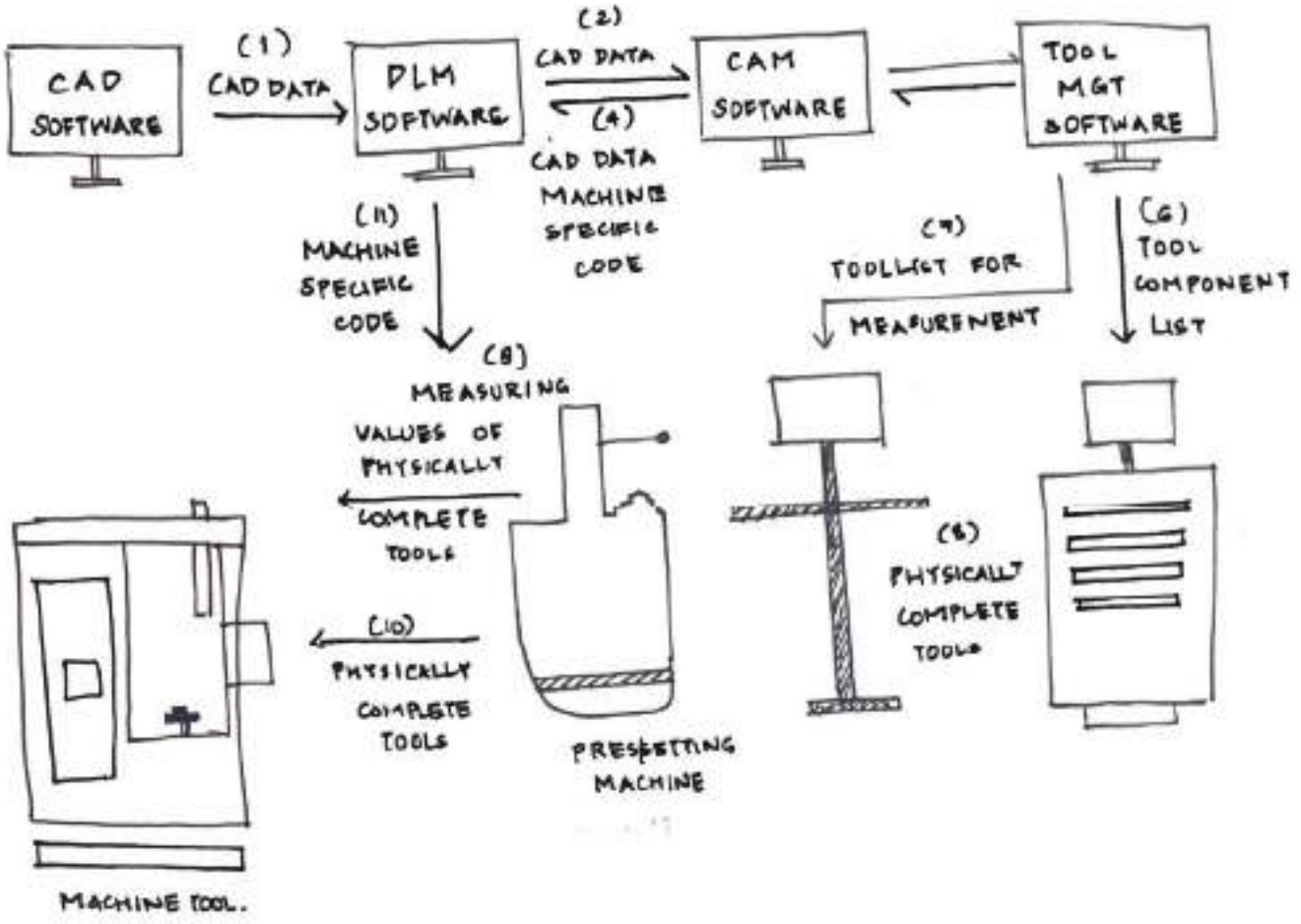
→ Offers architects maximum control over the visual representations of their designs. It allows them to get a diff. perspective.

→ Also helps professionals reuse designs as needed.

→ Easier sharing of designs b/w teams

→ Allows users to clearly see various iteration of a design

→ Pre-Engineered construction is gaining strength all around the world as it is affordable & requires less energy & material to produce the parts (in the majority of cases)



SOME POPULAR SOFTWARES FOR CAD IN CONSTRUCTION

→ REVIT
→ AUTOCAD
→ MICROSTATION
→ SKYCIV STRUCTURAL 3D.

SOME APPLICATIONS OF CAD/CAM IN CONSTRUCTION

(1) 2D FABRICATION

CNC cutting or 2D fabrication

(2) SUBTRACTIVE FABRICATION

It involves removal of specified volume of material from solids using multi-axis milling.

In CNC (Computer Numerical Control) milling a dedicated computer system performs the basic controlling functions over the movement of a machine tool using a set of coded instructions.

(3) ADDITIVE FABRICATION.

it involves incremental forming by adding material in layer-by-layer fashion, in a process converse of milling. It is often referred to as layered manufacturing, solid freeform fabrication, rapid prototyping or desktop manufacturing.

All additive fabrication technologies share the same principle in that the the digital (solid) model is sliced into 2-D layers.

(4) FORMATIVE ~~FOUNDATION~~ FABRICATION

In formative ~~foundation~~ fabrication mechanical forces, restricting forms, heat or steam are applied on a material so as to form it into the desired shape through reshaping or deformation, which can be axially or surface constrained.

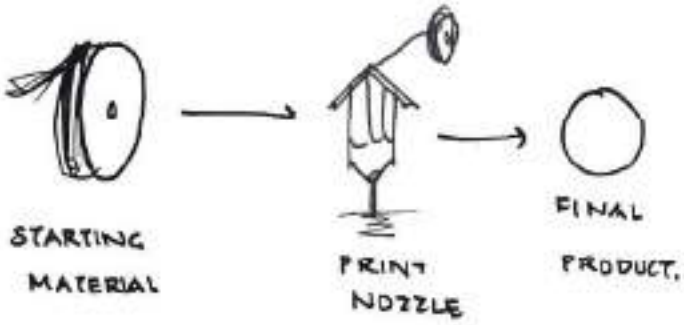
(5) ASSEMBLY

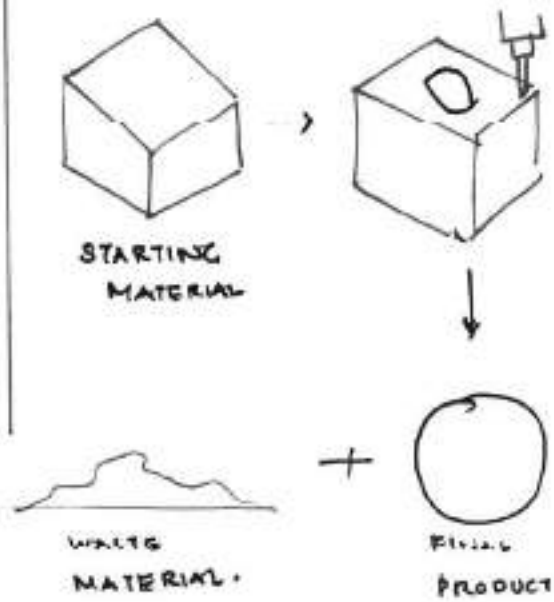
After the components are digitally fabricated, their assembly on site can be augmented w digital technology. Digital 3D models can be used to determine the location of each component, to move each component to its location, & finally, to fix each component in its proper place.

PROCESS OF DESIGN:

(1) The design is created in a CAD program.
(2) The design is imported into a CAM program
(3) The imported data is used to generate a G-code
(4) The G-code is downloaded into the machine
(5) The machine creates the physical product.

ADDITIVE MANUFACTURING	SUBTRACTIVE MANUFACTURING.
• involves adding layers of material to create an object	• removes material from an object
• process includes 3D printing, direct digital manufacturing, rapid prototyping or additive & layered fabrication.	• The process is either by manual removal, traditional machinery or CNC machining.
• uses computers & specialist 3D printing equipment to create products or prototypes.	• uses computer & robotics to assist standard machining processes. eg: turning, drilling or mining.





2. EXPLAIN 3D PRINTING PROCESS, AND VARIOUS TYPES OF 3D PRINTERS?

2. 3D PRINTING

3D Printing or additive manufacturing is a process in which a digital file can be used to create three-dimensional solid things via additive manufacturing from a digital file.

Utilizing additive methods, 3D printed objects are produced. In an additive process, an object is made by adding layers of material one after another until the product is made. It is possible to think of each of these levels as a thinly sliced cross-section of the object.

3D printing is the opposite of subtractive manufacturing which is cutting out/hollowing out a piece of metal or plastic with for instance a milling machine.

3D printing enables you to produce complex shapes using less material than traditional manufacturing methods.

3D printing is convenient for CAD: Computer Aided Design & CAM: computer Aided Manufacturing.

Traditional CAD-CAM systems are imprecise & perform poorly when used for cutting. Compared to traditional subtractive technology, the situation is more simpler with the CAM system for the layer production process.

The most popular method of creating 3D models is called Fused Filament Fabrication (FFF). It makes use of thermoplastic filaments such as PLA (polyactic acid), ABS (acrylonitride butamide styrene), and others that are heated & extruded by an extrusion head.

VARIOUS COMPONENTS OF A 3D PRINTER.

- controller board
- stripper motors
- end stops
- print bed surfaces
- dual extrusion
- filament
- belts
- power supply unit
- print head
- user interface & connectivity
- frame
- threaded rods
- print bed
- Feeder system
- File transfer options

MATERIALS

- Plastic
  - Polyastic Acid (PLA)
  - Acrylonitrile Butadiene styrene (ABS)
  - Polyvinyl Alcohol Plastic (PVA)
  - Polycarbonate (PC)
  - Acrylonitrile styrene Acrylate (ASA)
  - Polyethylene Terephthalate Glycol (PETG)
- Nylon
- Resin
- Metals
- Ceramics
- hybrid materials
- flexible materials

VARIOUS TYPES.

(1) STEREOLITHOGRAPHY (SLA)

- Its the world's ~~historical distinction of~~ first 3D printing technology.
- It is a fast prototyping process. It is precise & known for its fine details.
- It uses mirrors, known as galvanometers or galvos, with one positioned on the X axis & another on the Y-axis. These galvos rapidly aim a laser beam across a vat of resin, selectively curing & solidifying a cross section of the object inside this building area, building it up layer by layer.
- Most SLA printers use a solid-state laser to cure parts. The disadvantage of these types of 3D printing technology using a point laser is that it can take longer to trace the cross section of an object.
- It is an economical option.

(2) DIGITAL LIGHT PROCESSING (DLP)

- DLP uses a digital light projector to flash a single image of each layer all at once (or multiple flashes for larger parts)
- Because the projector is a digital screen, the image of each layer is composed of square pixels, resulting in a layer formed from small rectangular blocks called voxels.
- Light is projected onto the resin using light-emitting diode (LED) screen or a UV light source (lamp) that is directed to the build surface by a digital micromirror device (DMD).
- A DMD is an array of micromirrors that control where light is projected & generate the light-pattern on the build surface.

(3) FUSED DEPOSITION MODELING (FDM)

- Also referred to as Fused Filament Fabrication or FFF.
- The way it usually works is that a spool of filament is loaded into the 3D printer & fed through to a printer nozzle in the extrusion head. The printer nozzle is heated to the desired temperature, whereupon a motor pushes the filament through the heated nozzle, causing it to melt.
- the printer then moves the extrusion head along with specified coordinates laying down the molten material onto the build plate, where it cools down & solidifies.
- Once a layer is complete, the printer proceeds to lay down another layer. This process of printing cross-sections is repeated, building layer-upon-layer until the object is fully formed.
- Depending on the object's geometry, it is sometimes necessary to add support structures ~~etc.~~
- FDM is used is in 3D printed buildings by extruding clay or concrete, ~~3D printed deserts by extruding chocolate~~

(4) SELECTIVE LASER SINTERING (SLS)

- SLS 3D printers use a high power laser to sinter small particles of polymer powder into a solid structure.
- The unfused powder supports the part during printing & eliminates the need for dedicated support structures.
- This makes SLS ideal for complex geometries including interior features.
- The most common material for selective laser sintering is nylon, a popular engineering thermoplastic with excellent mechanical properties.
- low cost per part, high productivity.

(5) SELECTIVE LASER MELTING (SLM)

- applied to production of metal parts
- It heats the powder to a point so that it can fuse on a molecular level
- SLM uses the laser to achieve a full melt of the metal powder forming a homogeneous part. This results in a part that has a single melting temperature
- It is a costly technology.

(6) ELECTRONIC BEAM MELTING (EBM)

- It uses high energy beam, or electrons, to induce fusion b/w the particles of metal powder.
- A focused electron beam across a thin layer of powder, causing localised melting & solidification over a specific cross-sectional area.
- has a superior build speed due to its higher energy density.
- EBM parts are fabricated in vacuum & the process can only be used w/ conductive materials.

(7) LAMINATED OBJECT MANUFACTURING (LOM)

- rapid prototyping system that works by fusing or laminating layers of plastic or paper using both heat & pressure.
- A computer controlled blade or laser cuts the object to the desired shape.
- one of the fastest methods

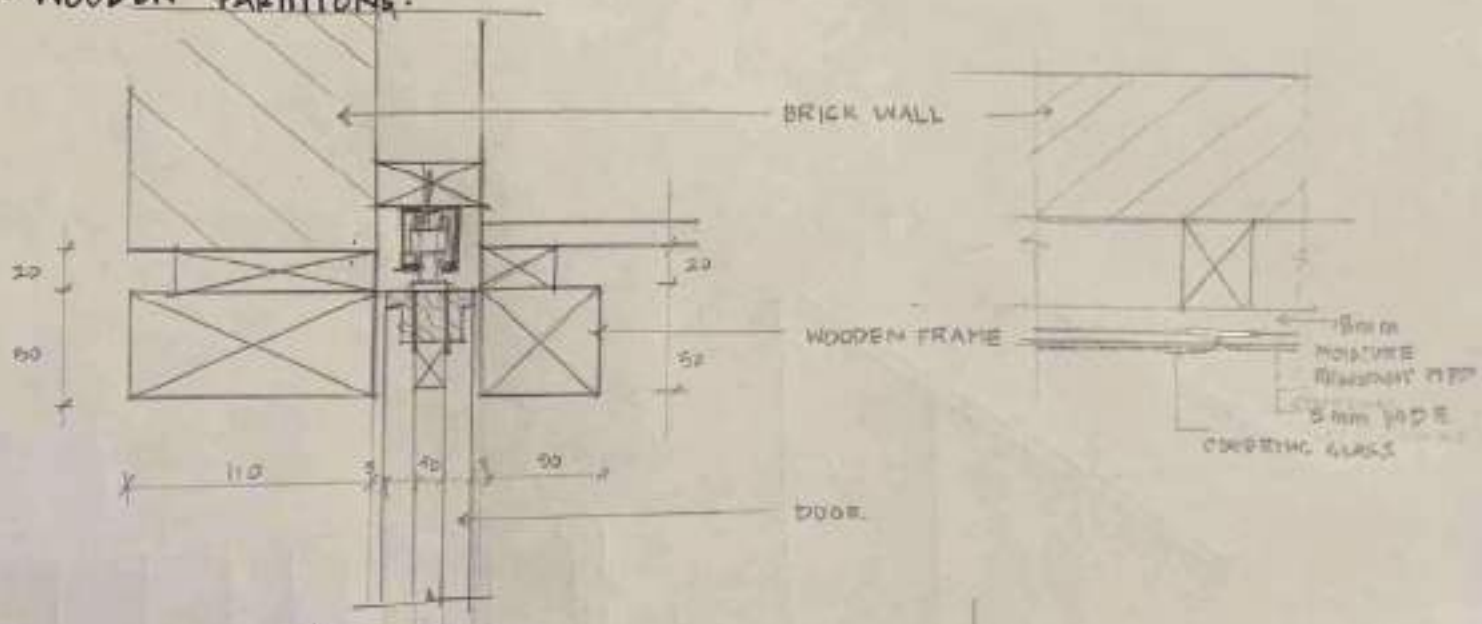
(8) BINDER JETTING (BJ)

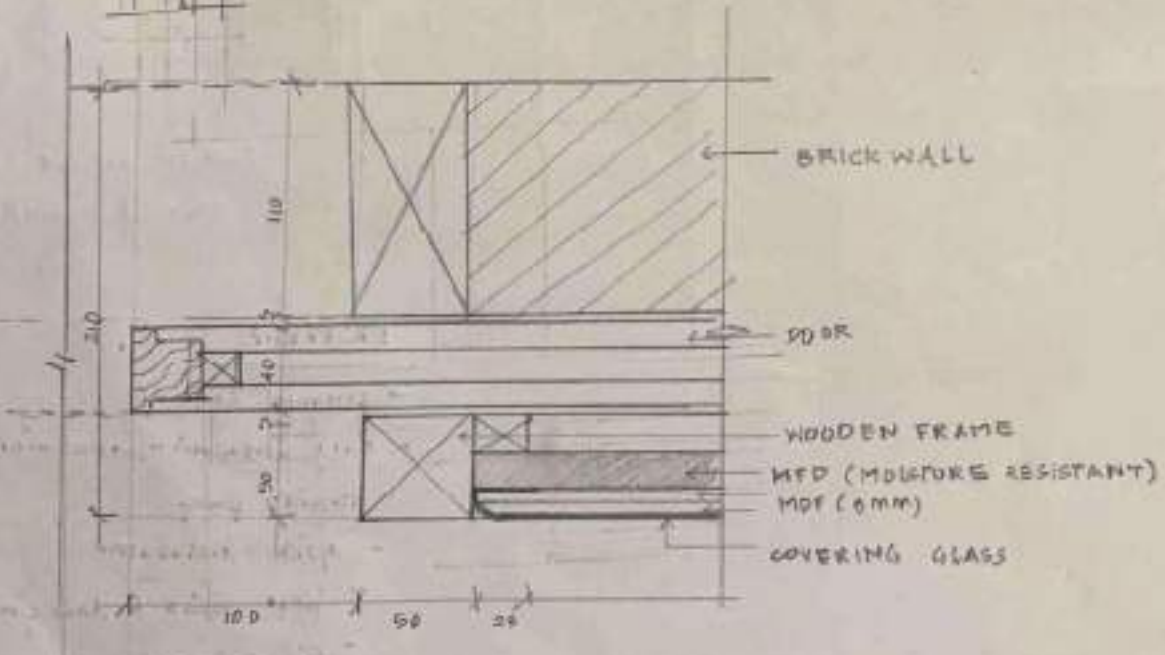
- BJ deposits a thin layer of powdered ~~metal~~ material (metal, polymer sand, ceramic) onto the build platform, after which drops of adhesive are deposited by a print head to bind the particles together.
- once a layer has been printed, the powder bed is lowered, & a new layer of powder is spread over the recently printed layer. This process is repeated until a complete object is formed.
- The object is then left in the powder to cure & gain strength. Afterwards, the object is removed from the powder bed, & any unbound powder is removed using compressed air.

