### PREFAB MATERIALS

TYPES OF PREFAB MATERIALS .

- Wood
- Tile
- Steel
- Glass
- Stone

#### <u>1.WOOD</u>

Wood is the hard fibrous material that forms the main part of most trees, bushes and shrubs. It consists of:

Cellulose Hemi-cellulose Lignin

Cellulose is a natural fiber with the following structure



These cellulose fibers bond together to form sheets which are held together with lignin forming the substance we know as wood.

Wood Cellulose is formed by the vascular cambium in trees and grows from the center outwards forming characteristic growth rings.



### Chemical and physical properties of wood

#### PHYSICAL PROPERTIES

- Wood is Hygroscopic meaning that it takes in or gives up moisture to the atmosphere
- Timber cell walls shrink when exposed to air
- Timber strength, hardness and stiffness increase during drying period

# CHAMICAL PROPERTIES Lignin vascular cambium Cellulose Hemi-cellulose Lignin vascular cambium Advantages and disadvantages of wood

#### **ADVANTAGES**

- has greater resistance to fire
- has high strength compared to its weight
- flexible for component design (prefabricated panel systems)
- durable
- easily worked on & shaped
- comfortable & more resistant to earthquakes

#### DISADVANTAGES

- Edges of board are unattractive and can't be covered.
- Not suitable for many joints
- still may contain natural defects such as knots due to the sheets of veneer.
- Low on strength, it is less dense and can easily get damaged while handling.
- Not durable, particle boards are prone to getting damaged because of moisture and humidity.
- cannot support heavy loads.

-Not as eco-friendly as solid wood, this wood has a added chemicals to it like glue so this product is not 100 percent natural.

#### Suggested applications of wood

- floors, walls, and roofs In home construction
- wind bracing panels
- concrete shuttering panels







## Manufacturing process of wood

STAGE ONE: felling STAGE TWO: stacked in a clearing. STAGE THREE: The logs are transported to the sawmill STAGE FOUR: the logs are cut into boards STAGE FIVE: seasoning



### 2.TILES

• A ceramic tile is simply any tile that is made from a ceramic material such as earthenware or porcelain. Indeed, they are made from a mix of clays, sand and other natural products.

### Chemical and physical properties of tile

Resistance to abrasion. ...

Freeze-resistance....

Thermal shock resistance. ...

Bending strength and breaking force. ...

**Chemical** resistance. ...

Stain resistance. ...

Properties related to safety.



### Advantages and disadvantages oftile

#### <u>Advantages of a tile</u>

- Long Lasting Ceramic
- Low Maintenance
- Virtually Unlimited Designs
  Stands Up to High Traffic
  Great Investment
- Disadvantages of tile
- Difficult to Install
- May Chip or Crack
- Hard Unforgiving Surface
- Colder Perception





### Suggested applications of tile

- wall and flooring tiles
- Benchtops
- splash backs





### Manufacturing process of tile

- Batching
- Mixing and grinding
- Spray drying
- Forming
- Drying
- Glazing
- Firing



#### 3.STEEL

• Steel is an alloy of iron and carbon containing less than two percent carbon and 1 percent manganese, and sma of silicon, phosphorous, Sulphur and oxygen.

#### Chemical and physical properties of steel

#### PHYSICAL PROPARTIES OF STEEL

- High corrosion resistant.
- higher cryogenic toughness
- •higher work hardening rate more attractive appearance

#### **CHEMICAL PROPERTIES OF STEEL**

- Chromium
- Nickel
- nitrogen molybdenum
- silicon
- Aluminum
- carbon



### Advantages and disadvantages ofsteel

#### **ADVANTAGES**

- Steel is a structurally stable materiel.
- steel is eco-friendly and energy efficient.
- Steel is durable and can withstand most weather conditions.
- 90 percent recyclable according to Hewlett, a freelance writer.
- flame resistant

#### **DISADVANTAGES**

- Can develop mould during winter
- it may corrode or be rusty
- it may be toxic to the environment





