1. INTRODUCTION

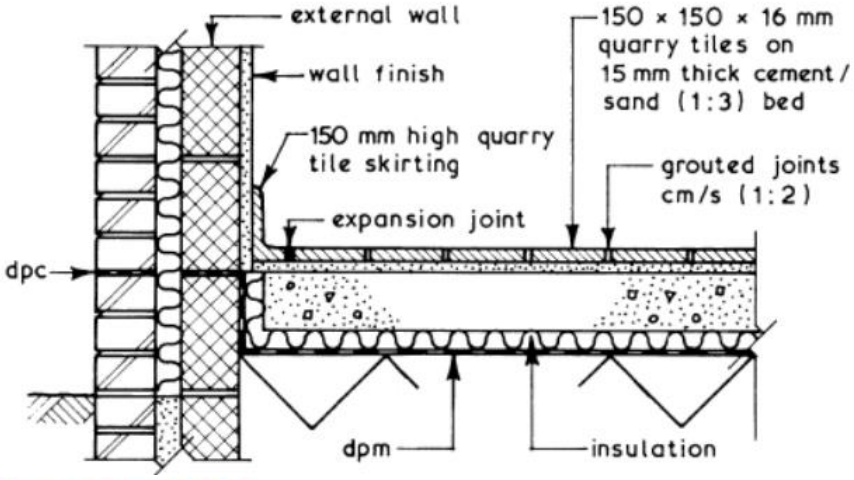
- The purpose of a floor is to provide a level surface capable of supporting:
  - The occupants of a building,
  - Furniture,
  - Equipment, and
  - Sometimes the internal partition.
- Primary functions of a floor:
  i. Provide a level surface with sufficient strength to support the imposed loads of people and furniture.
  ii. Exclude the passage of water and water vapor to the interior of the building.
  iii. Provide resistance to unacceptable heat loss through the floor.
  iv. Provide the correct type of surface to receive the chosen finish.

1. INTRODUCTION (CONT...)

- To perform its function a floor must satisfy the following requirements:
  i. Adequate strength and stability,
  ii. Adequate fire resistance,
  iii. Sound insulation,
  iv. Damp resistance, and
  v. Thermal insulation.
- In the traditional floor construction, a floor is needed to have a clean, smooth, impervious, level and durable surface.
- Floors are classified as **ground floor** and **upper floor**.
- The floors resting directly on the ground surface are known as **ground floors**.
- While the other floors of each storey, situated above the ground level are known as **upper floors**.

2. COMPONENTS OF A FLOOR

- A floor is composed of two essential components:
  - Sub-floor, base course or floor base
  - Floor covering or simply, flooring
- The **floor base** is a structural component, which supports the floor covering.



3. GROUND FLOORS

3.1 INTRODUCTION

- Ground floors are further subdivided into **solid floors**, **suspended floors** and **basement floors**.

Solid floors

- The floors supported directly on the ground are known as solid floors.

Suspended floors

- These are floors supported above the ground level.
- Suspended floors do not rely on the ground for support.

Basement floors

- These are floors resting at the lowest/basement level.
- Resistance to moisture ingress is one of the main criteria in the design of basement floors.

3. GROUND FLOORS (CONT...)

3.2 FUNCTIONAL REQUIREMENT OF GROUND FLOORS

- For good performance of a ground floor, it should be able to perform the following:

1. Support with out failure the loads imposed on it.
2. Prevent dampness inside the building by providing a damp proof membrane in or below the floor.
3. Prevent the growth of matter and other living organisms.
4. Be reasonably durable so as to require minimum maintenance or replacement work.
5. Provide a surface finish with a standard of appearance, comfort, cleanliness, and heat retention.

3. GROUND FLOORS (CONT...)

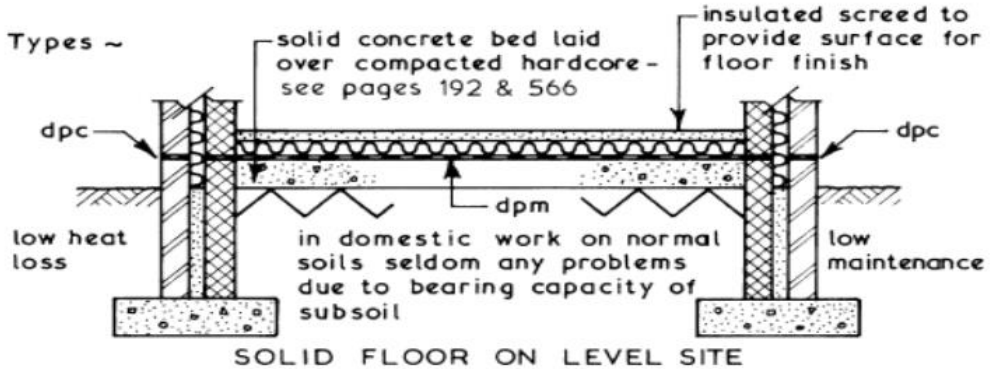
3.3 SOLID FLOORS

- A solid ground floor consists of three components

i. **Hard core**: The main purpose is to prevent the dampness from the soil penetrating and affecting the floor through capillary action.

ii. **Damp proof membrane**: an impervious layer such as heavy duty polythene sheeting to prevent moisture passing through the floor to the interior of the building.