(9) MATERIAL JETTING (MJ)

- Works in the same way as inkjet printing, except, rather than laying down ink on a page, this process deposits layers of liquid material on one or more print heads.
- The layers are then cured before the process begins again for the next layer.
- MJ require the use of support structures but these can be made from a water soluble material that can be washed away once the build is complete.
- One of most expensive

- WOODEN PARTITIONS.



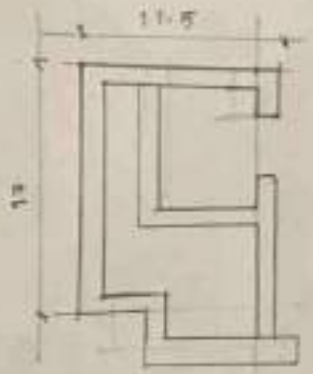


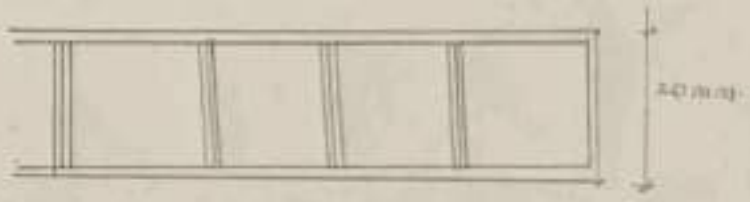
PROPERTIES

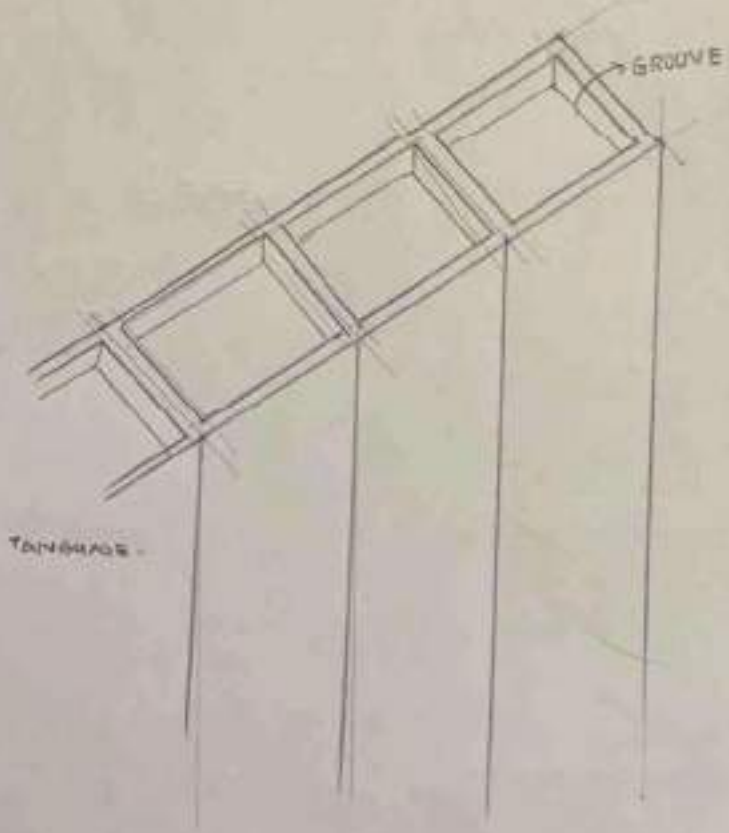
- light wt.
- natural & earthly appearance
- easy to construct
- not fire resistant
- prone to termite attacks
- not suitable for damp locations

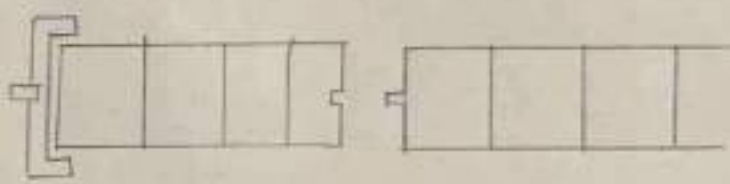
D E T A I L S : W O O D E N P A R T I T I O N S.

• PVC PARTITIONS.







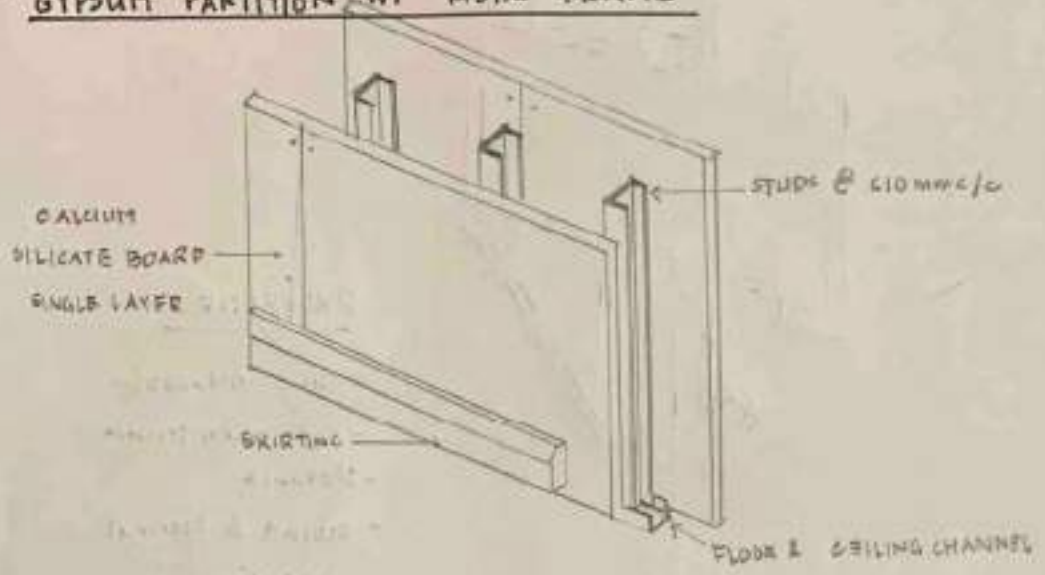


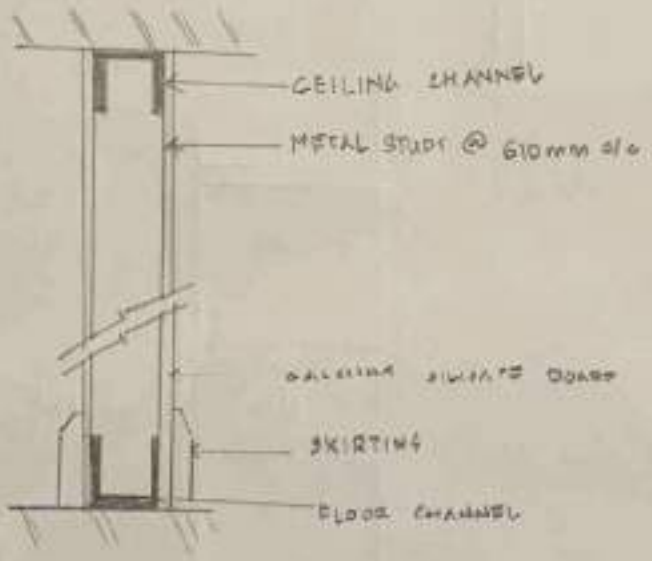
SLIP ON OUTSIDE EDGE
(TONGUE IS TRIMMED)

PROPERTIES

- Durable, light wt.
- easy installation, economical
- termite proof
- quick installation
- heat, noise & dust proof
- fire resistant

* GYPSUM PARTITION W/ METAL FRAME

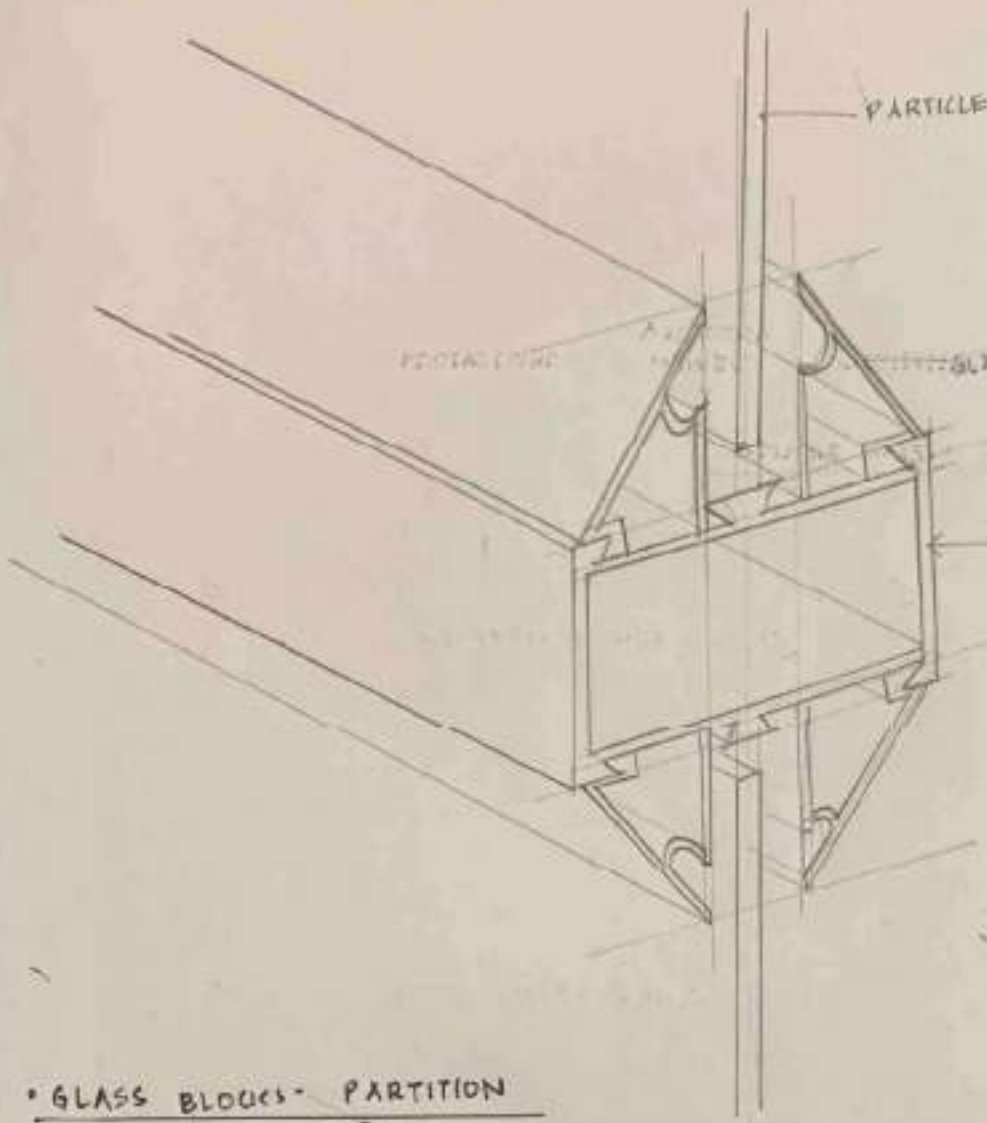




PROPERTIES

- non-load bearing
- simple to use construction
- fire resistant
- sound insulating
- no expansion/contraction during setting.

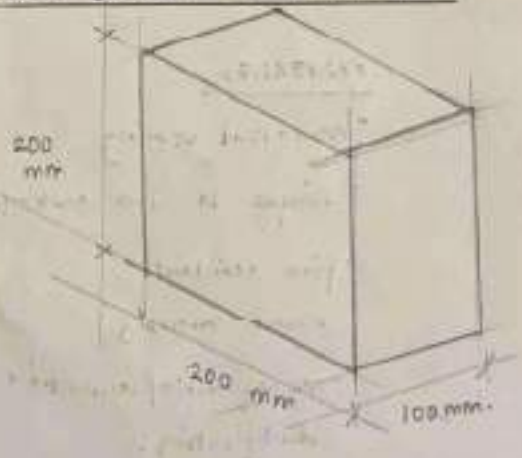
• ALUMINIUM PARTITIONS.



PROPERTIES

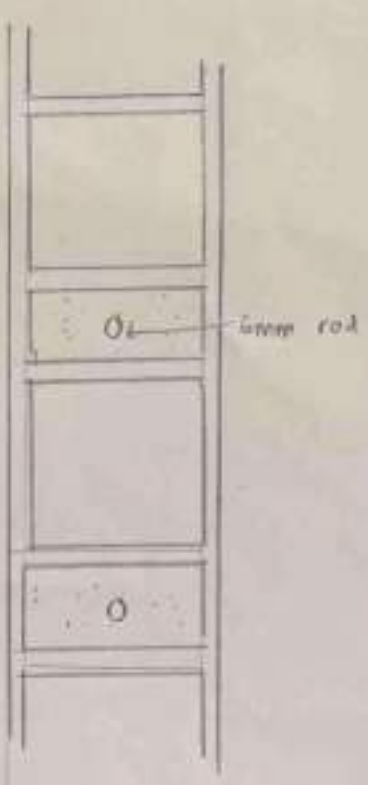
- easy installation
- low maintenance
- durable
- sound & thermal insulation.

• GLASS BLOCKS - PARTITION



PROPERTIES

- permit natural light to pass through
- strong
- customizable
- thermal & sound insulation.



PART-1

1. WHAT ARE THE PROPERTIES OF BAMBOO?

→ INTRODUCTION TO BAMBOO

- It is one of the oldest & traditional construction material used in different construction activities.

- The bamboo strength is more as compared to other material. Bamboo as a building material has greater compressive strength & it is lightweight so it is widely used as a construction material.

- Bamboo is used in construction widely for various purposes such as scaffolding, construction of bridges & structure, etc.

- Bamboo is one of the fastest growing plants all over the world. It is a renewable resource which can be cultivated in diff. types of soil.

- Bamboo is referred mostly in the earthquake-prone regions due to its elastic properties.

- It is widely used for construction of partition walls, beams, roofing material, etc.

- It has a natural surface which is smooth & clean & v. attractive & doesn't require painting.

- It is a cost-effective construction material.

- Structural bamboo is used for the construction of various structural elements such as beam & columns, etc.

- It has high load bearing capacity.

- It has high compressive & tensile strength.

- Because of the circular & hollow section of bamboo, it is very lightweight & is very easy to handle & transport.

→ PROPERTIES OF BAMBOO AS A CONSTRUCTION MATERIAL.

(I) COMPRESSIVE STRENGTH OF BAMBOO

The dimmer tubes of bamboo have greater compressive strength value.

(II) TENSILE STRENGTH

Bamboo has greater tensile strength than compressive strength.
The fibres present in bamboo have high elastic & tensile strength.

(III) ELASTIC MODULUS

More elastic modulus, higher the quality of bamboo.

Accumulation of the strong fibre in the Tube wall of the bamboo affects the elastic modulus.

(IV) SHRINKAGE

It shrinks more as compared to wood & timber when it losses water.

(V) FIRE RESISTANCE

It has good heat preservation & heat insulation property.

2. HOW IS BAMBOO TREATED?

→ WATER-LEACHING.

- It is a simples' ancestral technique.
- concept relies on submerging the bamboo in flowing, clean water for a certain period (4-8 months). The water-soluble substances present in the bamboo, such as starch & sugars, will be washed away slowly.
- This makes the pole less attractive to insects as food.
- Bamboo is still not completely resistant to insect attacks & molds following this process.

→ FERMENTATION.

- the idea is to compost the bamboo within mud & Tree leaves for a few months. (3-4 months).
- The microorganisms & bacteria in the compost converts the starches & sugars into acid thus lowering the likelihood of insect predation. This method, although ingenious, is v. inconsistent & lacks assurance that will protect the bamboo from farther insect infestation further down the line.

→ SMOKING & HEATING

- Smoking bamboo poles reduces the moisture content in freshly harvested bamboo & extrudes out the sugars that are in the pole.
- Furthermore, the chemical compounds found in smoke are absorbed by the bamboo tissues & help to protect them from insects.
- The main challenge w/ this method is to maintain consistency of heat & smoke quality throughout the bamboo preservation process, so that each pole is treated uniformly. Burning large amounts of mat. to create smoke also has its own environmental challenges.

→ SALTWATER & SEAWATER.

- Submerging bamboo into salt water is an effective Treatment solution.
- The bamboo is submerged in the ocean for 30 days - 3 months to allow the fibers to absorb the salt solution & release the sugary sap from the parenchyma within the bamboo.
- Holes are punched through the core of the pole, to break free the internodes of the bamboo to allow for maximum penetration of salts into the bamboo. On some occasions, minuscule holes are also drilled from the outside skin at each internode for v. thick-walled bamboo.
- The only challenges w/ this method is that seawater is composed of Na & Cl. (NaCl). & Cl is highly corrosive.
- This presents issues during construction as it rusts steel bolts used for joinery connections & collects humidity out of the air which can lead to issues in the long term.
- not environmentally harmful.

→ BORIC ACID BORAX

- curing bamboo w/ borax & boric acid is the most bamboo preservation method (for indoor use) around the world because it is effective & more environmentally friendly than other wood preservatives
- The combination of boric acid & borax in a ratio of 1:1.5 is an alkaline salt called: Disodium octaborate Tetrahydrate ($Na_2B_8O_{13} \times 4H_2O$) & is available in pre-mixed powder form, usually under the commercial names: TimtBor or SoluBor, among others
- Disodium Octaborate Tetrahydrate is a white, odorless, powdered substance that is not flammable, combustible, or explosive & has acute low oral & dermal toxicity. The product itself is fire retardant & shows no hazardous decomposition.
- This salt, is used as an insecticide & fungicide.
- It has an infinite shelf life & is not affected by temperature.
- Diluted w/ water, bamboo can be impregnated, submerged or sprayed w/ the chemical

→ COPPER CHROME ARSENIC (CCA)

- It is a heavy duty broad spectrum chemical bamboo preservative patented as Ascu
- It has been found to provide protection for 50 years or more.
- Outdoor use is recommended only due to the arsenic component, which can also cause a green coloration on the bamboo.

→ COPPER CHROME BORON (CCB)

- less effective w/ a lower degree of fixation, because of the boron component.

→ ZINC CHROME

- highly hygroscopic
- treated bamboo will give a wet look in rainy season.
- helps paints & other finishes.

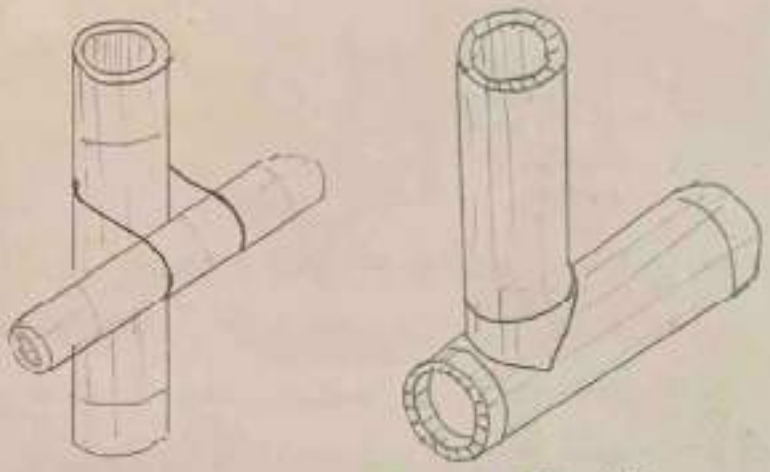
→ COPPER CHROME ACETIC

- 8% outdoor use
- structures exposed to weather & in ground contact.