### Suggested applications of steel



Construction is one of the **largest end-use** industries of stainless **steel** products. Various infrastructure and construction sites require a massive amount of product to enhance the aesthetic appeal and corrosion resistance of the structure



# Manufacturing process of steel

Steel production can be broken down into six steps:

- 1. Ironmaking
- 2. Primary Steelmaking
- 3. Secondary Steelmaking
- stirring
- ladle furnace
- ladle injection
- degassing
- 4. Continuous Casting
- 5. Primary Forming
- 6. Manufacturing, Fabrication, and Finishing
- (e.g. cold rolling)

- machining (e.g. drilling)
- joining (e.g. welding)
- coating (e.g. galvanizing)
- <u>heat treatment</u> (e.g. tempering)
- surface treatment (e.g.
- carburizing)





Glass is a clear material made up of a combination of sand/silica, soda ash and limestone, melted together at high temperature.



### Chemical and physical properties of glass

#### **PHYSICAL PROPERTIES OF GLASS**

-Your typical 6mm thick clear glass is 87 percent transparent allowing visible light to pass through it.

- glass is chemical resistant
- -glass can be heavy even in relatively small sizes.
- -glass is a strong building material with greater capacity to

resist compression and tension.

#### **CHEMICAL PROPERTIES OF GLASS**

-All the chemical properties of glass are found within the material namely: silica, soda ash and limestone.

### Advantages and disadvantages of glass

#### **ADVANTAGE OF GLASS**

#### **DISADVANTAGES OF GLASS**

-Glass is 100% recyclable- water resistant.-does not rust

- -An expensive material -sensitive material, can easily break
- It can easily melt in high temperatures
- -its little pieces can be harmful when broken

### Suggested applications of glass

Solar energy control in buildings, glare reduction in buildings, reduction of light in special areas such as ophthalmic wards.

Airports and other controlled towers, computer rooms for strict atmospheric control.

Glass is normally used in bathroom areas for considerable privacy.

Rooflights, light dissuasion in museums and libraries

### Manufacturing process of glass

Stage 1: Melting and refining Stage 2: Float bath Stage 3: Coating Stage 4: Annealing Stage 5: Inspection





#### 5.STONE

Stones are part of smaller fragments of rock and are the ones used for building purposes. Minerals are the ones which form the rocks which could be mono-mineral e.g. gypsum, quartz sand or poly-mineral e.g. basalt and granite are the substances having a definite chemical

composition and molecular structure

### Chemical and physical properties of stone

#### **Chemical properties**

- Siliceous rocks-contain more silica in them which makes them more durable and hard e.g. granite and quartzite
- Argillaceous rocks-have more clay in them they should be densely compacted for them to be durable tho brittle e.g. slates

Calcareous rocks-have more calcium carbonate in them e.g. limestone and marble **Physical properties** 

- Stratified these have planes and cleavage esp. sedimentary
- Unratified-those of crystalline granular or compact granular e.g. volcanic rocks or sedimentary affected by movements of the earth
- Foliated-those that tend to split in a particular direction e.g. metamorphic

### Advantages and disadvantages of stone

#### Advantages of natural stone:

1. Low price. Generally, very good imported natural stone in market is available in 400-500 RMB while this price can only get middle level <u>artificial</u>

#### stone.

- 2. Natural pattern, more selection.
- 3. Good hardness.
- 4. High density.

5. Anti-abrasion. Natural stone can be used in outdoor high visitors flow rate and required high performance in service life places.

Disadvantages of natural stone:

Natural stone is heavy.

There will be gap between two.

It is difficult to connect.

It is impossible to be seamless.

High permeability.

Stains are hard to clean.

Insufficient elasticity, if hit it a thump will make it crack.