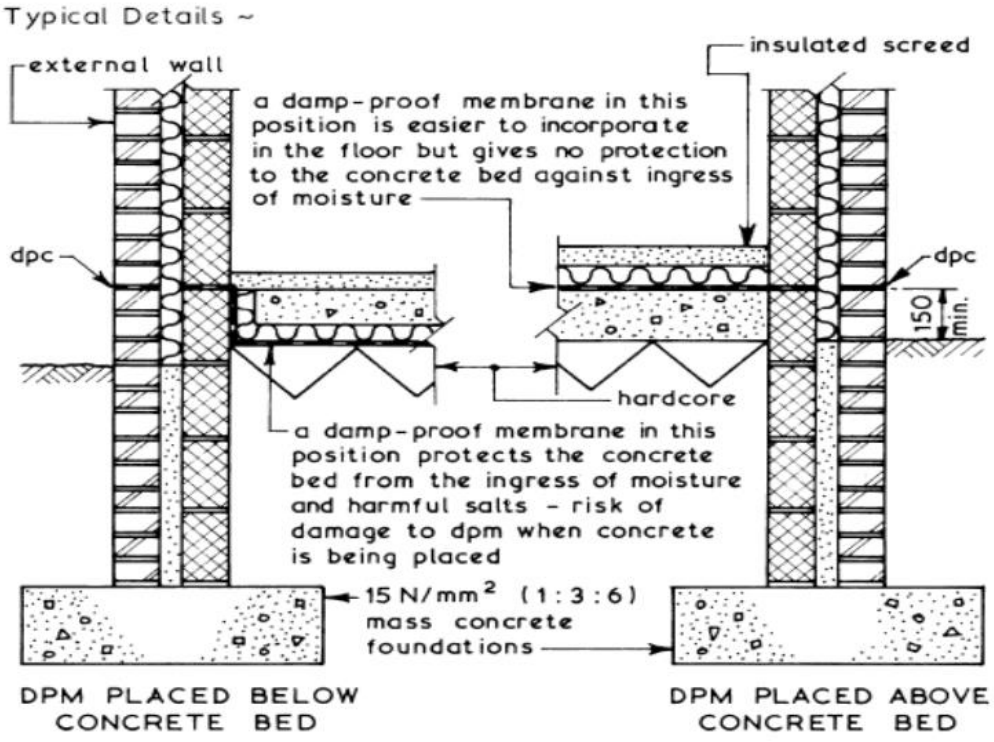
iii. **Concrete bed**: the component providing the solid level surface to which screeds and finishes can be applied.



SOLID FLOOR ON LEVEL SITE

3. GROUND FLOORS (CONT...)

3.3 SOLID FLOORS (cont...)



3. GROUND FLOORS (CONT...)

3.4 SUSPENDED FLOORS

- Being supported on other elements of structure, there is a void beneath these floors.
- Suspended floor is needed rather than a ground bearing slab on the following occasions:
  - soil with a low bearing capacity,
  - sloping sites,
  - soils containing aggressive chemicals, and
  - sites with high water levels.
- Suspended floors are most commonly constructed using timber and concrete beams and blocks.

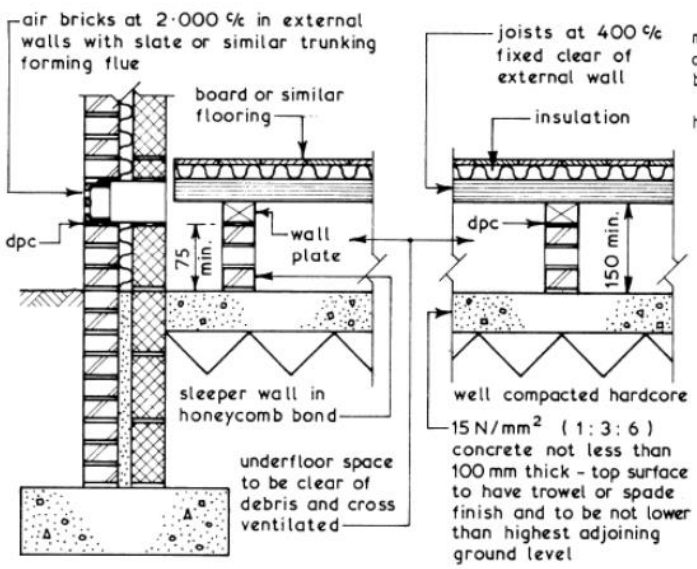
Construction of Suspended timber floors

Suspended concrete beam and blocks

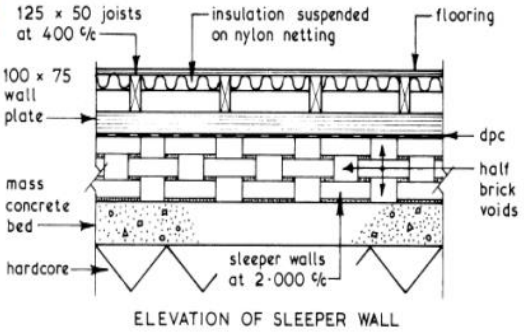
3. GROUND FLOORS (CONT...)

3.4 SUSPENDED FLOORS (cont...)

Typical Details ~



Suspended timber ground floor



Sleeper wall

4. UPPER FLOORS

4.1 INTRODUCTION

- An upper floor is basically a principal structural element, and the general structural design of a building greatly influence the choice of type of floor.
- Upper floors are supported either on the walls or on columns; they have therefore the major problems of strength and stability.
- The structural design of the of upper floors has to be such as to support:
  - The loads set up by the use of the building,
  - Self weight of the floor,
  - Weight of partitions, etc.
- An upper floor can be constructed either from timber or concrete (Cast in situ and precast concrete).

4. UPPER FLOORS (CONT...)

- Upper floors are regarded to be composed of three parts:
  - The structural element,
  - Upper surface or floor finish, and
  - Lower surface or ceiling.

4.2 FUNCTIONAL REQUIREMENTS OF UPPER FLOORS

- An upper floor should:
  1. Sustain its own weight and any other weights imposed on it.
  2. Offer fire resistance especially in very tall buildings.
  3. Minimise noise transfer from upper floor to the lower floor.
  4. Be reasonably durable – minimum maintenance and replacement.
  5. Provide an acceptable surface finish which is safe, comfortable, clean and of good appearance.
  6. prevent dampness.

4. UPPER FLOORS (CONT...)

4.3 CONCRETE FLOORS (R.C.C. FLOORS)

- Floors of modern buildings are invariably made of reinforced cement concrete (R.C.C) for different advantages:
  - Moderately cheap,
  - Quite durable,
  - Easy to construct,
  - Fire proof and damp proof,
  - Can be used in large spans, etc.
- R.C.C floors can be cast in situ or prefabricated.

4.3.1 CAST IN SITU R.C.C FLOORS

- Cast in situ concrete floors give the maximum freedom in design since they can take up any shape dictated by the plan.