→ FIRE RETARDANT PRESERVATIVE

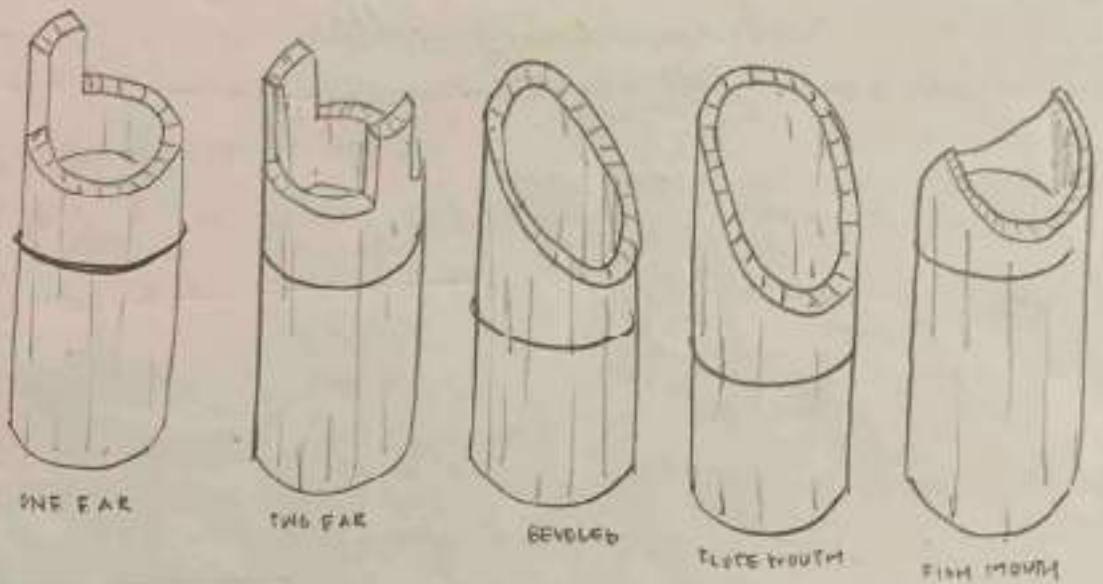
- intended to protect materials against fire as well as decay & insect attacks.

3. ENUMERATE THE JOINTS IN BAMBOO STRUCTURES.



NODES USED

BAMBOO CUTS



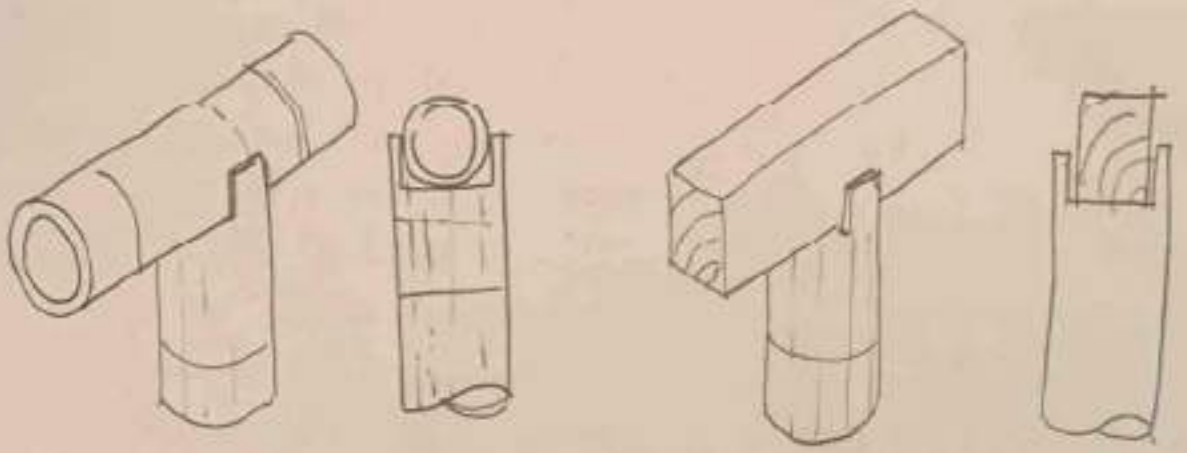
ONE EAR

TWO EAR

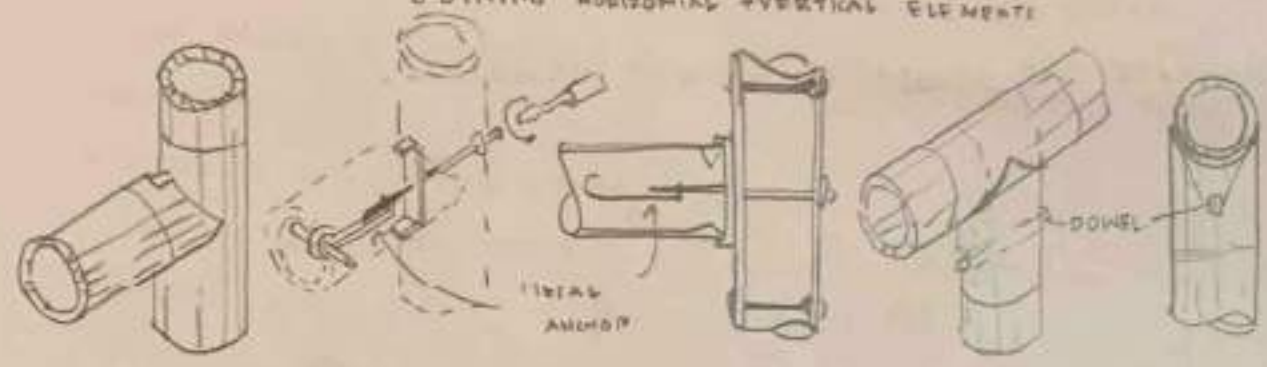
BEVELED

FLUTE MOUTH

FISH MOUTH

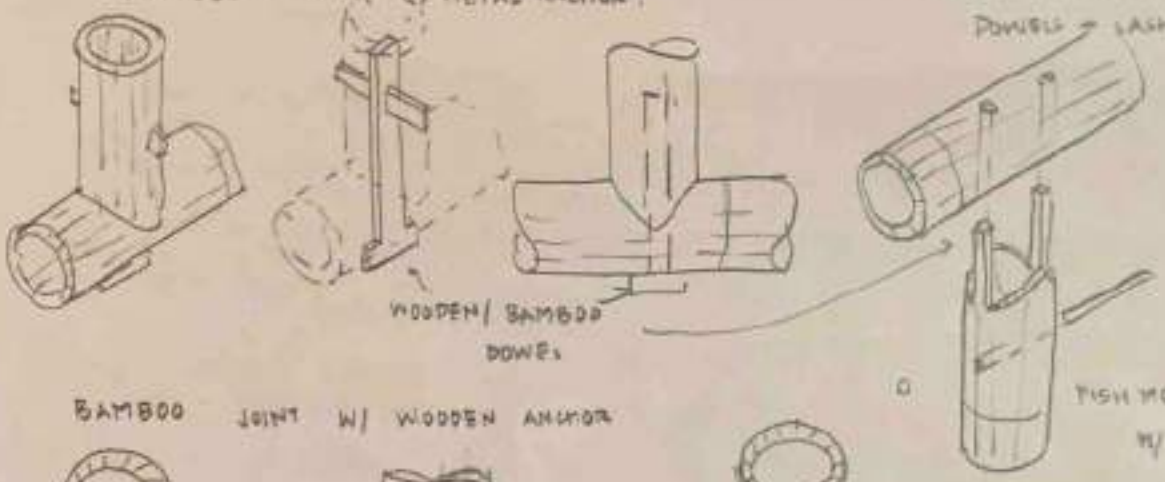


JOINING HORIZONTAL + VERTICAL ELEMENTS



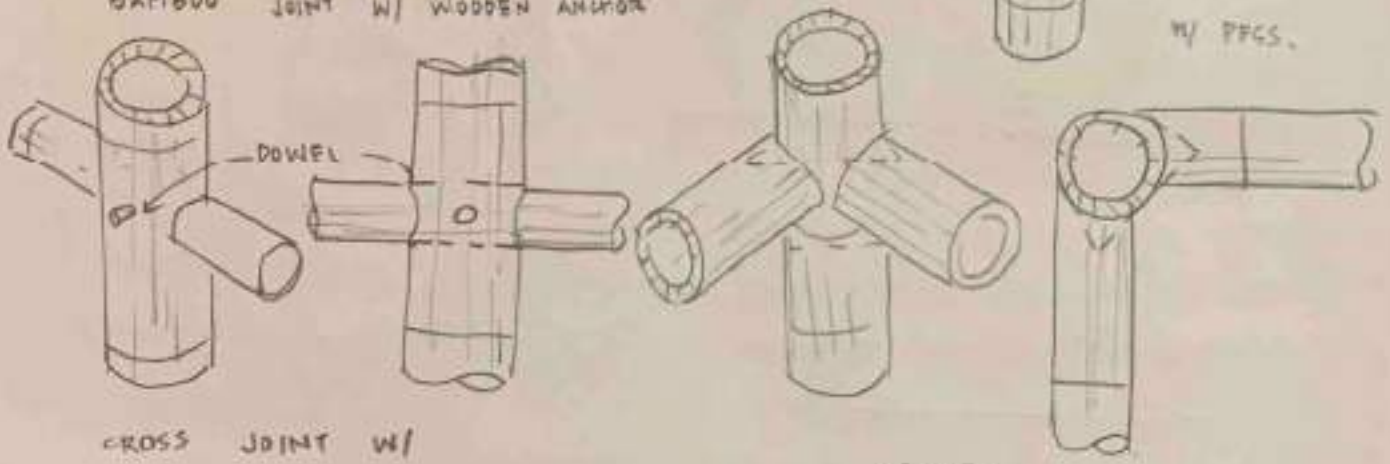
BAMBOO JOINT W/ METAL ANCHOR.

JOINING BAMBOO W/
DOWELS + LASHING



BAMBOO JOINT W/ WOODEN ANCHOR

TISH MOUNT JOINT
W/ PFCS.



CROSS JOINT W/
DOWEL

CORNER
JOINT.

4. WHAT ARE THE ADVANTAGES & DISADVANTAGES OF BAMBOO IN CONSTRUCTION ?

→ ADVANTAGES.

- It has high tensile strength as compared to steel because of its fibres run axially.
- It has good elastic property so that it widely used in the earthquake-prone areas.
- It has high fire resistance & it can withstand up to 4000°C.
- It is economical & easy to use as compared to another type of construction material.
- It is easier for transportation & construction.
- It is lightweight material as compared to other construction material & doesn't cause pollution.
- It is an environment friendly construction material.
- It is more durable as compared to other construction materials.

→ DISADVANTAGES.

- It shrinks much greater as compared to other types of materials.
- If bamboo isn't sufficiently treated, it may undergo the fungus attack or attacks caused by insects.
- There may be a problem of swelling & shrinkage of bamboo in the concrete.
- Bamboo may absorb water during the casting & curing of the concrete.

PART 1. SHALLOW FOUNDATIONS

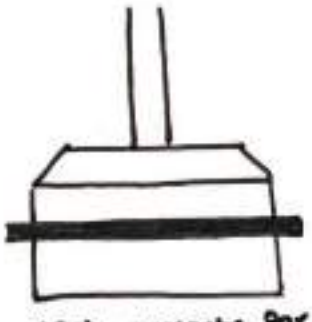
A shallow foundation is a type of building foundation that transfers structural load to the earth v. near to the surface, rather than to a subsurface layer or a range of depths, as does a deep foundations.

A) ISOLATED (PAD) FOOTING

Also called as spread footing, pad footing & individual footing. It is provided to support an individual column.

A spread footing is circular, square or rectangular slab of uniform thickness. Sometimes, it is stepped or haunched to spread the load over a large area.

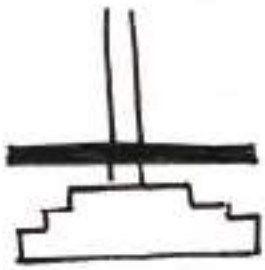
These are usually shallow but can be deep.



mast concrete for steel column.

Tapered

Plain reinforcement concrete.



Stepped reinforcement concrete.

Each type of footing is selected based on the soil condition & configuration of imposed loads.

ADVANTAGES:

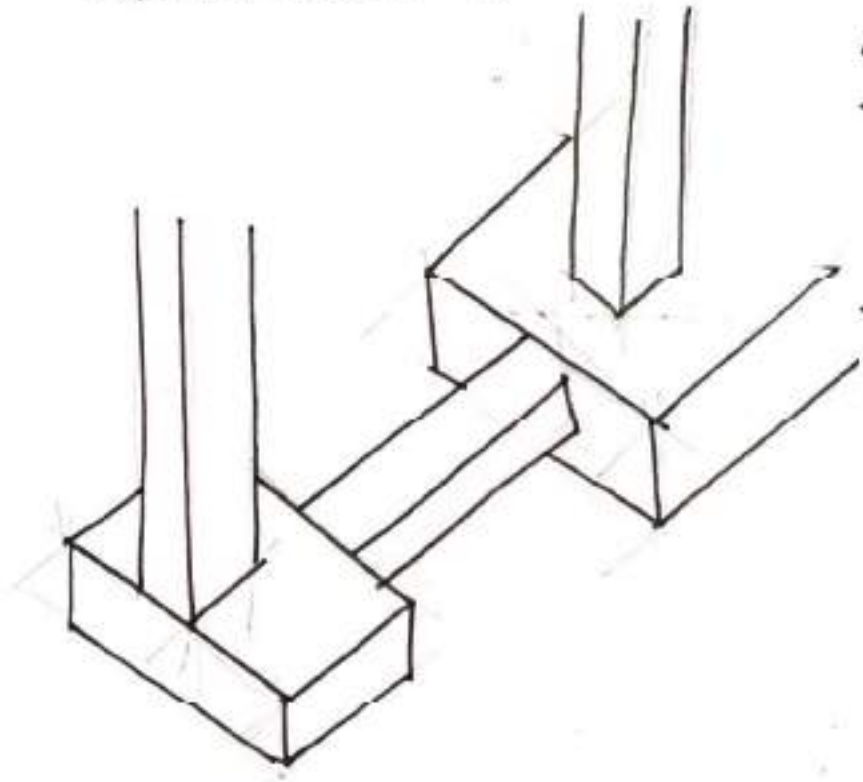
- isolated footings are economical.
- they are easy to construct.
- can be constructed by unskilled workers.
- it requires less earth excavation.

DISADVANTAGES:

- soil needs stability all around the base of the structure.
- to cope w/ the high load, it can be v. large in size.
- separate foundations make this design weak against the differential settlement that may affect the building.

→ STRAP FOOTINGS.

- It is a unique kind of compound footing.
- In this, the dist. of the column from the edge is v. small that it might need extra excavation.
- done when there is limited space for foundations so, instead of separate footings, they are associated w/ a solid concrete bar.
- utilized to help disperse the heaviness of either intensely or whimsically stacked segment footings to nearby footings.
- objective is to have a uniform bearing pressing factor & to limit differential settlement b/w sections.



ADVANTAGES:

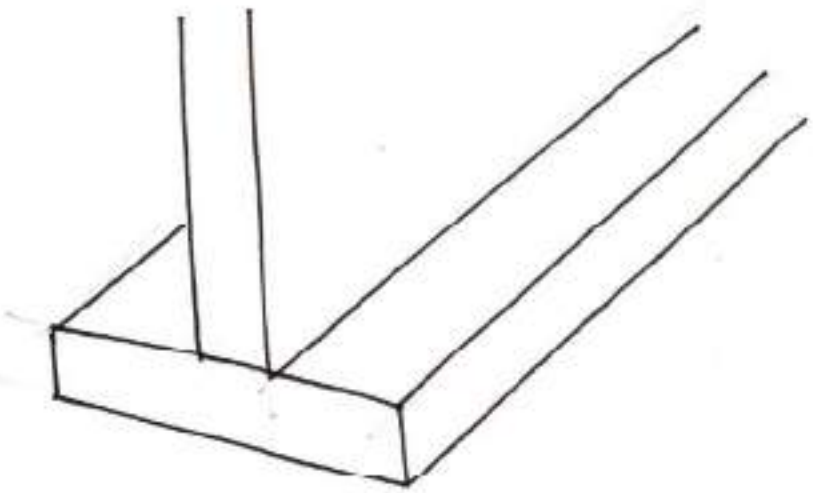
- helps distribute load uniformly & transfer moment to the adjacent footing.
- helps prevent the column from tilting.
- employment of a strap footing may be excusable when the gap b/w columns is long & a regular combined footing is unpractical due to the required massive excavation.

DISADVANTAGES

- require skilled labour as it is a difficult design.
- time consuming.

→ STRIP FOUNDATION.

- often used within low to medium rise residential buildings.
- suitable only where the ground conditions are stable & w/ good-load-bearing capacity.
- They are fast & cost-effective to build.
- They can be used to support load-bearing walls, where the load-bearing capacity of the underlying ground has been evaluated & is deemed to be sufficient.
- It can also be used to support closely-grouped columns.



ADVANTAGES

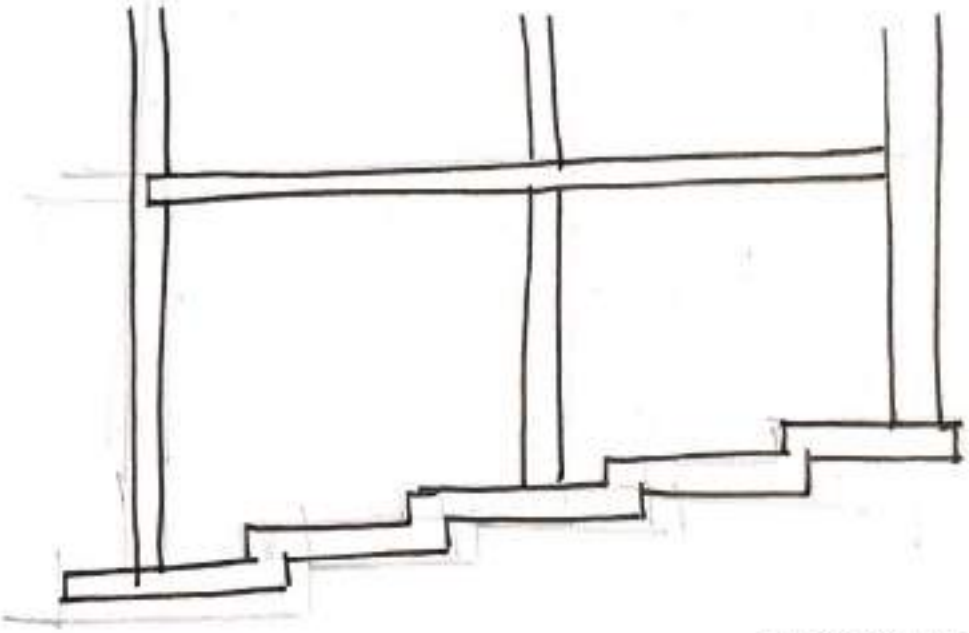
- inexpensive in terms of construction & mat.,
- quick & straight forward construction.
- simple formwork & reinforcement installation rqd.