### Suggested applications of stone

- for construction purposes
- On structures-foundations walls, columns, lintels, arches roofs, floors, D.P.C
  - Face work-where bricks make walls but facing is by stone, we call that composite masonry
  - Paving-covering floors of bldgs. and road paving
- -miscellaneous uses
- Making cement ,concrete
  - $\,\circ\,$  Ballasts for rail ways



#### CONSTRUCTION PREFABRICATION

- Three main steps
  - 1. Manufacturing components off-site (Factories or workshops)
  - 2. Transport components to site
  - 3. Assembly at needed positions

OFF-SITE fabrication Transport to site Assemble

### CONSTRUCTION PREFABRICATION

IF divided according to type of materials used



#### CONSTRUCTION PREFAB

Direct Applications of Prefab



#### TIMBER WOOD FRAMING

Box Frame

Cruck Frame

Common Rafter Cruck blades Common Rafter Purlin Vind Brace Vall plate Vall plate

Aisled Frame





#### PANELIZED WOOD FRAMING

All-wood panelized framing

Hybrid panelized framing





#### CONCRETE

### PRE-STRESSED CONCRETE

- How ?
  - Pre-tensioned tendons instead of normal steel bars
  - Allow concrete to withstand tension by friction
- Benefits:
  - Longer spans
  - Thinner slabs ((Cost-Saving))
  - Fewer joints between spans



#### PRECAST SLABS

- Solid Flat (Traditional)
- Hollow Core Flat
  - High-rise, Bridges
  - Lower cost, lower weight and fast assembly
- Single T
- Double T
  - Up to 24 m span or more
  - Flooring systems in garages, Bridges

_		T	
SOLID FLAT SLAB	HOLLOW CORE SLAB	DOUBLE TEE	SINGLE THE
Widda wry	2; 4; 8' wide (610, 1220, 2440 mm)	8"; 10" wide (2441; 3030 mm)	8, 10' mide (344), 200 mm)
	()4", 34" some metudiktiven)		

### PRECAST BUILDING SYSTEMS

- Large Panel System
  - Large wall and floor panels
  - BOX-like Rooms
  - Horizontal and Vertical Joints
- Lift slab system with walls
  - Precast Columns (Two stories High)
  - Precast RC slabs joined by special joints to columns



#### PRECAST BUILDING SYSTEMS

- Frame System
  - Beam-Column Junctions
  - Corbels at columns for beams



#### STEEL FRAMING

- Super-structure Skeleton
- Vertical I-shaped Columns and Horizontal I-beams
- Rectangular grid supporting floors , walls.....etc.
- Cased by Fire-Resistant Coating or concrete layer
- Skyscrapers became possible



### **PREFABRICATION IN SKYSCRAPERS**

- You can think of using prefabricated materials in the building of skyscrapers as " some LEGO<sup>®</sup> assembly" on an immense and monumental scale.
- All prefab assemblies are transported to site and lifted by cranes to needed positions then joined by workers one by one.







#### PREFABRICATED SKYSCRAPERS

• Mini Sky City:

-57 stories.

-19 atriums with 10 m tall each.

-4,000 people working spaces.

-800 households.

(Location : Changsha, China.)



#### SEGMENTAL BRIDGES

- Support towers at sides
- Concrete Prefab segments lifted by cranes
- Attached together by steel reinforcements
- A popular example is
  - Mike O'Callaghan–Pat Tillman Memorial Bridge



#### MODULAR HOUSES

- Full rooms or floors are just ready for assembly
- Cranes assemble the house in few days
- Advantages:
  - Cost Saving
  - Time-efficient
  - Fewer Crews
  - No site disturbance
  - No weather delays



#### **BASIC CRITERIA**

- Construction Time
- Construction Cost
- Quality
- Site Complexity

#### ADVANTAGES

#### 1.Construction Time:

- Indoor Fabrication
- Independence of weather conditions

#### 2.Construction Cost:

- Bulk orders
- Less Indirect Costs
- Fewer Labor
- Less holding costs
- 3. Quality:
- Ongoing Quality Surveillance
- Stable production Conditions

#### 4.Site Complexity:

- Less overlapping activities
- Standard construction method

#### DISADVANTAGES

- •Road transport maximum widths.
- •The need for police escorts.
- •Height restrictions under bridges.
- •Daytime traffic restrictions in city centers.
- •Maximum load capacities of site crane age and temporary gantries.

#### THANK YOU