4. UPPER FLOORS (CONT...)

4.3.1 CAST IN SITU R.C.C FLOORS (CONT...)

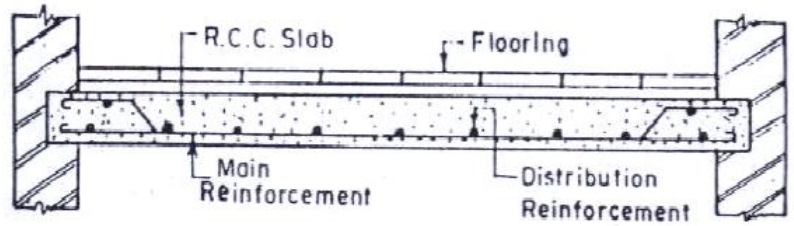
- Based on the design requirements cast in situ concrete can be:
  - Simple slab flooring
  - Beam and slab flooring
  - Flat slab flooring
  - Waffle grid slab flooring
  - Drop slab floor
  - Ribbed or hollow tiled flooring

A) SIMPLE SLAB FLOORING

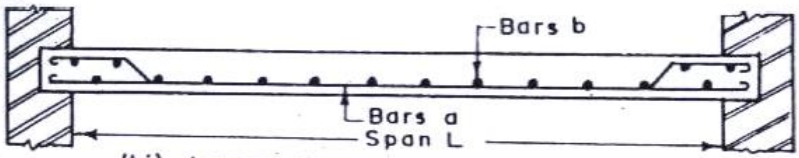
- These slabs are quite suitable and economical for short spans and in most cases they are wall supported.
  - One way reinforced slab ($l_y/l_x > 2$). : the main reinforcement is placed in the direction of the shortest side.
  - Two way reinforced slab ($l_y/l_x < 2$). : the main reinforcement is placed in both directions.

4. UPPER FLOORS (CONT...)

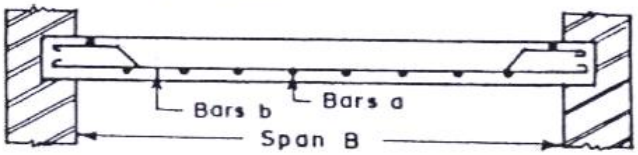
A) SIMPLE SLAB FLOORING (CONT...)



(a) One Way Reinforcement



(bi) Longer Span



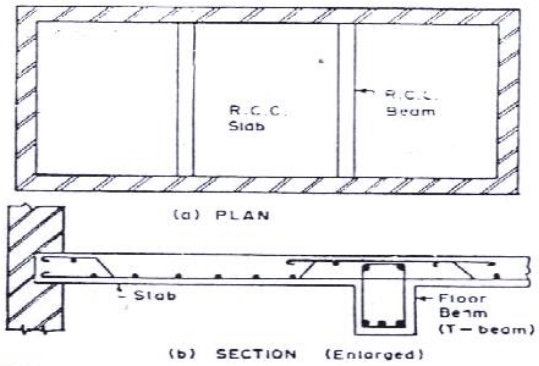
(bii) Shorter Span

(b) Two Way Reinforced Slab (Sections)

4. UPPER FLOORS (CONT...)

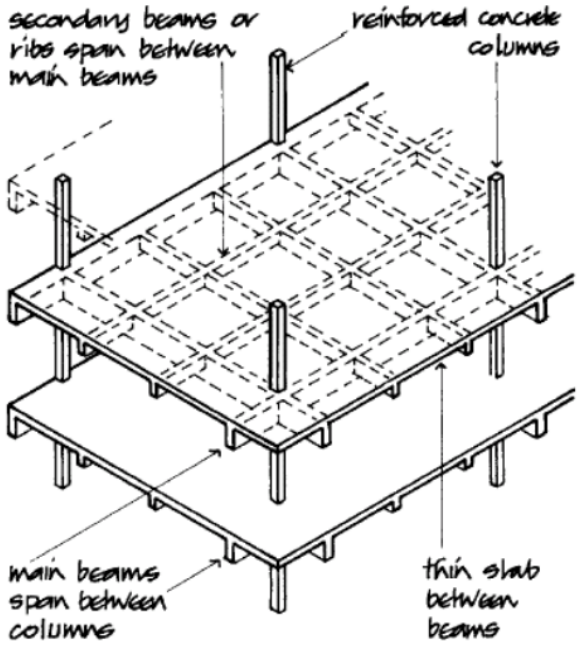
B) BEAM AND SLAB FLOORING

- When the width of the room becomes more, the span of slab increases, and simple R.C.C slab becomes more uneconomical. In that case, the floor structure consists of RCC beams and slab cast monolithically.
- The beams known as T-beams, act as intermediate supports to the slab which is continuous over these beams.
- These types of floors are generally the most economic and most usual form of floor construction.

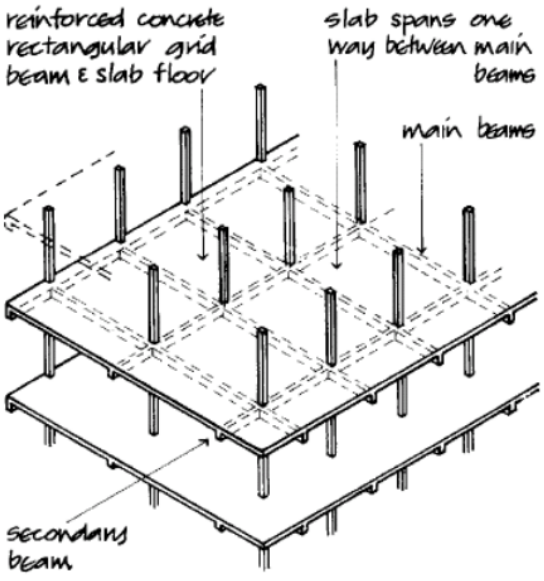


4. UPPER FLOORS (CONT...)

B) BEAM AND SLAB FLOORING (CONT...)



Square grid beam and slab floor

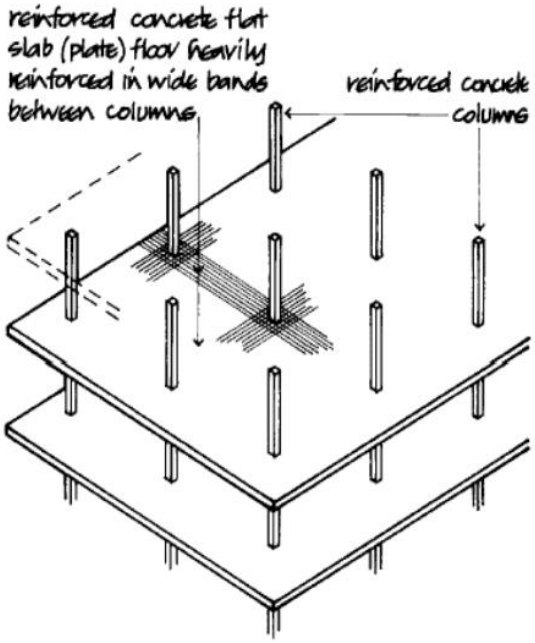


Rectangular grid beam and slab floor

4. UPPER FLOORS (CONT...)

C) FLAT SLAB FLOORING

- The slab is of uniform thickness throughout with out down stand beams and with the reinforcement more closely spaced.
- The reinforced slab is monolithically cast with the supporting columns with out any provision of beams.
- The flat slab transfers the load directly to the supporting columns suitably spaced below the slab.
- Used in case of large span and heavy loads.