DISADVANTAGES

- only suitable for fairly small construction
- if soil conditions are weak or irregular can lead to structural issues
- unsuitable for sloping sites.

→ STEPPED FOOTING

- prevent abrupt & excessive changes in level, which could lead to a weakening & movement.
- also used to avoid abrupt & excessive increases in foundation depth at corners & intersections.
- each step in the foundation should be no more than the foundation's thickness.
- The higher-level foundation should also overlap the lower-level foundation by at least twice the step's ht., or by the foundation's thickness, or by at least 300 mm (whichever is greatest)
- used to avoid a disparity in the settlement
- aids in the prevention of any lateral structural movement.
- It is made up of a series of concrete steps that are erected in a horizontal manner on the ground's sloping surface.



ADVANTAGES

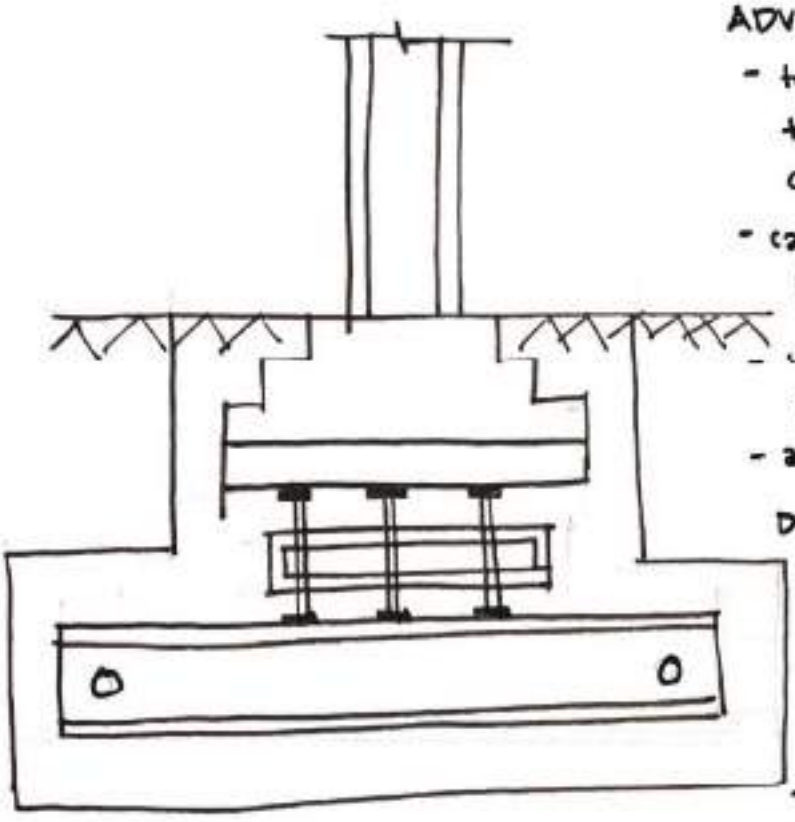
- prevents sudden & extreme level changes that can result in a weakening & movement.
- easier to put together
- increased effective depth against shear / moment at post's neck.
- cost effective.

DISADVANTAGES

- when it comes to using steel & conc., this is relatively wasteful.

→ GRILLAGE FOOTING.

- consists of one or more tiers of beams (steel or Timber) superimposed at right angles to each other on a concrete layer to dispere load over an extensive area.
- generally used for heavy structural columns, piers, & scaffolds where the foundation is expected to disperse heavy loads over large areas.
- w/ the use of a grillage foundation, deep excavation can be avoided, & the depth of the foundation can be limited from 1m to 1.5m.



ADVANTAGES

- time rqd for installation & casting of this is comparitively less than that of conventional foundation.
- capable of successfully transforming heavy loads over a larger area.
- used to construct significant structures such as column piers & scaffolds.
- avoids deep excavations.

DISADVANTAGES

- steel joints require protection from oxidation of by concrete
- for greater depth the construction of piles is needed in this foundation.
- not suitable for multi story bldg.
- space below the grillage needs to be filled & watered.

B) RAFT (MAT) FOUNDATION.

Mat/Raft foundation is a continuous thick concrete slab on the soil that extends the entire footprint of the bldg & increases the earth-bearing capacity power.

It is used in those places where we have less bearing capacity of the soil.

When the footing area increases, SBC also increases.
This footing reduces the stress of the soil at the same place.

This foundation is beneficial for basement structure.

First, a waterproof membrane sheet is placed over the ground surface, & then 4" PCC is poured to create a level base for the mat/raft foundation.

After PCC, reinforcement steel bars are tied (cage) in place & then desired th. of concrete is poured in place.

USE OF MAT FOUNDATION:

1. SBC is weak & not capable of transferring the load of the bldg to the ground.
2. A column is placed near the property line, & walls are so close that individual footing would overlap.
3. If a deep foundation (pile foundation) cost is higher than the raft foundation, we use it to make the structure economical.
4. When a deep spread footing, columns can cover upto 50% of the foundational area.

TYPES OF RAFT FOUNDATION:

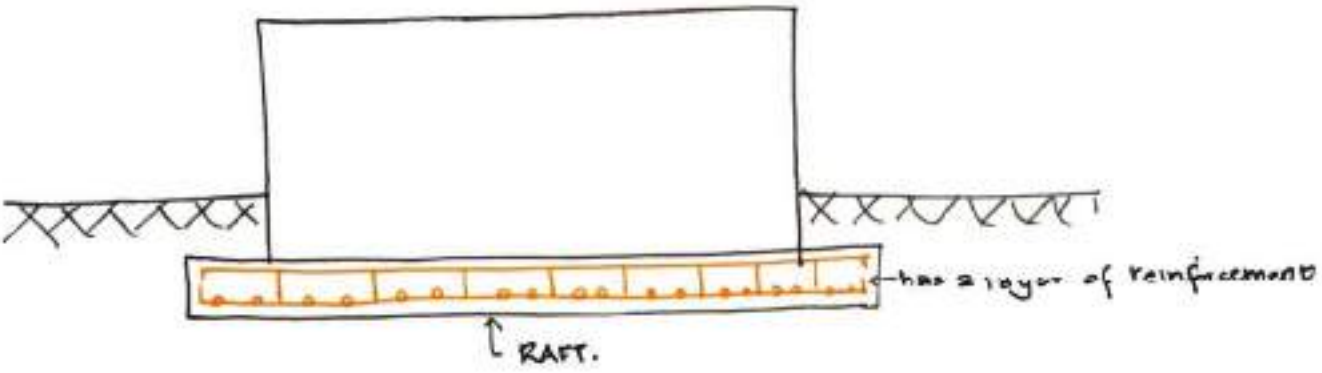
(i) FLAT PLATE RAFT

Used in small & light wt. load structure.

This type of foundation is suitable when the soil is compressible.

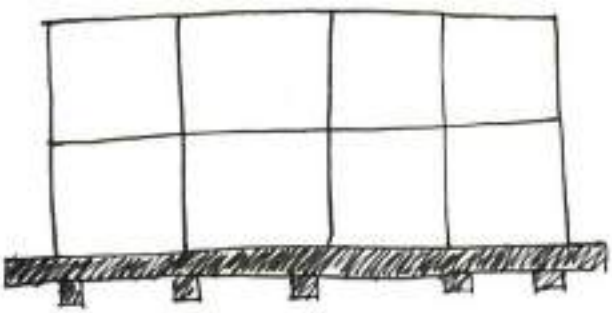
The reinforcement bars are provided in both directions, top & bottom, in the form of a mesh (cage)

A min. of 6" of RCC slab is used in this foundation.



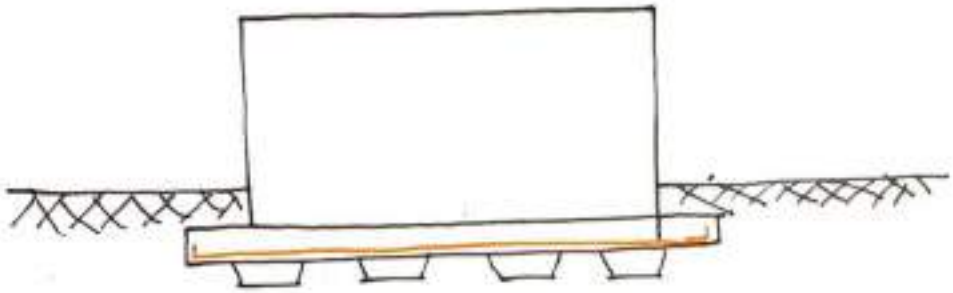
(2) THICKENED PLATE UNDER COLUMNS.

- slab thickness should be increased when the upcoming column loads are weighty.
- Flat plat not suitable in those structures where column loads are high - the plate is used.
- Heavy loads create diagnol shear in the slab & create a negative bending



(3) TWO WAY SLAB & BEAM.

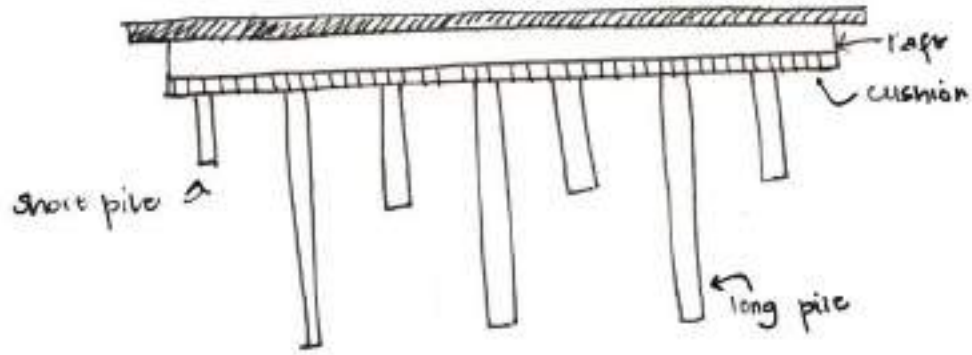
- The beam placed in ⊥r direction & all beams are connected by an RCC slab.
- The columns are placed at the intersection of beams
- suitable when columns are carrying unequal loads & the spacing is large b/w them.



It uses the concept of buoyancy.

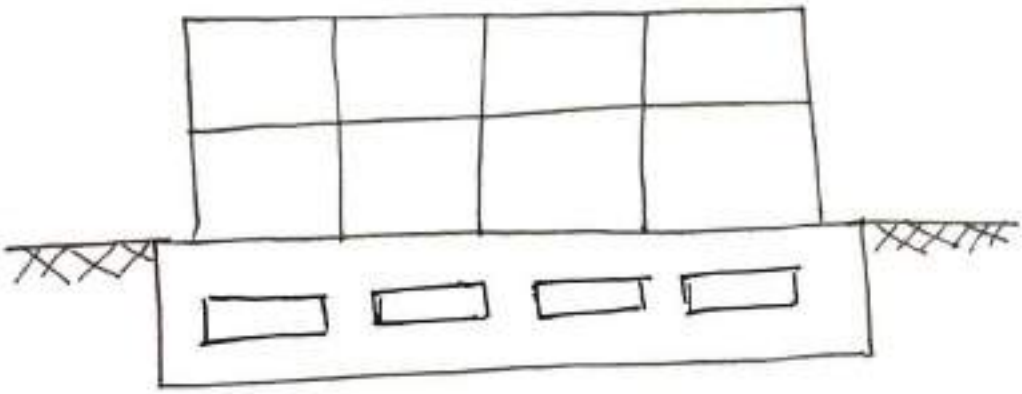
(4) PILED RAFT FOUNDATION.

- It is supported by piles in the soil.
- Suitable for the ground of high compressibility & where the water table is high.
- mainly used for high rise buildings.
- piles work to reduce the amount of soil settlement (w/ time) & increase the SBC.



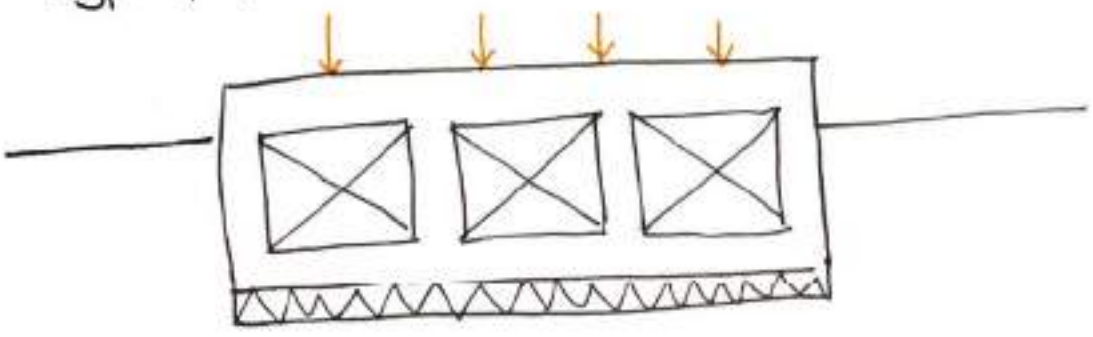
(5) RIGID FRAME RAFT.

- used which columns have a v. high load on them.
- Basement Rcc walls act as a deep beam or ribs.
- If foundation depth > 90cm, then rigid frame is used.



(6) CELLULAR MAT FOUNDATION.

- also termed as a box mat foundation
- structures of boxes formed, walls of all box act as beams.
- walls are connected by slabs at the top & bottom
- this type of foundation



ADVANTAGES:

- Raft foundations are constructed for shallow depths hence, it requires less excavation.
- well suitable in soil of LBC.
- loads coming from superstructure are distributed over a large area.
- Differential settlement of soil can be reduced.

DISADVANTAGES:

- in some cases, large amount of reinforcement is rqd. for the raft fundation which increases the cost of project.
- Special attention on raft foundations is rqd. in case of concentrated loads.
- If they are not treated properly, there is a chance of edge erosion.
- Skilled workers are rqd. to construct the raft foundations.

PART 2: DEEP FOUNDATIONS

When the depth of the foundation is greater than the width of the foundation, it is called a deep foundation. If the required depth of the foundation is exceeded 3m, then the foundation has to be designed as a deep foundation.

USE OF DEEP FOUNDATION

- Used when the soil has a low bearing capacity.
- Suitable when the self-wt. of the structure is v. high
- To sustain high rise structure from the sudden impact, a deep foundation is the most preferable.
- Mostly used where the soil is v. loose & low dense

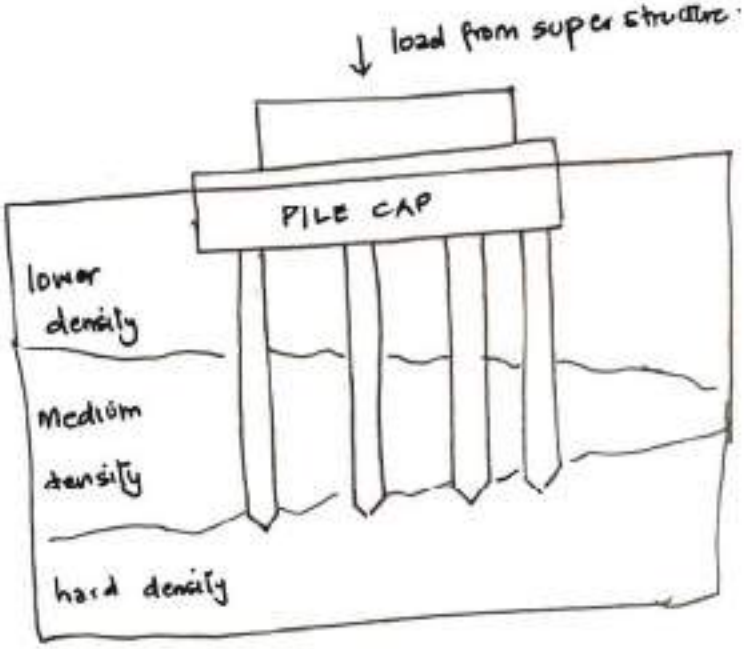
TYPES OF ~~PILE~~ DEEP FOUNDATION

- Pile foundation
- Caisson or well foundation
- Pier foundation.

PILE FOUNDATION.

The most common type of deep foundation widely used for large structure. The pile foundation method is suitable for clayey soil or where the soil contains low bearing capacity.

The load will transfer from the superstructure to the deep ground soil through a vertical pile. Different type of pile foundations are ~~deep ground soil through~~ * used depending on soil conditions.

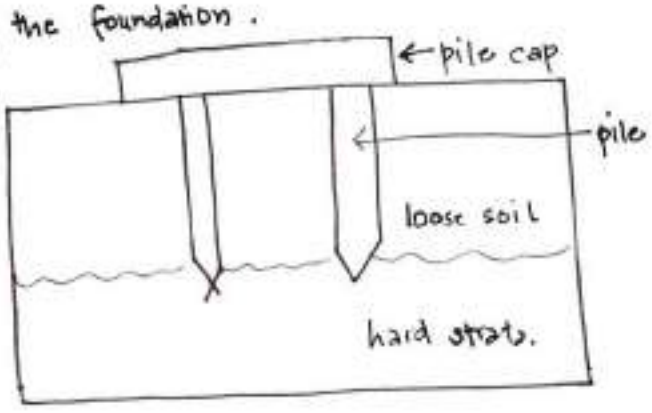


TYPES OF PILE :-

↳ END BEARING PILE.

The end bearing pile are driven into the soft, hard soil where the depth of pile does not exceed 40m. The end of the pile is placed over the hard rock at a considerable deep depth.

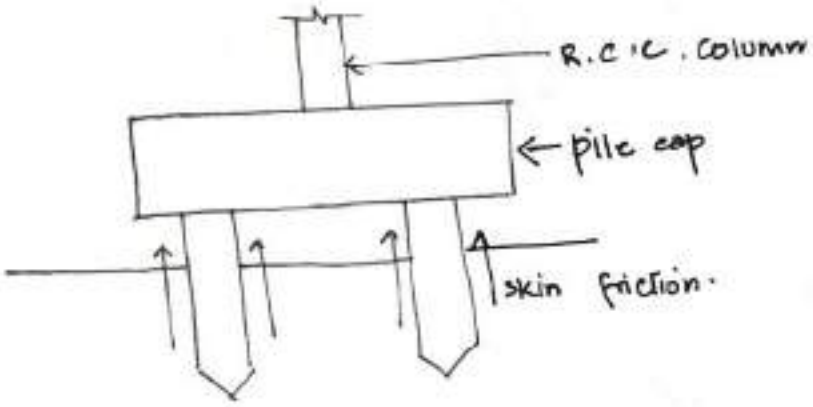
The structure load will be transferred to the ground soil through vertical members of the foundation.



↳ FRICTION PILE.

The methodology of friction pile driven is the same as the end-bearing pile. The friction pile ~~using~~ is used where the pile depth is beyond 40m.