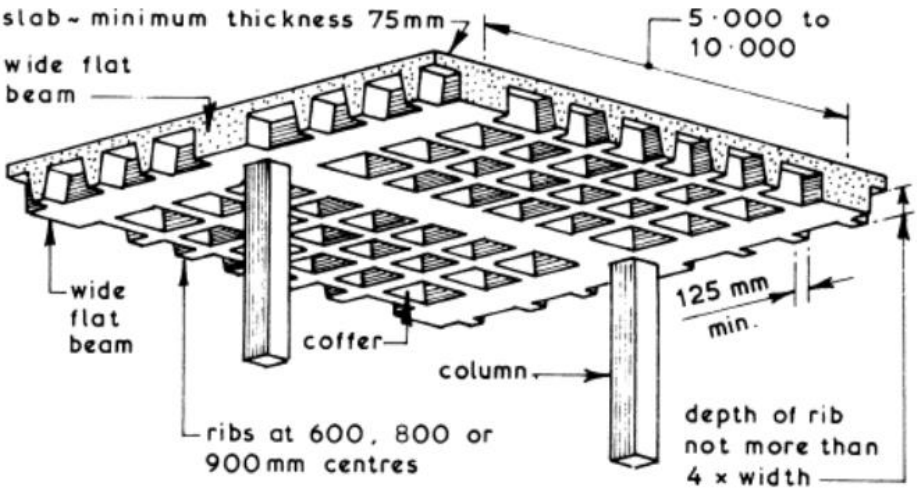


Flat slab (plate) floor

4. UPPER FLOORS (CONT...)

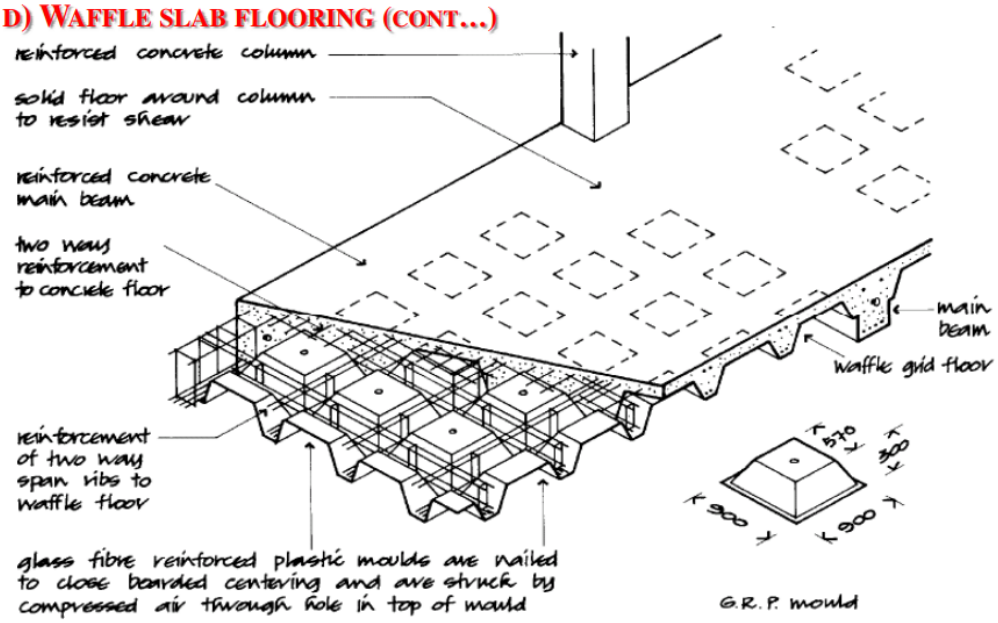
D) WAFFLE SLAB FLOORING

- The intermediate cross beams are cast on a rectangular square grid that gives the under side of the floor the appearance of a waffle.
- The advantage of the intermediate beams of the waffle is they support a thin floor slab and reduce the dead weight of the floor.
- This type of floor is used where a widely spaced square column grid is necessary and floors support comparatively heavy loads.



4. UPPER FLOORS (CONT...)

D) WAFFLE SLAB FLOORING (CONT...)

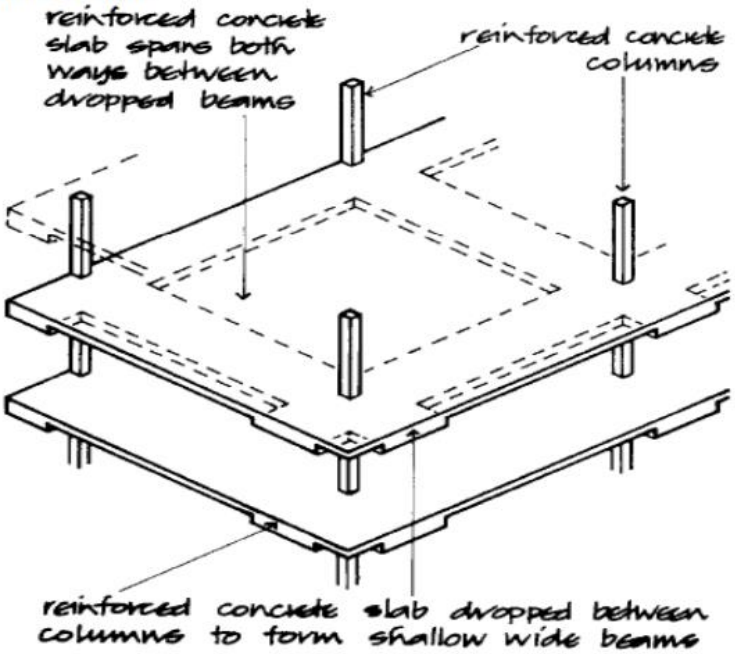


Waffle grid in-situ cast reinforced concrete floor

4. UPPER FLOORS (CONT...)

E) DROP SLAB FLOORING

- A floor slab which is thickened between columns in the form of a shallow but wide beam.

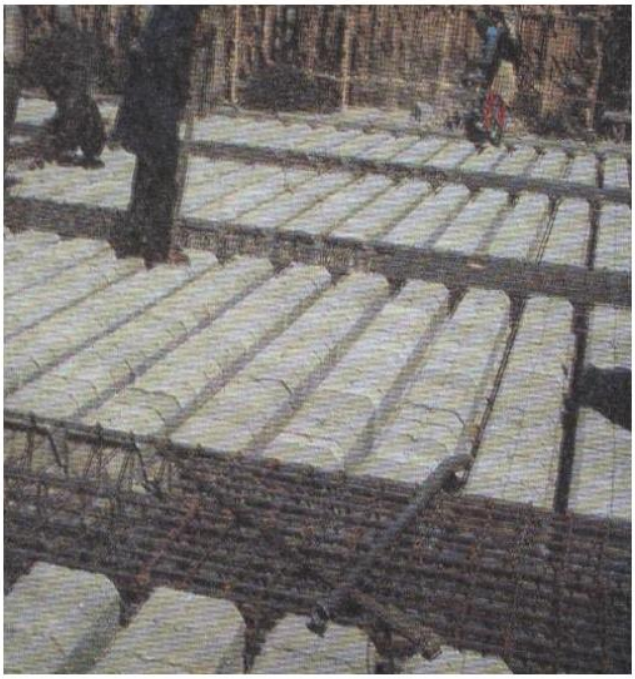


Drop slab floor

4. UPPER FLOORS (CONT...)

F) RIBBED SLAB FLOORING

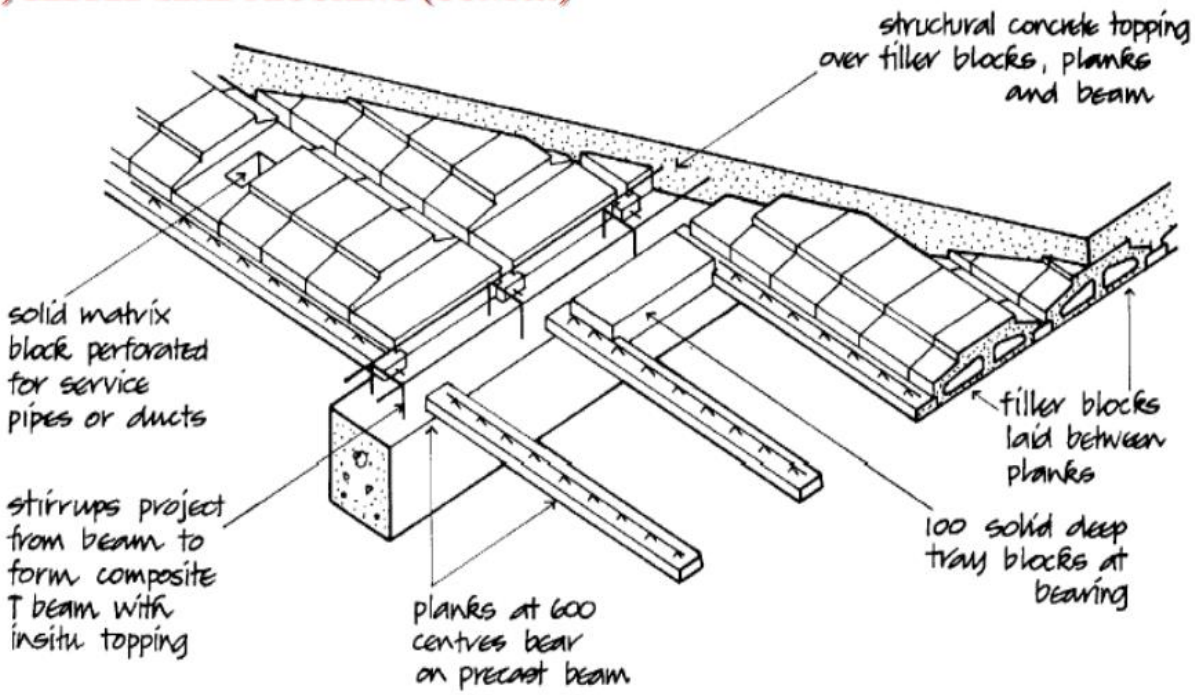
- Advantages of ribbed slab:
  - They are light in weight.
  - They provide better thermal insulation.
  - They have better sound proofing qualities.
  - They have better fire resistance.
  - Convenient installation of electrical and plumbing.



Ribbed slab before concrete casting

4. UPPER FLOORS (CONT...)

F) RIBBED SLAB FLOORING (CONT...)



Precast beam and filler block floor

4. UPPER FLOORS (CONT...)

4.3.2 PRECAST CONCRETE FLOORS

- Precast concrete floors are designed primarily with object of eliminating formwork and wet poring, which make the installation of an in situ floor rather a slow process.
- Precast concrete floors can be erected rapidly and immediately and they are lighter in weight.

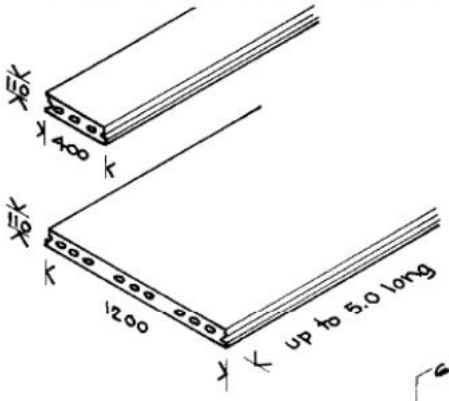
Advantages	Disadvantages
• Elimination of the need for formwork • Curing time of concrete is eliminated • Superior quality • Erection at every weather condition	• Less flexible in design terms • Problems at connections • Requirements for lifting device • High degree of site accuracy is required

4. UPPER FLOORS (CONT...)

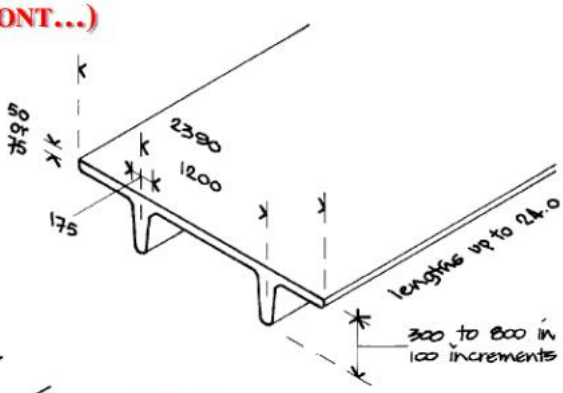
4.3.2 PRECAST CONCRETE FLOORS (CONT...)