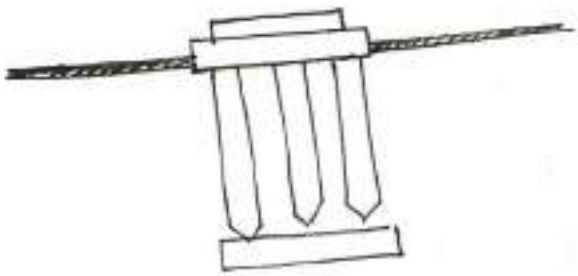
The friction piles slightly float in the soil, & the skin friction happens by the surrounding soil will transfer the load.



→ BASED ON MATERIAL

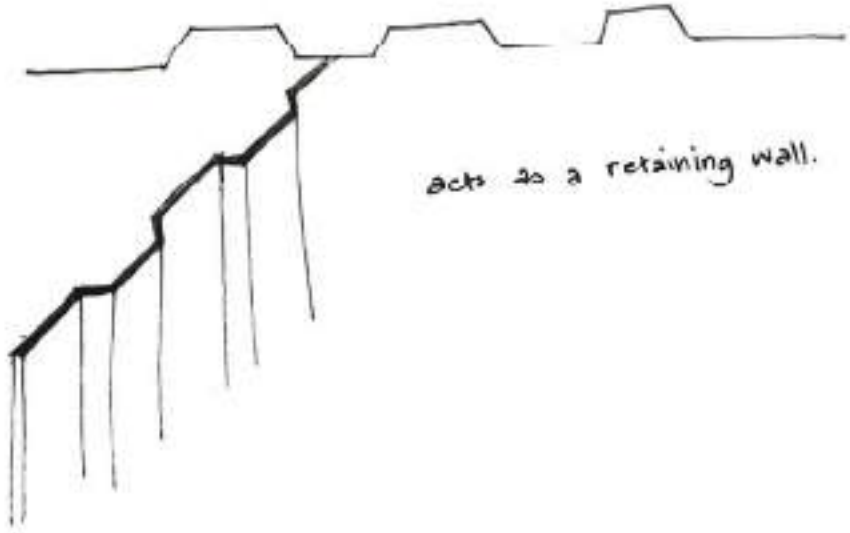
↳ WOODEN PILE.

Used where wood is abundantly available.



If treated, can be put into water.

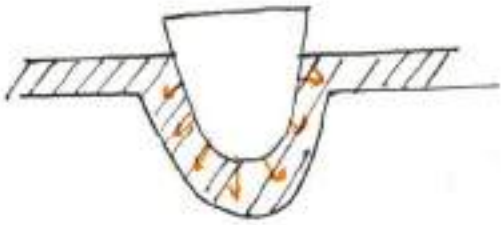
→ STEEL SHEET PILES



acts as a retaining wall.

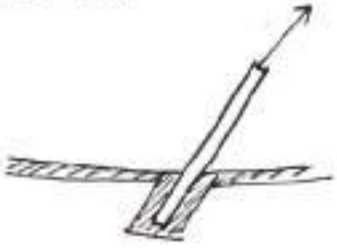
→ NON - PRESTRESSED PILES

→ COMPACTION PILE

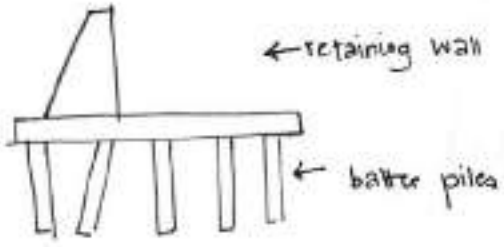


try to increase the density of soil by making holes in the plot.

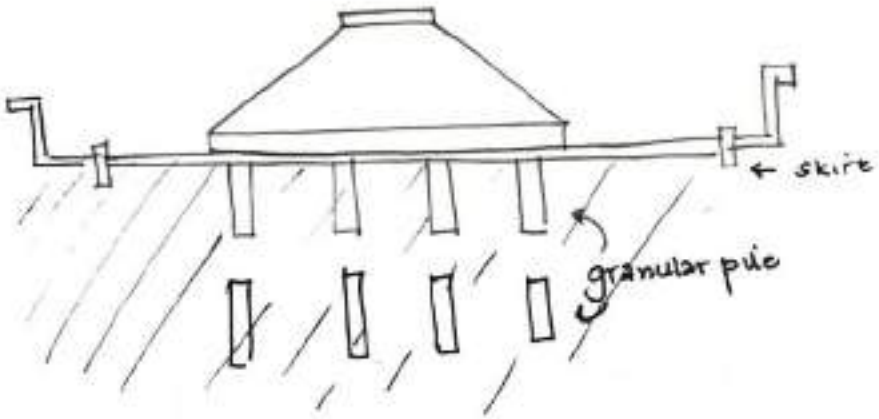
→ TENSION PILE



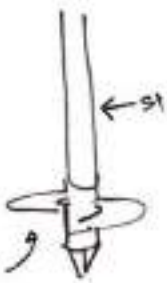
→ BATTER PILES



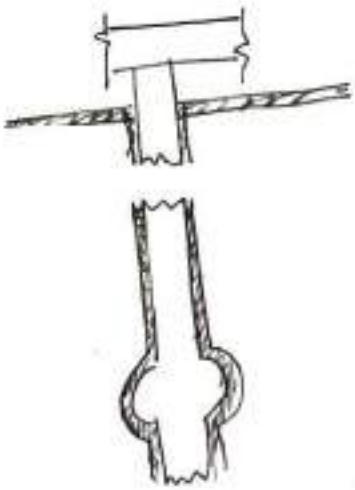
→ SKIRTED GRANULAR PILE



→ SCREW PILE



→ UNDER REAMED PILE



→ CLASSIFICATION BASED ON USE / FUNCTION:

- Bearing piles or end-bearing piles
- friction / skin friction piles
- sheet piles
- tension / uplift piles
- ANCHOR PILES: used to provide anchorage against H pull from sheet piling wall or other forces.
- BATTER PILES: driven at an inclination to resist large H & inclined forces.
- FENDER PILES: used to protect concrete deck or other waterfront structure from the abrasion or impact caused by ships.

→ SIMPLEX PILE.

- pipe of cast iron of dia. 40cm.
- has an undercast heel
- banged underground by an automatic hammer until reaching the arable land for the establishment.
- then, concrete is poured inside it & banged by another hammer.
- in the meantime, pipe raised so as not to enter the soil inside.

This pile can bear about 40 - 50 ton.

→ FRANKIE PILE.

- no. of tubes entering each other in order to easily access to great depths within the earth.
- heel of RCC can be used & left in ground to prevent entry of cold water pipe.

→ VIBRO PILE

- steel pipe of dia. 40cm.
- conical heel w/ seperate flange
- hanged underground w/ automatic hammer until reaching arable land.
- then rigel is removed & put into a Tube.
- after that, concrete is poured.

→ Straus pile
→ kimbersol pile
→ composite pile
→ raymond pile.

→ CLASSIFICATION OF PILE WRT EFFECT ON SOIL

↳ DRIVEN PILES / DISPLACEMENT PILES

in the process of driving the pile into the ground, soil is moved radially as the pile shafts enter the ground.

There may also be a component of v. movement of soil.

↳ BORED PILE / REPLACEMENT PILE

EARTH RETAINING STRUCTURES:

1. The structure used to retain or support the material / soil is called retaining structure, eg: retaining walls, which may be of RCC, brick or stone masonry or sheet piling, etc.

RETAINING WALLS:

It is a structure designed to sustain the mat. pressure of earth or other mat. as grains, ores, etc.

A retaining wall is a structure designed to sustain the mat. pressure of earth or other mat. as grains, ores, etc.

They are commonly used to accomodate changes in grade, provide increases in right of way & buttress the toe of slopes (also called grade separators)

In a broad sense, retaining structures can be classified acc. to their face inclination: if it is $> 70°$, they are typically characterized as retaining walls, while slopes have face inclination flatter than $70°$.

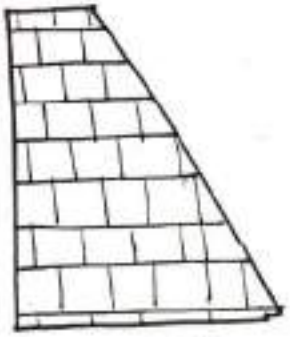
There are several types:
- gravity
- sheet pile
- cantilever
- anchored earth / mechanically stabilized earth (reinforced earth) walls & slopes.

→ GRAVITY RETAINING WALL STRUCTURE.

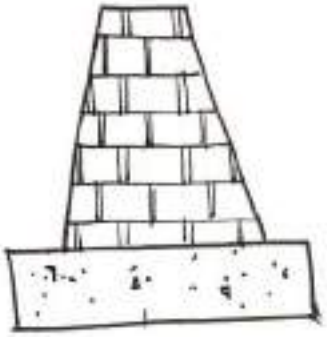
It is the simplest of all & is made up of:

1) concrete
2) Brick masonry
3) Stone masonry

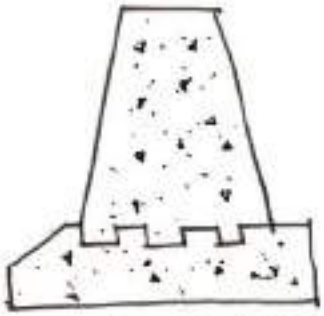
Gravity retaining walk use the gravitational force of their own weight to resist the lateral earth pressure from the soil behind them, which prevents toppling & sliding. They are the simplest & earliest recorded type of retaining wall, & are usually built of masonry, brick, concrete blocks or mass cast-in-situ conc.



Masonry unit

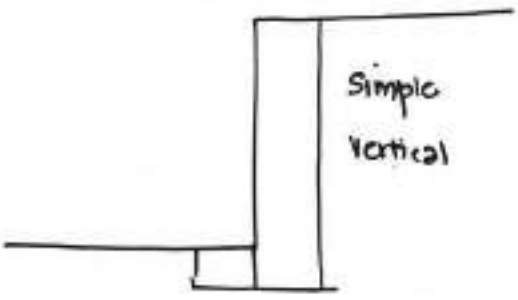


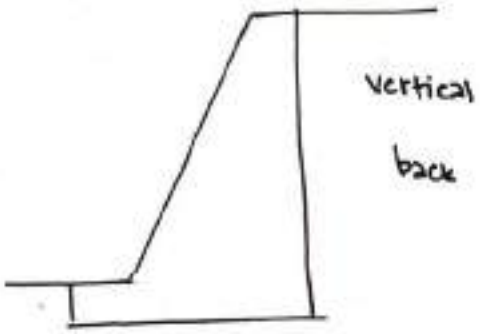
stone

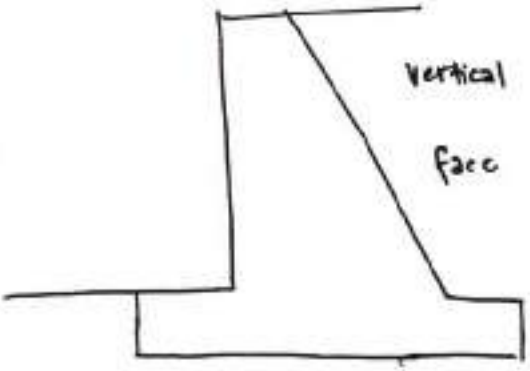


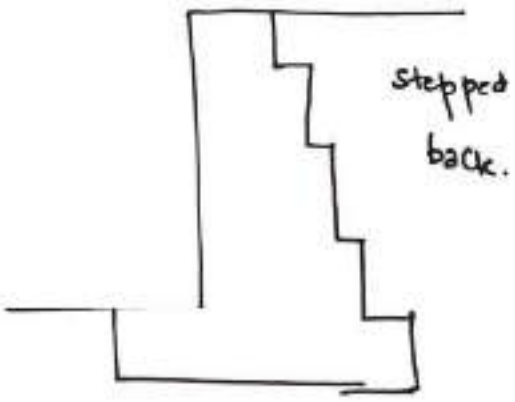
poured concrete.

Gravity retaining walls are typically wider at the base, w/ sloped faces, enabling them to resist the higher lateral earth pressure at depth.

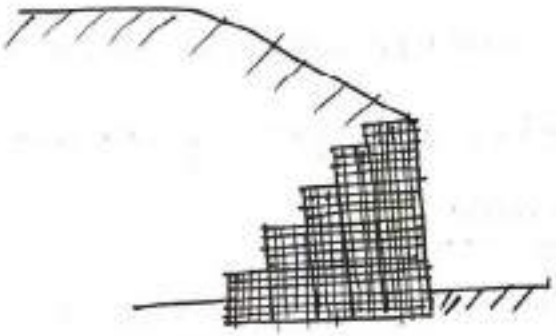




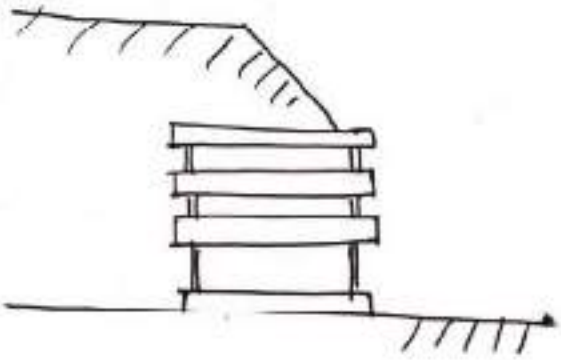




GABION is another type of gabion wall. It is used to provide erosion & scour protection along riverbanks & waterways. Gabions are Typically made of wire mesh baskets that are filled w/ rocks & stacked on Top of each other to form a retaining wall.

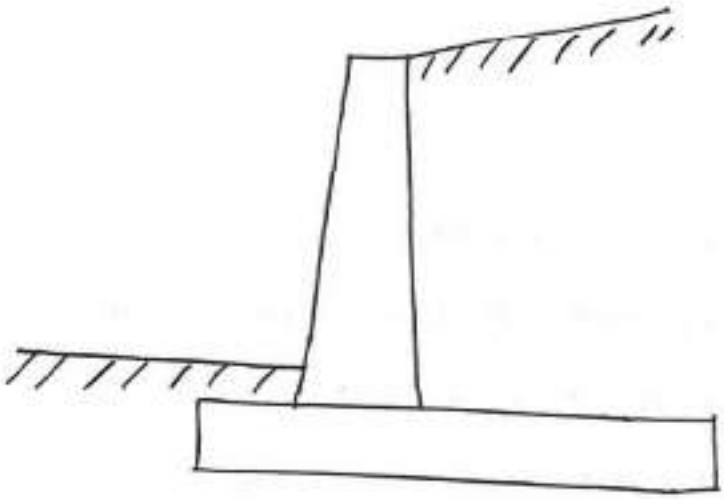


CRIB walls typically consist of interlocking precast concrete structural elements that are filled w/ free draining material (typically gravelly soil). Due to relatively low construction cost & time rqd. to construct these walls, they are commonly used for supporting roadway & highway cuts.



→ CANTILEVER RETAINING WALLS.

They are built using RCC, w/ a relatively thin stem, w/ an L-shaped, or inverted T-shaped foundation. The vertical stress behind the wall is transferred onto the foundation, preventing toppling due to lateral earth pressure from the same soil mass.

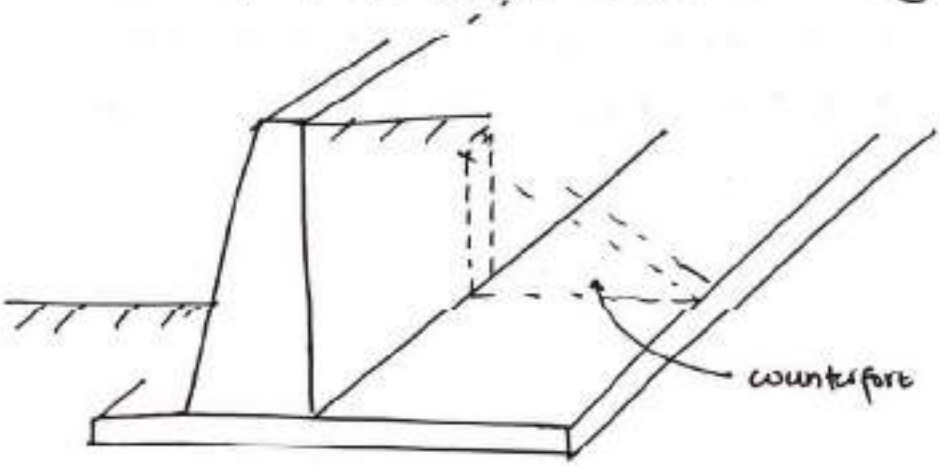


Additionary, a T-shaped foundation benefits from the wt. of soil (& ... vertical stress) in front of the wall, providing further stability. Foundations sometimes include a 'key' in their base, which sticks into the ground to prevent sliding failure.

They take up little space once built, & are suitable for retaining hts. of upto 5m. However, construction does require space behind the wall, so they are not particularly suited to retaining existing slopes, unless temporary support is provided during construction.

→ COUNTERFORT / BUTTRESSED RETAINING WALL.

These are cantilever walls strengthened w/ counterforts monolithic w/ the back of the wall slab & base slab. The counterforts act as tension stiffners & connect the wall slab & the base to reduce the bending & shearing stresses.



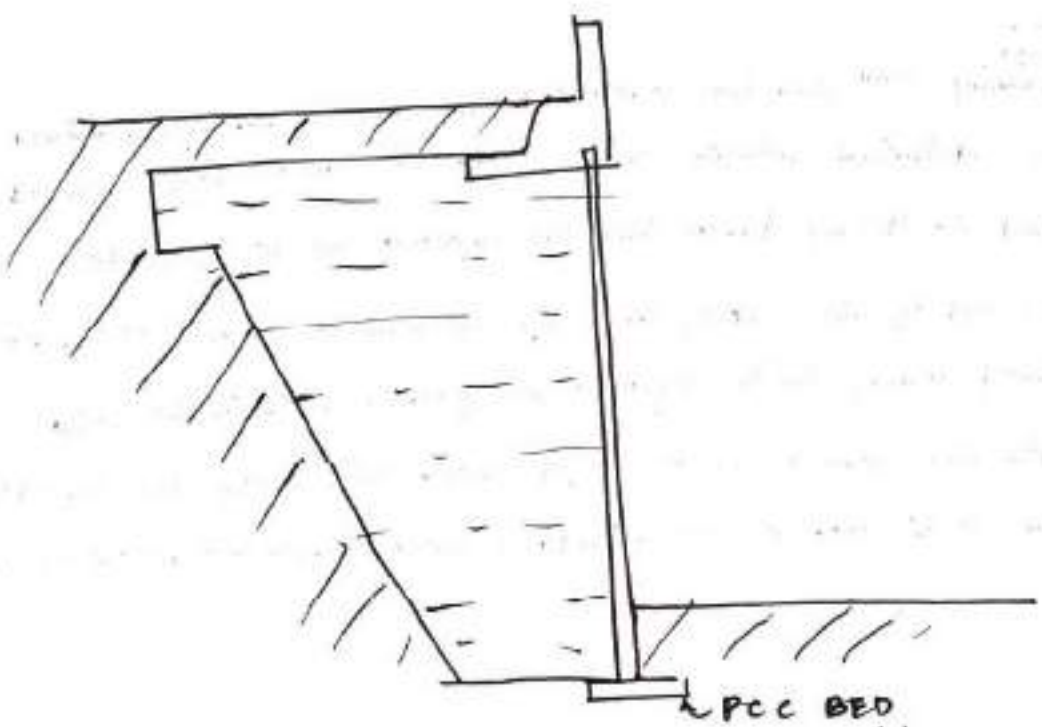
To reduce the bending moments in vertical walls of great ht, counterforts are used, spaced at dist. from each other equal to or slightly larger than one-half of the ht. counterforts are used for high walls w/ hts greater than 8-12m.

→ REINFORCED SOIL RETAINING WALL / MECHANICALLY STABILIZED EARTH (MSE) WALLS

Mechanically stabilized earth walls are those structures which are made using steel or Geotextile soil reinforcements which are placed in layers within a controlled granular fill.

Reinforced soils can also be used as retaining walls, if they are built as an integral part of the design & to act as an alt. to the use of RCC or other solutions on the grounds of economy or as result of the ground conditions.

Reinforcing elements are typically made of metallic reinforcement (eg: welded wire mesh, steel strip & bar mat) or polymeric reinforcement (eg: geogrids)

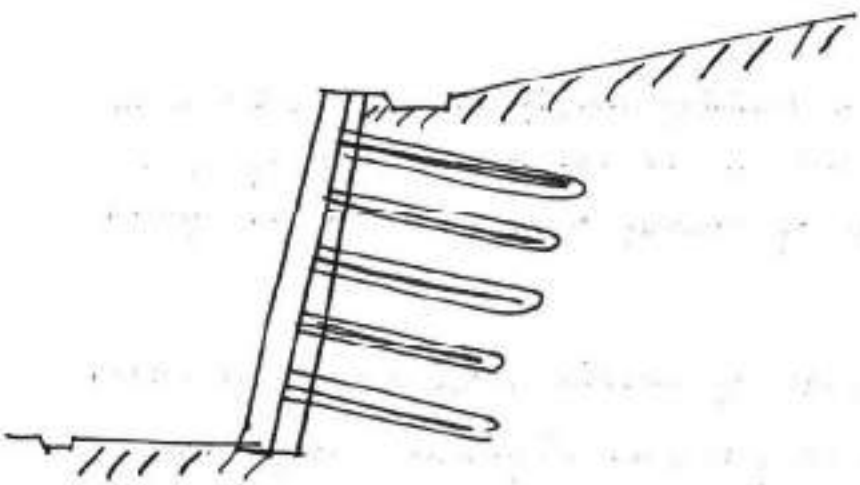


→ SOIL NAILED WALL.

Constructing a soil nailed wall involves reinforcing the soil as work progresses in the area being excavated by the introduction of bars which essentially work in tension, called Passive Bars. They are usually parallel to one another & slightly inclined downward. These bars can also work partially in bending & in shear. The skin friction b/w the soil & the nails puts the nails in tension.

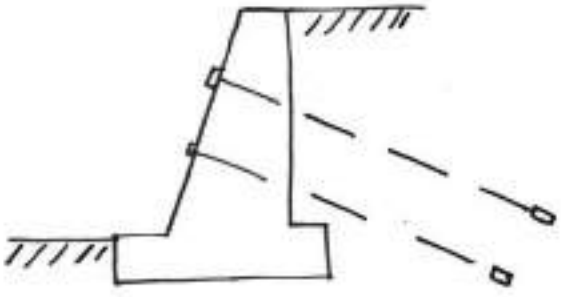
A rigid or flexible facing (often sprayed conc) or isolated soil nail heads maybe used at the surface.

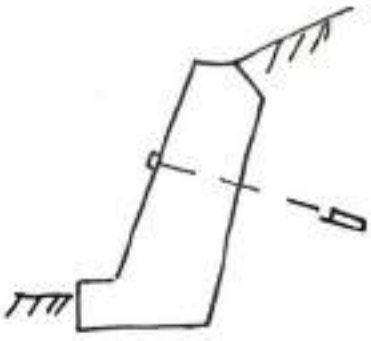
The bars are usually installed into a pre-drilled hole & then grouted into place or drilled & grouted simultaneously.



→ ANCHORED WALL.

An anchored retaining wall can be constructed in any of the aforementioned styles but also includes additional strength using cables or other stays anchored in the rock or soil behind it. Usually driven into the material w/ boring, anchors are then expanded at the end of the cable either by mechanical means or often by injecting pressurized conc., which expands to form a bulb in the soil. Technically complex, this method is v. useful where high loads are expected, or where the wall itself has to be slender & would otherwise be too weak.

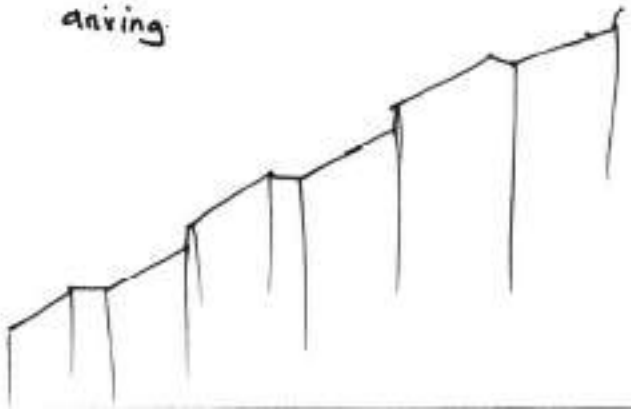


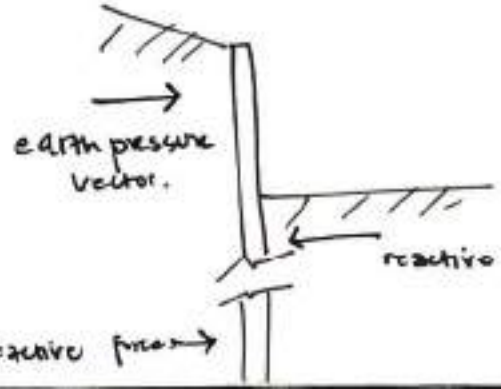


→ SHEET PILED WALLS

Piling is earth retention & excavation support technique that retains soil, victimization sheet sections w/ interlocking edges. Pile acts as a temp. certificate wall that has been driven into a slope or excavation to support the soft soils collapse from higher ground to lower ground. It provides high resistance to driving stresses & helps to light wt.

Sheet piles will be reused on many comes & long service life above or below water w/ modest protection. Simple to adapt the pile length by either attachment or bolting & joints square measure less apt. to deform throughout driving.





→ PILED RETAINING WALLS

- They are constructed by driving ~~them~~ RCC piles adjacent to each other
- forced into a depth that is sufficient to counter the force which tries to push over the wall.
- it is employed in both temporary & permanent works.
- They offer high stiffness retaining elements which are able to hold lateral pressure in large excavation depth w/ almost no disturbance to surrounding structures or properties.
- ~~other~~

° RETAINING WALL MATERIALS

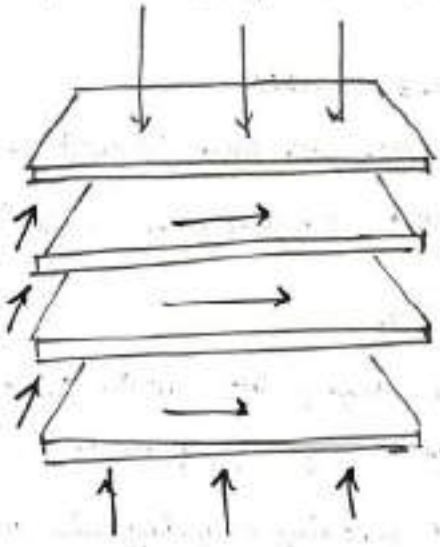
- Wood / Timber
- Masonry
- Poured concrete
- interlocking concrete blocks

°PLYWOOD

Plywood is a material manufactured from thin layers of 'plies' of wood veneer that are glued together w/ adjacent layer having their wood grain rotated up to 90° to one another. This pattern adds strength & stability that resistants shrinkage & expansion caused by moisture.

TYPES OF PLYWOOD :

- hardwood plywood
- project plywood panels
- marker board
- canada plywood
- plywood sheathing or structural plywood.
- softwood plywood
- hardwood plywood
- tropical plywood
- aircraft plywood
- decorative plywood
- flexible plywood
- marine plywood.



MANUFACTURING PROCESS

The main steps of plywood manufacturing process

A. Selection of Log
B. Layer formation
C. Exposure of Heat
D. Gluing
E. Baking
F. Finishing

A. SELECTION OF LOG.

The log selected is known as peeler. Peeler is straight & has a good diameter as large no. of layer are expected to make from it.

B. LAYER FORMATION

large blade is used for the processing of thin layer inside a mill & made sheet of veneer. A horizontal placement of log under blade is maintained to get a better result. Continuously blade is pressed & several layer are cut into pieces.

C. EXPOSURE TO HEAT

The sheets are then exposed to heat for removing water content from those. An good dehydration of sheets is confirmed before next step.

D. GLUING.

After drying the sheets those are glued together maintaining the system of a different type of plywood.

After patching & grading this gluing takes place.

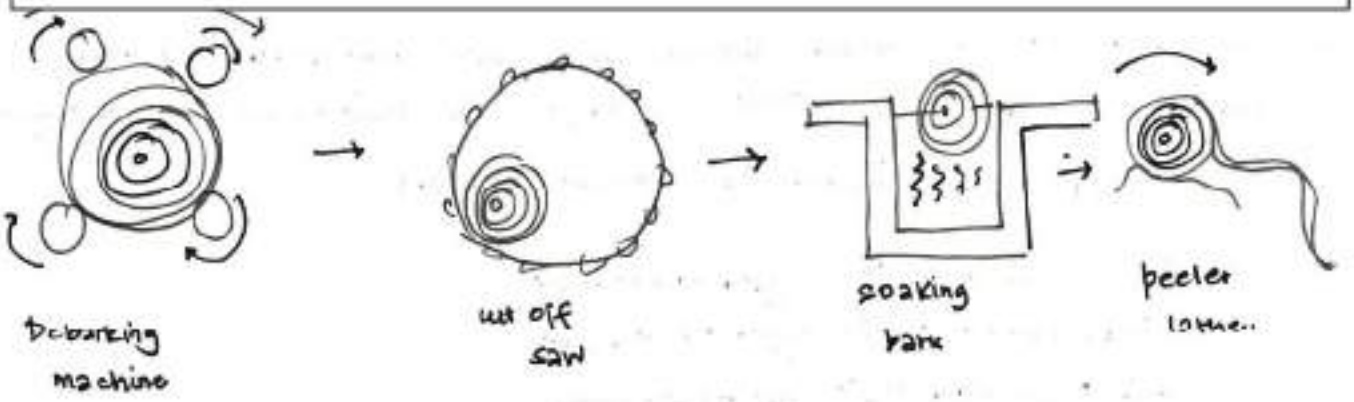
Urea formaldehyde & phenol formaldehyde is used for gluing. And formogylax is used for fungal resistance quality.

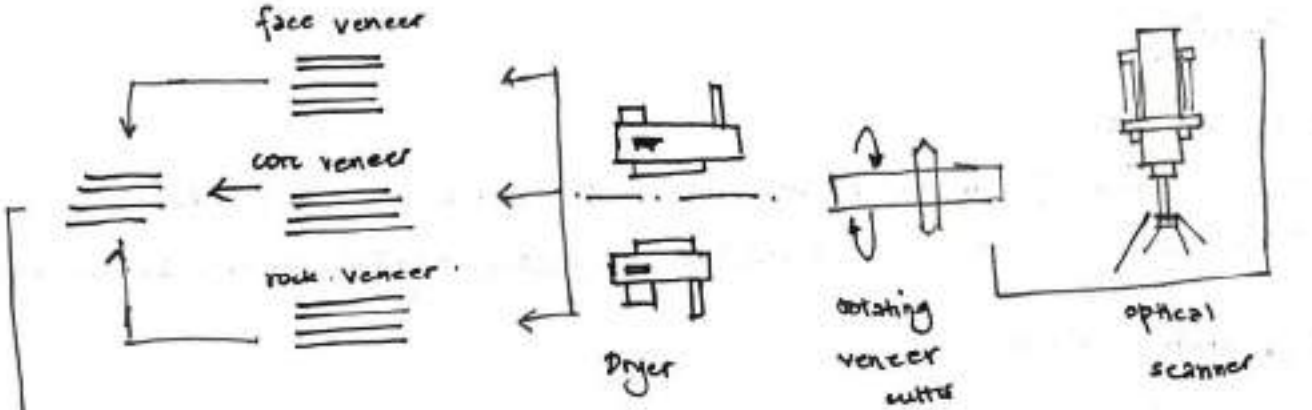
E. BAKING

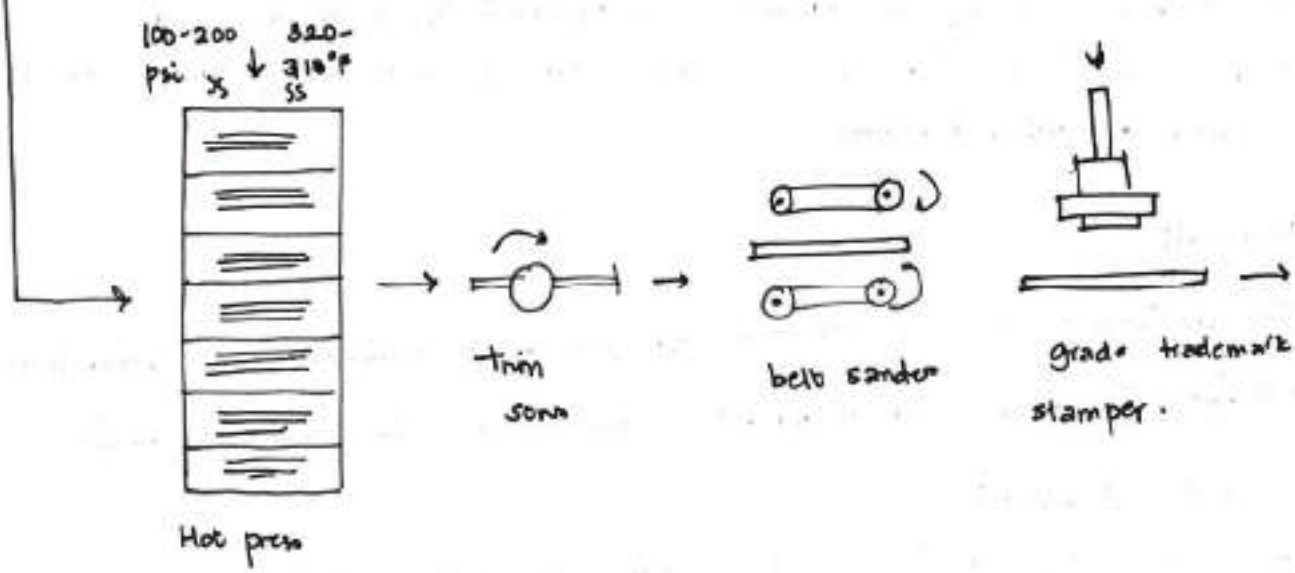
The glued plywood 1° sheets are sent for baking & pressing at rqd temp & pressure. The minimum temp. is 140°C & pressure is 1.8 Mega Pascal.

F. FINISHING

Finally, defects of manufactured plywood sheets are solved. Holes pin & any unfinished edges are giving finishing. Also resizing, reshaping takes place.


Debarking machine
cut off saw
soaking tank
peeler lathe..


face veneer
core veneer
rock veneer
Dryer
optical scanner


100-200 psi
320-310°F
trim saw
belt sander
grade trademark stamper.
Hot press

APPLICATIONS

- subflooring
- mezzanine decks
- wall panelling
- roof sheathing
- shuttering
- furnitures.

STRUCTURAL CHARACTERISTICS

- Thicker panels can span greater distances under the same loads. In bending, the max. stress occurs in the outermost layers, one in tension, the other in compression
- Basic plywood can be divided into three main categories:

  Birch plywood - density approx - 680kg/m³
  Mixed plywood - density approx - 620 kg/m³
  conifer plywood - density 460 - 520kg/m³.

PROPERTIES

- HIGH STRENGTH.
  - The grains of each veneer are laid at 90° angles to each other.
  - This makes the whole sheet resistant to splitting, especially when nailed at edges
- HIGH PANEL SHEAR
  - plywood is made w/ an odd no of layers, making it tough to bend
  - cross lamination increases the panel shear of plywood, important in bracing panels & fabricated beams.
- FLEXIBILITY
  - The thickness of each veneer can vary from a few millimeter to several inches.
  - Thinner Veneers are used to increase flexibility for use in ceilings & panellings.
- MOISTURE RESISTANCE
  - The type of adhesive used to bind the veneer makes the plywood resistant to moisture & humidity.

- A layer of paint or varnish can increase resistance to water damage.
- The cross lamination ensures the veneers do not warp, shrink or expand when exposed to water & extreme temp.

- CHEMICAL RESISTANCE.
  - Plywood treated w/ preservative does not corrode when exposed to chemicals

- HIGH IMPACT RESISTANCE
  - High tensile strength due to cross lamination of panels which distribute force over a large no area & reduce tensile stress.

- SURFACE DIMENSIONAL STABILITY
- FIRE, WATER & CHEMICAL RESISTANT
- STRENGTH TO WEIGHT RATIO.

DEMERITS

- Porous & susceptible to water damage if exposed to leaks over time.

SIZES

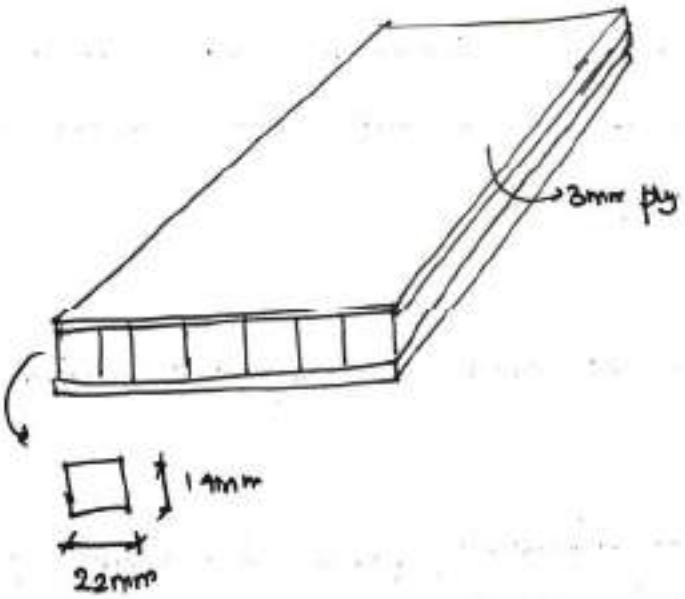
- 8' x 4'
- 8' x 3'
- 7' x 4'
- 7' x 3'
- 6' x 4'
- 6' x 3'

THICKNESS

- 4mm
- 6mm
- 9mm
- 12mm
- 15mm
- 25mm
- 32mm.