4. UPPER FLOORS (CONT...)

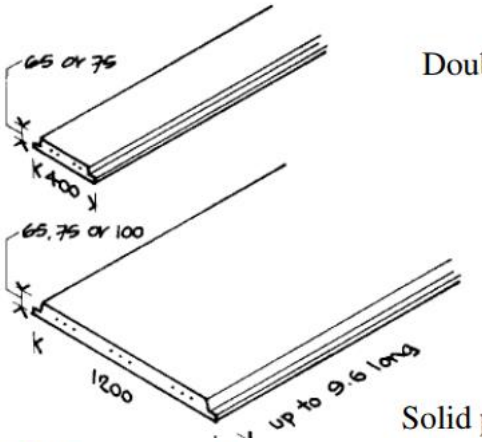
4.3.2 PRECAST CONCRETE FLOORS (CONT...)



Hollow precast



Double T beam



Solid plank

4. UPPER FLOORS (CONT...)

4.4 TIMBER FLOORS

- The fact that wood can be glued, laminated or bonded to metal or plates make it versatile construction material.
- Timber floors essentially consist of boarding supported on timber joists called floor joists.
- The structural element of timber floors is the joist.
- The joists are designed to carry the necessary load across the span, and the floor planking adds to the rigidity of the floor.
- Timber floors though quite light in weight, have poor fire resistance and sound insulation properties.
- The resistance of wood to fire and insects can be improved by coating.
- Care also should be taken in moisture flow.

4. UPPER FLOORS (CONT...)

4.4 TIMBER FLOORS (CONT...)

5. FLOOR FINISHES

- The choice of floor finishes depends on the use to which the floor is likely to be employed.
- The following are the factors that affect the choice of flooring materials:

1. **Initial cost**: The cost of the material should be in conformity with the type of building, and its likely use.
2. **Appearance**: covering should give pleasing appearance, it should produce a desired color effect and architectural beauty.
3. **Cleanliness**: the flooring should be capable of being cleaned easily, and it should be non absorbent.
4. **Durability**: the flooring should have sufficient resistance to wear, temperature changes, disintegration with time and decay.
5. **Damp resistance**: flooring should offer sufficient resistance against dampness.

5. FLOOR FINISHES (CONT...)

6. **Thermal insulation**: the flooring should offer reasonably good thermal insulation.
7. **Sound insulation**: flooring should insulate the noise. It should not be such that noise is produced when users walk on it.
8. **Fire resistance**: Flooring material should offer sufficient fire resistance so that fire barriers are obtained between different levels of building.
9. **Smoothness**: the flooring material should be smooth, and should have even surface. However it should not be slippery.
10. **Hardness**: It should be sufficiently hard so as to have resistance to indentation marks, in prints etc.
11. **Maintenance**: the flooring material should require least maintenance. However, whenever repairs are required, it should be such that repairs can be done easily with least expenditure.

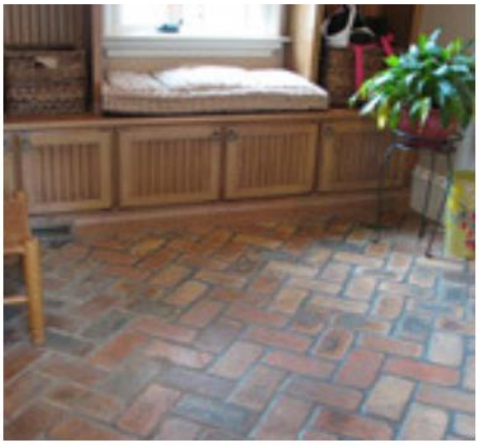
5. FLOOR FINISHES (CONT...)

5.1 BRICK FLOORING

- Is used in cheap constructions, especially where good bricks are available.
- Is specially suited for warehouses, stores, pedestrian walk ways, etc.
- Good quality bricks of various shapes and colors can be used.
- **Base course:**
  - Sub grade is compacted properly and a 7.5 cm thick layer of sand is spread.
  - 10-15cm thick layer of lean concrete is laid over the prepared sub grade.
  - Slopes shall be properly provided
- **Construction:**
  - Bricks shall be socked and wetted
  - The joints are rendered flushed and finished
  - The brick flooring shall be cured for 3-7 days to improve the durability

5. FLOOR FINISHES (CONT...)

5.1 BRICK FLOORING (CONT...)





5. FLOOR FINISHES (CONT...)

5.2 FLAG STONE FLOORING

- Dressed stone having rectangular or square sizes or any shapes are used for making floors.
- Stone flooring can be used for garages, entrance corridors, pedestrian walkways, etc.
- **Base course:**
  - properly compacted ground or concrete base
- **Construction:**
  - Joints are pointed and cured
  - Provision of slope is necessary
- **Advantages:**
  - Hard, durable and resistant to wear and tear
  - Easy in construction and maintenance
- Not suitable in places like residential building or important public building.

5. FLOOR FINISHES (CONT...)

5.2 FLAG STONE FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

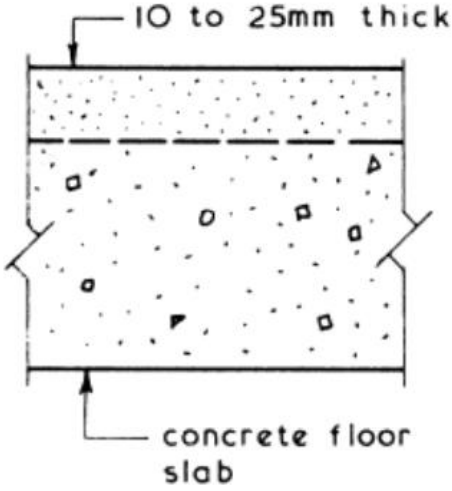
5.3 CEMENT CONCRETE FLOORING

- Suitable for residential, commercial and even industrial buildings, laboratories, garage and ware houses.
- **Properties:**
  - Moderately cheap, durable and easy to construct
  - Moderately resistant to oil and weak acids
- **Components:**
  - Base concrete and toping (wearing) surface.
- **Construction:**
  - The components can be constructed monolithically or independently
  - Monolithically the topping is damaged during subsequent operation
    hair cracks are developed
    work progress is low
  - Independently: base surface is covered with slurry, mix 1:2:4
  - In both cases the floor should be cured properly (at least for 7 days).