BLOCKBOARD

Blockboard is a type of plywood that is engineered in a special way. It is produced in such a way that the softwood strips are found b/w 2 layers of the wood veneers in the core of the sheet. This contributes to the dimensional stability of the board. The presence of softwood strips ensures that the board is able to hold nails & screws better than the other engineered boards. Though it is lighter than plywood, it does not split or splinter while cutting because of the presence of softwood in its core.



100mm th. strips on edges of door for hinges handles etc.

PROPERTIES

- Good dimensional stability
- Good ability to hold nails & screws
- Light in wt.
- Modulus of elasticity: longitudinal
- density
- bonding strength
- formaldehyde emission
- Modulus of elasticity: other
- Thickness tolerance
- fire safety category
- strength & widen tolerance.

GRADES

- Moisture Resistant (MR) - int. grade [₹ 75 - 120]
- Boiling water proof (BWP) - ext. grade [₹ 120 - 200]

DEMERIT

- not as strong as plywood
- nails may sometimes enter the gap.

FINISHES

- laminate
- veneer
- paint

APPLICATIONS

- shelves
- wardrobes
- partitions
- doors
- furniture

TYPES OF BLOCKBOARD

A. Depending on quality of use
   - int. grade block board
   - ext. grade block board.

B. Depending on the raw wood used in the core
   - softwood blockboard
   - hardwood blockboard.

MANUFACTURING OF BLOCKBOARD

1. SLICING

The wood logs are cut & sliced to produce sheets, called strips. The block strips are usually 25mm in width.

2. ROTARY CUTTING

producing the veneer coating, which involves rotary cutting the logs to make the outer layer.

3. GLUING

glued together using adhesive like urea formaldehyde & plastic resin under high-pressure conditions.

4. DRYING

After gluing, the blocks are left in the sun for naturally drying in order to reduce the moisture & water content. The drying process continues until the humidity reduces to 10-12%. after which the blocks are processed to the next stage.

5. ATTACHING

blocks are attached w/ the softwood or hardwood (veneer), for int. grade & ext. grade respectively.

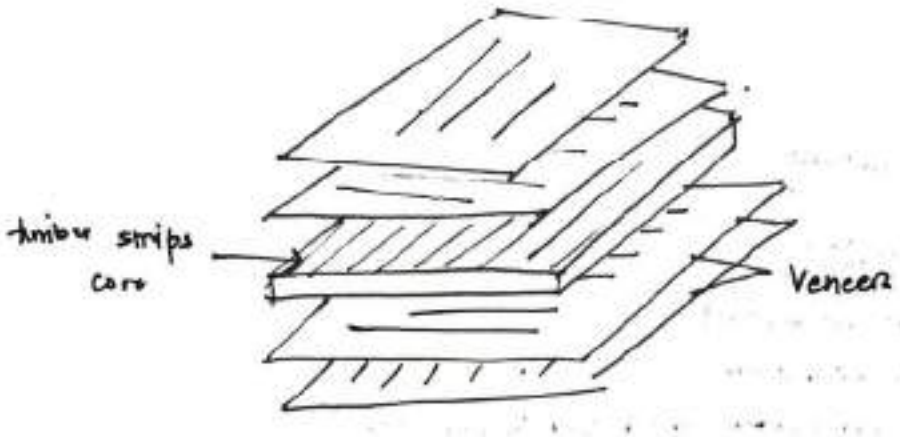
6. FINISHING

After it is ready, a final coating is done for extra strength & support.

STANDARD SIZES

8ft x 4ft
7ft x 4ft
7ft x 3ft
6ft x 4ft
6ft x 3ft.

Block board comes in various thicknesses - 16mm, 19mm, 25mm, 35mm, 50mm



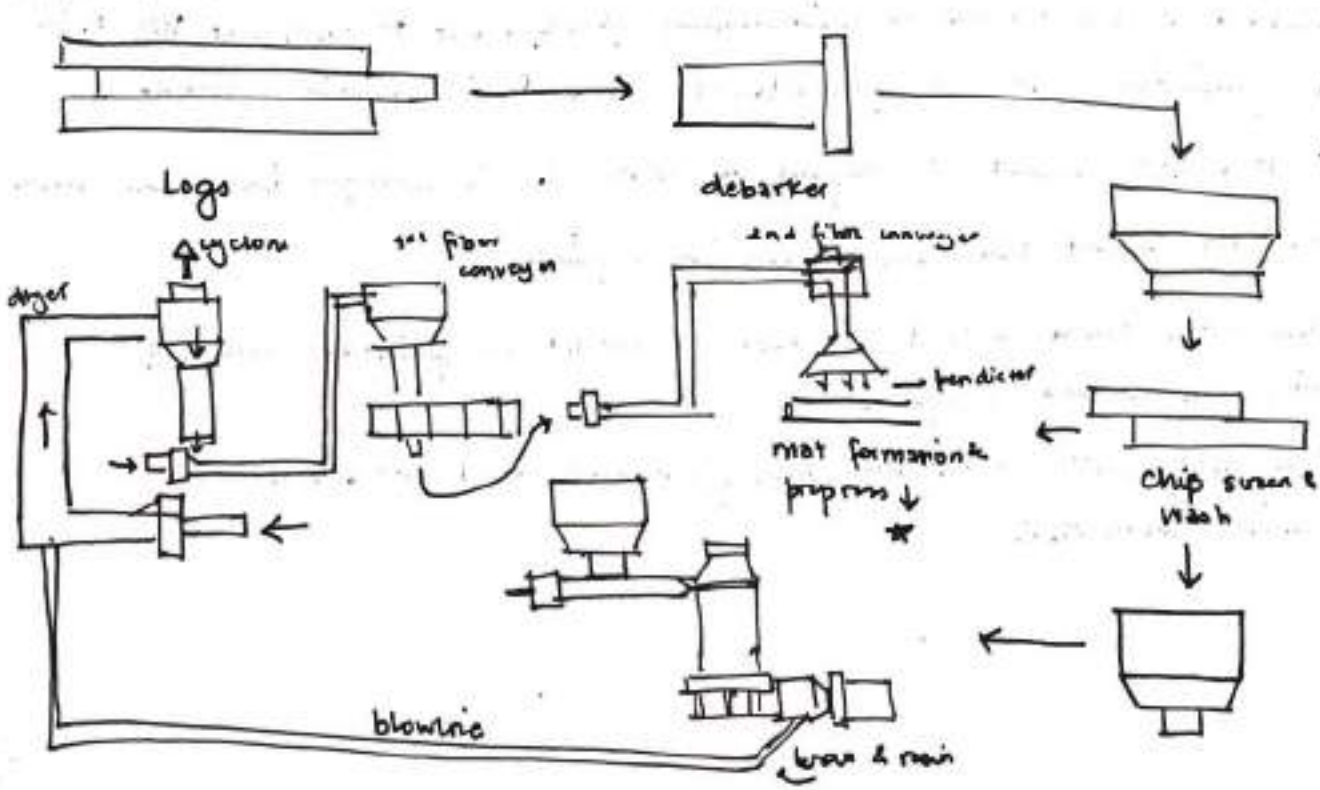
DEWAN

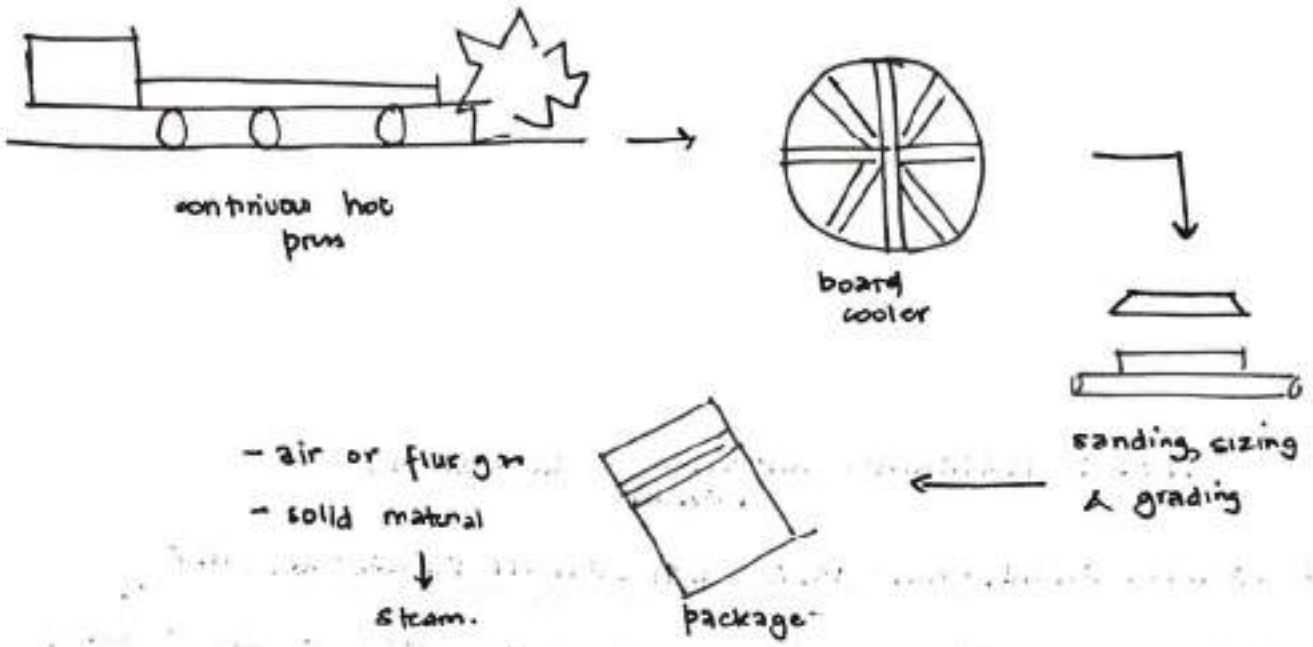
MEDIUM DENSITY FIBREBOARD (MDF) / HIGH DENSITY FIBREBOARD (HDF)

HDF or MDF are composite boards that are used in wood working to have / make cabinetry, wall panels, shelving & furniture. They can be pasted w/ veneers or laminate on one or both sides or can be finished w/ paint.

MANUFACTURING

HDF is an engineered wood product that is manufactured by hot pressing wood fibre that are extracted from waste chips or wood pulp & binding them into a board at v. high pressure using synthetic resins & binders.





FEATURES

- Like MDF, HDF also does not have any grain in cross-section as it is a composite material w/ uniform density. However, it is more compact than MDF & is correspondingly thinner & denser material
- As the name indicates, HDF is highly dense which makes it very thin. It is therefore not suitable for making grooves & mouldings.
- since it is manufactured using waste products like sawdust & wood fibre, it can be considered to be 'green' or environmentally friendly. But do watch out the toxic gas emissions due to formaldehyde used in its binding material.
- HDF does not contract or expand w/ heat etc. is therefore dimensionally stable.
- It can be finished using veneers, laminate & paint.
- It will swell when exposed to water & should be finished totally completely covering all exposed surfaces.
- HDF is much more economical than plywood or solid wood but more expensive than MDF.

FEATURES

- DENSITY

  HDF: Over 800 kg / m^3 upto 900 kg / m^3.

  MDF: standard grade : 600 – 800 kg / m^3

- HARDNESS

  HDF: Harder than MDF

  MDF: less hard than HDF but harder than particle board.

- SURFACE FINISHING

  HDF: smooth & uniform finish

  MDF: smooth & uniform surface.

- WORKABILITY

  HDF: not as easy to route & plane as MDF

  MDF: easy to cut into shapes, smoother & plane.

- COST

  HDF: indoor partitioning / furniture, floors, doors not suitable for ext. use.

  MDF: furniture that has grooves & mouldings / cornices cabinetry.

- THICKNESS

  HDF: as it is denser, HDF is typically thinner than MDF. This makes it unsuitable for making mouldings & skirting boards.

  MDF: Available in various thicknesses.

- NAIL HOLDING CAPACITY

HDF : Better than MDF

MDF : doesn't have v. good nail / screw holding capacity.

- RESISTANCE TO WATER OR HUMIDITY

HDF : it finished on all sides w/ edging can resist water or humidity. Never expose directly to water as it will swell up. Slightly more water-resistant than MDF.

MDF : It finished on all sides w/ edging, can resist water or humidity. Never expose directly to water as it will swell up.

- FINISHING

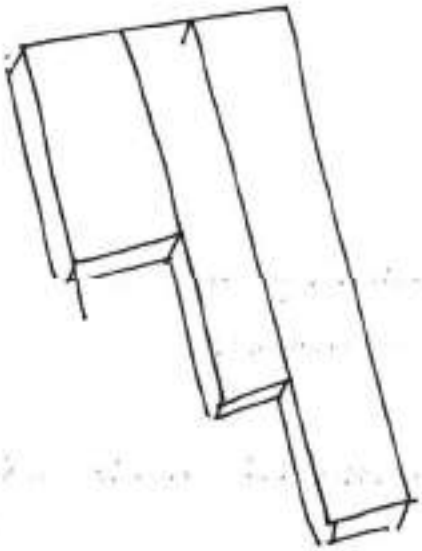
HDF : Finish w/ veneer, laminate or paint

MDF : finish w/ veneer, laminate or paint

- ENVIRONMENTAL ASPECTS

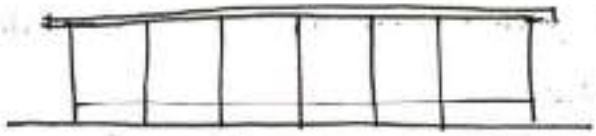
HDF - contains formaldehyde & other resins & binders & come w/ a risk of harmful out gassing.

MDF : contain formaldehyde & other resins & binders & come w/ a risk of harmful out gassing.



Substrate for laminated wooden flooring.

Wall shelves.



Kitchen cabinets

*PARTICLE BOARD

It is a wood wood product made by binding wooden chips, sawdust or sawmill shavings w/ a synthetic resin or some other binder. Urea formaldehyde is commonly used as a glue for binding wooden chips. Particle board can be used as a substitute for plywood for making furniture, inc. linings of walls & ceiling, as a substrate for countertops, floor decking, roof sheathing, underlayment & inc. decorative panelling, etc.

The chips are perpendicular to the surface.
*The chips in the surface layer are thinnner than those in the middle layer, so the surface is denser & more compact.

ADVANTAGES

- inexpensive
- light wt.
- environment friendly
- good thermo-acoustic properties
- ease of working
  - don't split when cut or nailed.

DISADVANTAGES

- ~~tool~~
- can't withstand heavy load
- prone to expansion due to moisture
- manufacturing contains urea formaldehyde can cause irritation to lungs & eyes & it is carcinogenic.

TYPES

- SINGLE-LAYER PARTICLE BOARD

It consists of wood particles of the same sizes which are pressed together. It is a flat & dense board that can be veneered or plastic laminated but not painted.

This is water-resistant type but not water-proof.

- THREE LAYER PARTICLE BOARD

It consists of a layer of large wood particles sandwiched b/w 2 layers made of v. small & highly dense wood particles. The amount of resin in the outer layer is more than in the inner layer. The smooth surface of a 3-layer particle board is ideal for painting.

- GRADED-DENSITY PARTICLE BOARD.

It consists of a layer of coarse wood particles. This type of particle board is used to make cabinets & wooden furniture.

- MELAMINE PARTICLE BOARD

It is made by fixing a decor paper infused w/ melamine on the surface of the particleboard under high heat & pressure. The wood particles in a melamine particle board are bonded using melamine-urea formaldehyde resin & wax emulsion. This makes it water-resistant. Melamine particle board resists scratches. It comes in a lot of colours & textures. Applications include wall paneling, furniture, wall cladding, wardrobes & modular kitchen.

- CEMENT-BONDED PARTICLE BOARD.

It has a magnesium-based cement or portland cement as the bonding agent. Cement content is 60%. While wooden particles such as wooden shavings, sawdust, & wood chips make up 20% of the composition. The remaining 20% is water. Due to the presence of cement, this type of particleboard is resistant to moisture, fire, termites & rot.

Suitable for constructing false ceilings, walls & permanent coverings for conc. floors & walls for bldg located in areas w/ high humidity. They are also used for making fire-resistant furniture products.

- VENEERED PARTICLE BOARD.

It means that it has a thin slice of wood called veneer attached to its surface. The veneered particleboard appears like a natural wooden board.

It is also resistant to warping as compared to a conventional particle board.

- LAMINATED PARTICLE BOARD

When a thin laminate sheet is attached to the surface of a plain particle board, it becomes laminated particleboard. A laminate sheet not only improves the aesthetics of the particleboard but also increases its durability.

USES

- They're used as coverings as hardwood floors. They protect hardwood boards against scratches. In addition, particle boards are also used to make floors in
- temporary structures.
- commonly used to make the core of solid core doors & flush doors. It is a good core mat. for doors because it has a smooth & flat surface that binds w/ the door skin easily & exhibits a good screw holding capacity for fixing hinges.
- Used for making false ceilings. This is because particle boards provide good thermal insulation. They are also used as ceiling tiles in many types of bridges.
- speakers are made of particle because they absorb sound.

GRADES

A, B, C, D & GIS

Grade A particle board are the best.

They have few knots, burls & unnoticeable patches.

GIS boards are 'good on one side' boards

STANDARD SIZES

wall & ceiling

600 x 2600 or 2750mm

1200 x 2600 or 2750 mm

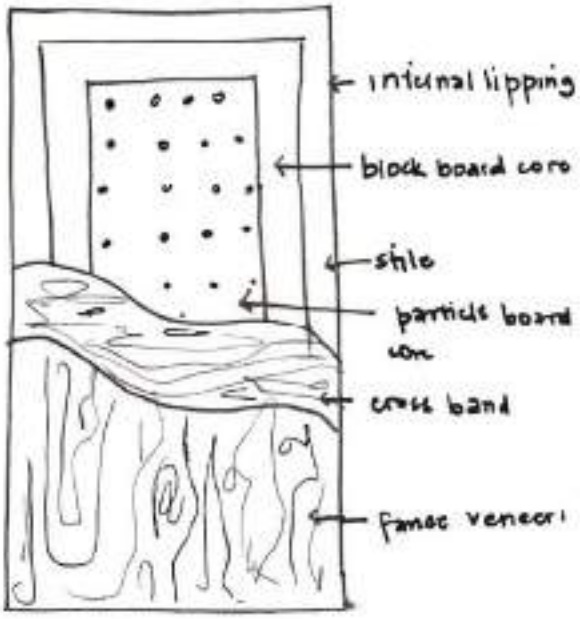
thickness - 12mm

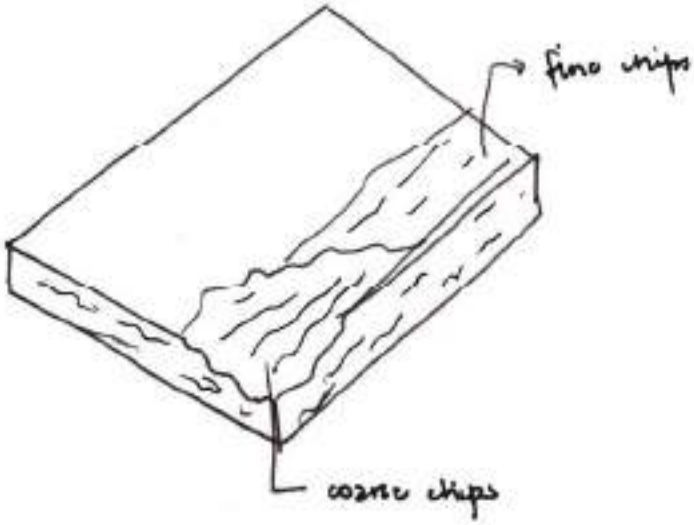
floor boards

600 x 2400 mm

1200 x 2400 mm

thickness - 22mm





• LAMINATES

They are popular surface-finishing material for home interiors, including furniture, floor & walls. A versatile mat., laminate is preferred over other finishing mat. owing to its classy appearance, quality & affordability.

Essentially, a composite artificial mat., it is made by pressing together min layers of flat paper & resins. The upper layer is often printed w/ a decorative pattern or colour.

TYPES

- High & Low pressure laminates

  In HPL, the decorative sheets are glued together & bonded under high pressure. They are highly durable w/ the ability to withstand heavy loads. On the other hand, in low pressure laminate or LPL, the layers of decorative kraft paper are directly glued to particleboard or fibreboard under pressure & heat, sealed w/ resin. The material cannot withstand heavy loads like HPL.

- Regular & compact laminate sheets

  These 2 types of laminates differ in terms of thickness. Regular laminate, which is glued to the surface of wood or plywood, has approx. a thickness ranging b/w 1.5mm to 8mm. compact laminates are self-supporting laminates that can be used directly w/o the supports of wood or plywood.

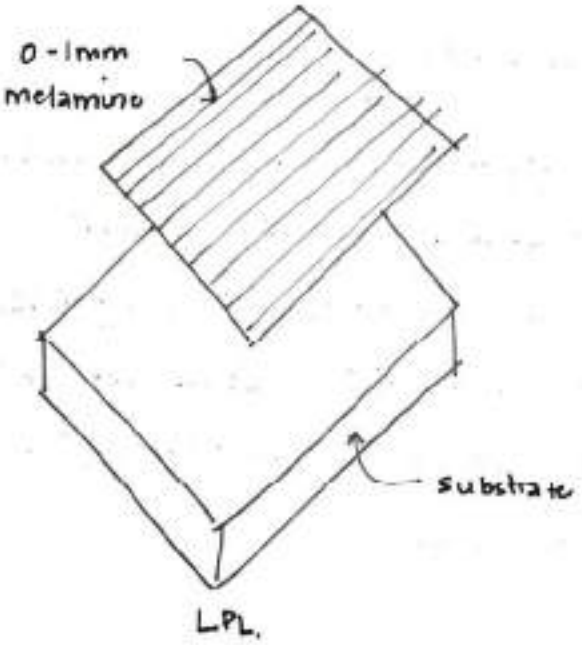
- Decorative & industrial laminates

these are known for their appear & availability in various patterns, texture, colour & finishes. The thickness of this mat. is about 1mm.

They have high resistance to wear & tear & can withstand heavy loads - They are used in making circuit boards, storage boxes & other kinds of furniture for industrial use.

- Based on surface finish

- solid coloured
- gloss coloured
- matt finished
- textured laminate
- wood grain
- metal
- leather laminate sheets



- Based on Advanced Properties

- fire - rated
- anti - bacterial
- outdoor UV
- electrostatic dissipative

USAGE

- Decorative laminate have greater aesthetic appeal in terms of laminate finishes & patterns
- Industrial laminate have higher strength & are more resistant to wear & tear, thus, they include high performance ones which are fire resistant / retardant, anti-bacterial & chemical resistant for application in hospitals & other industries
- compact laminate / laminate boards are fairly thickness ones. These boards are self supporting & you don't need to glue them onto any other mat.
- post formed laminate are flexible laminate versions are thinner than regular laminate.
- High pressure & low pressure laminate differ only in the pressure w/ which the laminate mat. is applied to a substrate, HPL is usually used w/ plywood while LPL finds its use w/ MDF.

- Regular & compact Laminate sheets. Regular laminates are substantially thinner, w/ a maximum th. of 1.5mm. compact laminate, on the other hand, have a max. thickness of 30mm. Designers use regular laminate sheets for stability & strength, whereas compact laminate sheets are also anti-bacterial, abrasion free, water & fire resistant.

COLOURS

can be found in multitude of colours & a wide variety of patterns Appearance of wood texture & other natural mat.

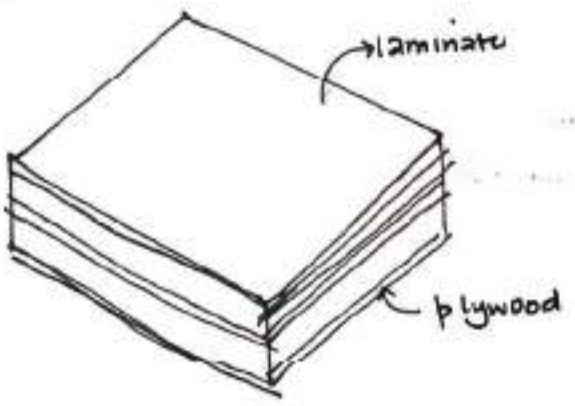
PRICE : ₹55 - ₹400/ ft².

STANDARD SIZES

Thickness : 0.6 - 1.3 mm

The thicker self supporting compact laminate have a th. ranging from 3 - 30 mm.

sizes : 2438 mm x 1219 mm (8'x4')
914 mm x 2134 mm (3'x7')



° WOOD WOOL

It is an man-made board mat. about 50-75mm th. comprising shredded timber bound together in a cement paste. It was generally during the 1960s to provide insulation often at roof level & as a permanent shutter to in-situ concrete.

Unfortunately, when woodwool was incorporated as a permanent shutter, extra great care was taken when placing conc. against the woodwool soffit shutters, inadequate compaction of the conc. could occur due to the compressible nature of the board. This lack of compaction resulted in voids & honeycombing on the soffit of the slab sometimes having to no cover to the reinforcing steel. If the wood wool boards were left in place, these defects then remained undetected.

Generally it is a by product of big timber industries in form of shavings of light wt. timbers like chir, deodar & kail, etc. At times it may be specially prepared w/ help of special planning machines.

It is effective heat & sound insulating mat. It is fairly cheap & flexible.

It is used in packaging of delicate mat. for transportation & in manufacturing of fibre boards.

The woodwool is a mix that a pressing procon is cut to create panels. The fibers of spruce (excellent for its resistance) in the mix, come from certified forest.

~~USE~~

SIZES

2m x 60cm

th: 15mm - 75mm

FEATURES

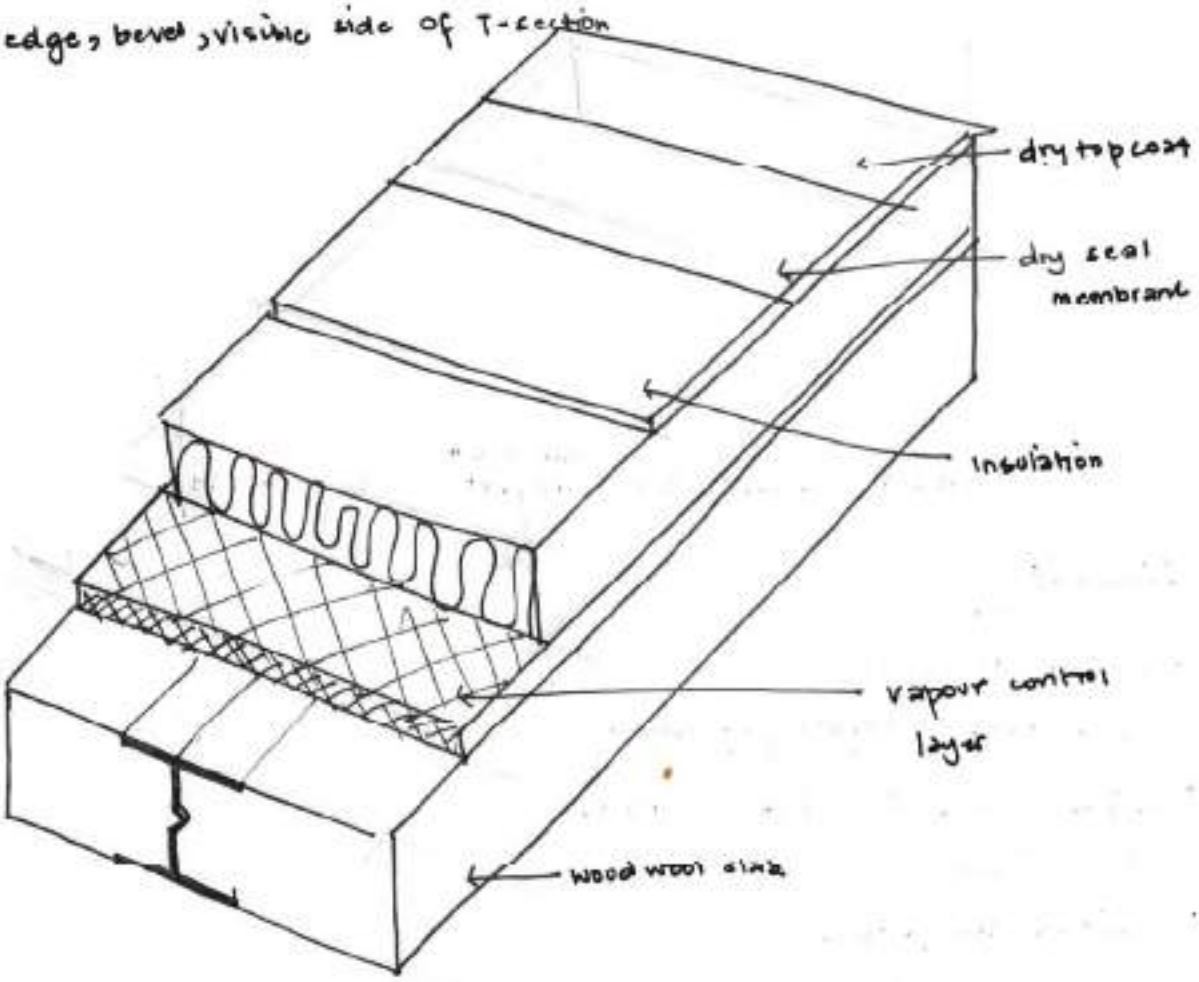
- aesthetically pleasing
- high sound absorption performance
- available in various edges & colours
- fire resistant
- environmentally friendly.
- paintable, w/ wide range of colours
- durable.

USES

- It can be used in cooling pads in home evaporative cooler systems known as 'swamp coolers'.
- mats & blankets for erosion control
- a mat. used in the production of cement bonded wood wool boards.
- garden mulches & as a growth medium for hydroponic gardens.
- in structures framed in wood or in metal the supporting structure, realized w/ uprights & beams, is spaced out by fibrous insulating mat. : wood wool.
- wood wool panels are available in diff. sizes, suitable for insulation of the walls of in termediate floors & ceilings of coverage & are also pre-fabricated, so they are produced in factory & then assembled on site.

EDGEs

square edge, bevel, visible side of T-section

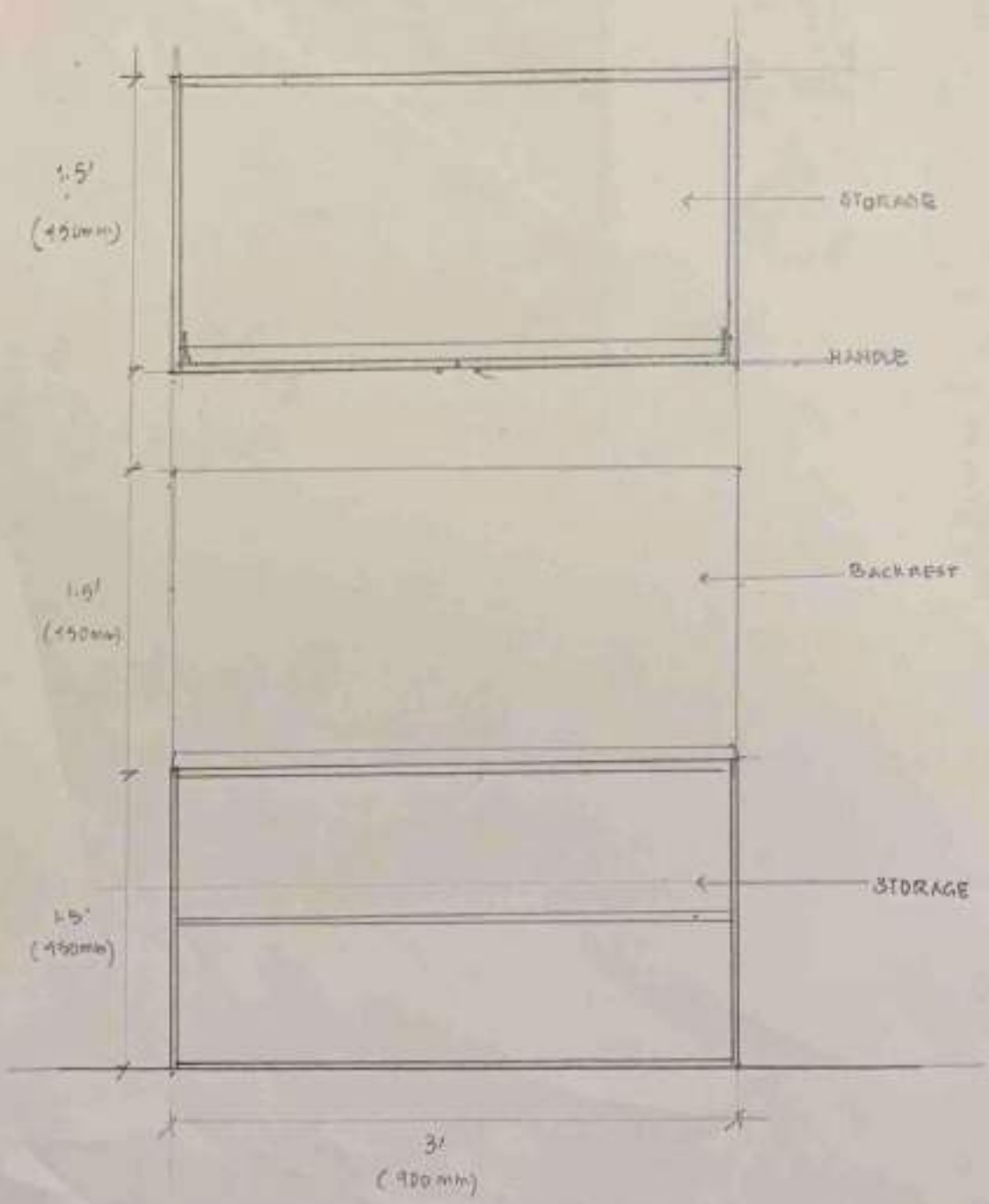


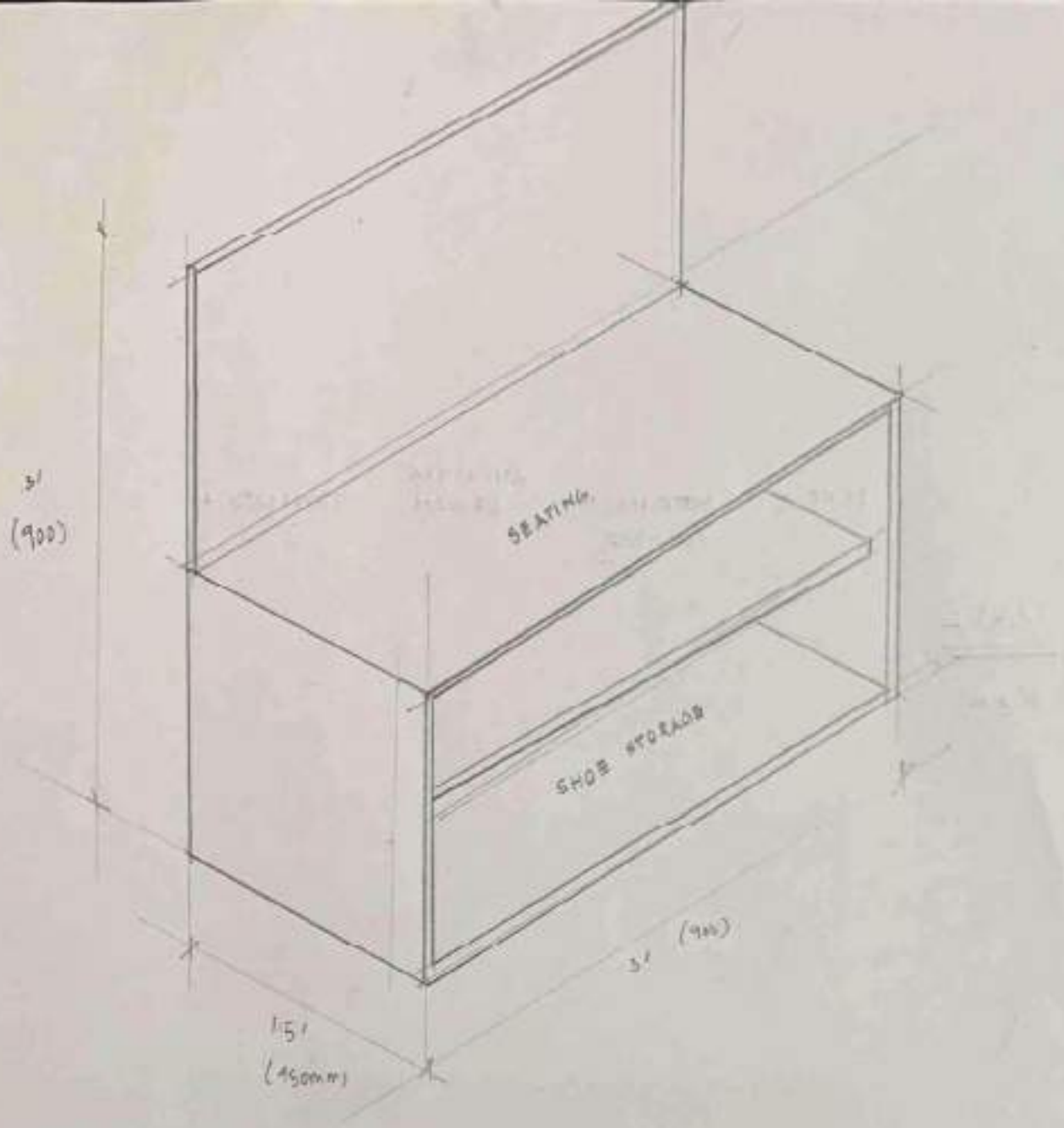
WOOD WOOL SLAB DECK.

PART 2

8' x 4'

SHOE STORAGE + SEATING.




3'
(900)
SEATING
SHOE STORAGE
1'5'
(450mm)
3' (9m)