5. FLOOR FINISHES (CONT...)

5.3 CEMENT CONCRETE FLOORING (CONT...)

Screed Types ~



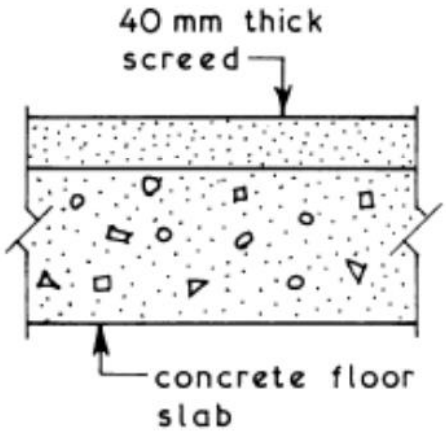
Monolithic Screeds –

screed laid directly on concrete floor slab within three hours of placing concrete – before any screed is placed all surface water should be removed – all screeding work should be carried out from scaffold board runways to avoid walking on the 'green' concrete slab.

5. FLOOR FINISHES (CONT...)

5.3 CEMENT CONCRETE FLOORING (CONT...)

Screed Types ~



Separate Screeds –

screed is laid onto the concrete floor slab after it has cured. The floor surface must be clean and rough enough to ensure an adequate bond unless the floor surface is prepared by applying a suitable bonding agent or by brushing with a cement/water grout of a thick cream like consistency just before laying the screed.

5. FLOOR FINISHES (CONT...)

5.3 CEMENT CONCRETE FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

5.4 GRANOLITHIC FLOORING

- Granolithic finish consists of rich concrete made with very hard and tough quality coarse aggregates such as granite, basalt, quartzite
- Suitable where hard resistant to wearing and durable floor is needed.
- **Mix proportion:**
  - 1:1:2 to 1:1:3 for heavy duty floors
  - 1:2:3 for public buildings
- **Thickness of finish:**
  - Minimum of 25mm when laid monolithically with the top concrete
  - Minimum of 35mm when laid over hardened surface.
- **Construction:**
  - Shall be laid before the base coarse has set
  - Surface is tamped and floated
  - Smoothened by steel trowel
  - Grinding and polishing is done after curing

5. FLOOR FINISHES (CONT...)

5.5 TILED FLOORING

- **Suitable:**
  - Residential houses, offices, schools and other public buildings
- **Properties:**
  - Made of cement, clay, concrete or terrazzo
  - Constructed in Square, hexagonal or other shapes and many colors.
- **Construction:**
  - Similar to laying stone or brick floor
  - Over a concrete base, a 25 to 30 mm thick layer of mortar is spread
  - Neat cement slurry is spread over the bedding mortar
  - Cement grouting of the joints
  - The flooring need to be cured for 7 days
  - Grinding and polishing

FLOOR FINISHES

TILED FLOORING

5. FLOOR FINISHES (CONT...)

5.6 WOODEN/TIMBER (PARQUET) FLOORING

- Timber is one of the oldest materials for floor finishing.
- **Suitable:**
  - Living and Dinning Rooms, Bed rooms, dance halls, auditoriums
- **Properties:**
  - Must have hard, Resistant to wear and durable surface
  - Selection shall be based on texture, color, defects and grain
  - Available in various shapes, sizes, texture and color
  - Shall be avoided in moist areas
- **Sub-base:** cement screed finished concrete base
- **Construction:**
  - Can be glued to concrete floors
  - Can be joined by nails
  - Protective coating like varnish, lacquer, wax shall be applied for long service periods

5. FLOOR FINISHES (CONT...)

5.6 WOODEN/TIMBER (PARQUET) FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

5.7 TERRAZZO FLOORING

- Terrazzo is concrete containing white and/or coloured cement and marble chips as an aggregate in proportion of 1:2 to 1:3.
- **Suitable:**
  - Residential, Offices and other public buildings
- **Properties:**
  - Marble Chips exposed by grinding, may vary from 3-6 mm
  - Decorative and high wearing resistance
  - Can be found in market as precast terrazzo in the form of tiles (20-30 cm, t = 2-3cm) even for Stair Treads and Risers or as cast in situ.
- **Sub-base:** concrete base
- **Construction:**
  - Shall be casted with the required mix proportion
  - Grinding in three levels and then cement grout to seal holes
  - Mirror - Polishing

5. FLOOR FINISHES (CONT...)

5.7 TERRAZZO FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

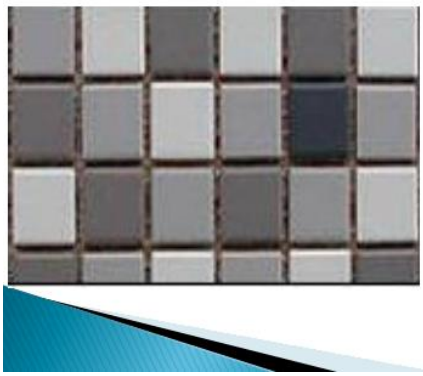
5.8 MOSAIC FLOORING

- Mosaic flooring is made of small pieces of broken tiles of china glazed or of cement, or of marble arranged in different pattern
- **Suitable:**
  - For Walls, Floors, Both internal and external, Stairs
- **Properties:**
  - Glazed or Unglazed
  - Impervious to water and have dense structure.
- **Types:**
  - **Porcelain** - made by dust press method from ceramic materials with vitreous body, resistant to freezing and thawing and abrasive wear.
  - **Natural Clay (Ceramic)** – made of natural clays or shale, which produce a strong longwearing structure with slightly textured surface.
- **Sub-base:** concrete base

5. FLOOR FINISHES (CONT...)

5.8 MOSAIC FLOORING (CONT...)

- **Construction:**
  - Concrete base made of mortar– mortar is spread & leveled to a depth of 5 to 8 cm.
  - 3mm thick suitable cementing material in the form of paste is spread
  - Mosaics are arranged in different pattern and hammered
  - Stone roller about 30 cm in dia. and 45-60 cm long is passed
  - White cement grout of creamy consistency is applied as a filler



5. FLOOR FINISHES (CONT...)

5.9 PLASTIC (PVC) FLOORING

- It is made of plastic material, called Poly-Vinyl-chloride (PVC).
- **Suitable:**
  - For residential (bedrooms) as well as non residential building
- **Properties:**
  - Fabricated in rolls or tiles with different colors
  - Resilient, smooth, good looking and cleanable
  - Easily damaged by heat or chemicals
- **Sub-base:**
  - concrete base (smoothly finished cement screed)
- **Construction:**
  - Adhesive shall be applied to the cement screed surface
  - Tiles are then pressed gently using lightweight rollers
  - Floor is washed with warm soap water

5. FLOOR FINISHES (CONT...)

5.9 PLASTIC (PVC) FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

5.10 MARBLE FLOORING

- Marble flooring is one of the most expensive floor finishes.
- **Suitable:**
  - Residential buildings (Stairs, Corridor, Kitchens), Public and Worship places
- **Properties:**
  - Made of sedimentary rocks
  - Different sources – Granite, Marble
  - Durable, Water proof but expensive
- **Sub-base:**
  - concrete base
- **Construction:**
  - Similar to tile and terrazzo flooring
  - Has to be cured and cleaned before use
  - Mirror - Polishing

5. FLOOR FINISHES (CONT...)

5.10 MARBLE FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

5.11 ASPHALT FLOORING

- Asphalt floorings are of many types and are used where wear resistance and durability are the main design factor.
- **Suitable:**
  - Mainly used in garages, stores, etc
- **Properties:**
  - Wear resistance and durable
  - Resilient, sound proof, non-absorbent and moisture proof
  - Used for basement floors, ground floors, floors exposed to external weather condition
- **Sub-base:**
  - concrete base
  - Wooden base (for asphaltic tiles only)

5. FLOOR FINISHES (CONT...)

5.11 ASPHALT FLOORING (CONT...)

- **Types:**
  - **Asphalt mastic**: Made of sand and asphalt mixed hot and laid in continuous sheets.
  - **Asphalt Titles** – made of asphalt and other ingredients such as asbestos fibers, by pressing the mix in different sizes, with thickness varying usually from 3 to 6 mm.
  - **Asphalt Mosaic** – similar to mastic but made with marble chips in the place of sand.
- **Construction:**
  - The mix is poured on the concrete base
  - Spread by means of trowel to get a level surface
  - A thin layer of sand is spread which is then rubbed with a trowel
  - Asphalt tiles are simply glued to the base surface

5. FLOOR FINISHES (CONT...)

5.11 ASPHALT FLOORING (CONT...)

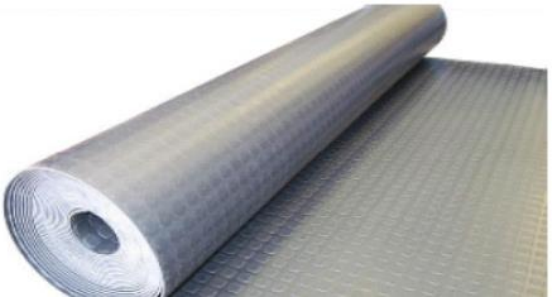
5. FLOOR FINISHES (CONT...)

5.12 RUBBER FLOORING

- It consists of sheets or tiles of rubber, in variety of patterns and colors.
- **Suitable:**
  - Offices or public building like hospitals, schools, gym etc.
- **Properties:**
  - It is manufactured by mixing pure rubber with fillers such as cotton fiber, granulated cork or asbestos fire.
  - Resilient and noise proof however they are costly
- **Sub-base:**
  - concrete base or wood
- **Construction:**
  - Fixed to the floor by means of appropriate adhesive or easily laid on the base surface

5. FLOOR FINISHES (CONT...)

5.12 RUBBER FLOORING (CONT...)



5. FLOOR FINISHES (CONT...)

5.13 CORK FLOORING

- Manufactured by baking cork granules with phenolic or other resin binders under pressure.
- **Suitable:**
  - Areas where quiet and comfort are of paramount importance such as libraries, theaters, art galleries, broadcasting stations, etc.
- **Properties:**
  - Perfectly noiseless
  - They are available in various sizes, thickness, and shades [size= 10x10cm to 30x90cm, Thickness= 5 to 15mm]
- **Sub-base:**
  - concrete base or wood
- **Construction:**
  - Fixed to concrete base by inserting a layer of saturated felt
  - By using fixing mechanism (suspended cork)

5. FLOOR FINISHES (CONT...)

5.13 CORK FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

5.14 GLASS FLOORING

- This is a special purpose flooring used in circumstances where it is desired to transmit light from upper floor to lower floor.
- **Suitable:**
  - Basement and upper floor where light has to be transmitted.
  - Very costly and not commonly used.
- **Properties:**
  - Structural glass, in the form of tiles or slabs (t = 12 to 30 mm)
- **Sub-base:**
  - Steel Frames
- **Construction:**
  - Suspended on closely placed frames
  - Care should be taken to avoid joint failures

5. FLOOR FINISHES (CONT...)

5.14 GLASS FLOORING (CONT...)

5. FLOOR FINISHES (CONT...)

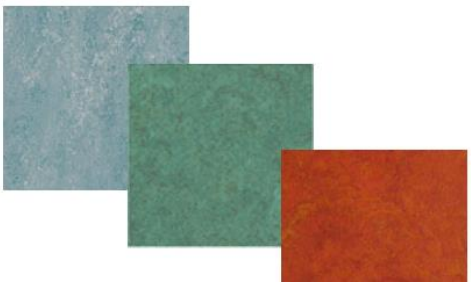
5.15 LINOLEUM FLOORING

- Linoleum sheets or tiles are manufactured by mixing oxidized linseed oil in gum, resins, pigments, wood flour, cork dust and other filler materials.
- **Suitable:**
  - Except for Bath rooms, kitchens, etc
- **Properties:**
  - Seasoned in ovens for 2-4 weeks (given several coats of lacquer for greater stain and spot resistance)
  - Attractive, resilient, durable, cheap and easily cleanable
  - Subjected to rotting when kept wet or moist for some time
- **Sub-base:**
  - Concrete or wood base
- **Construction:**
  - Linoleum sheets are easily spread or
  - Fixed or glued to base in various patterns

5. FLOOR FINISHES (CONT...)

5.15 LINOLEUM FLOORING (CONT...)

- The sheets are either plain or printed.
- Available in 2-6mm thickness and 2-4m wide roll.



5. FLOOR FINISHES (CONT...)

5.16 CARPET FLOORING

- A textile floor covering consisting of an upper layer of "pile" attached to a backing.
- **Suitable:**
  - Passage ways, Bed Rooms, Hall ways
- **Properties:**
  - The pile is generally either made from wool or a manmade fiber such as polypropylene, and usually consists of twisted tufts which are often heat-treated to maintain their structure.
- **Sub-base:**
  - Concrete or wood base
- **Construction:**
  - Carpets and carpet tiles can be laid loose, stuck with a suitable adhesive or in the case of carpets edge fixed using special grip strips.

5. FLOOR FINISHES (CONT...)

5.16 CARPET FLOORING (CONT...)