UNIT –II

CONSTRUCTION PRACTICES

Specification for construction

Specifications describe the materials and workmanship required for a development. They do not include cost, quantity or drawn information, and so need to be read alongside other information such as quantities, schedules and drawings.Specifications vary considerably depending on the stage to which the design has been developed, ranging from performance specifications (open specifications) that require further design work to be carried out, to prescriptive specifications (closed specifications) where the design is already complete.

Having a prescriptive specification when a contract is tendered gives the client more certainty about the end product, whereas a performance specification gives suppliers more scope to innovate, and adopt cost effective methods of work, potentially offering better value for money.Typically, performance specifications are written on projects that are straight-forward and are well-known building types, whereas prescriptive specifications are written for more complex buildings, or buildings where the client has requirements that might not be familiar to suppliers and where certainty regarding the exact nature of the completed development is more important to the client. An exception to this might be a repeat client such as a large retailer, where a specific, branded end result is required and so whilst the building type is well known, the specification is likely to be prescriptive.

Most projects will involve a combination of performance and prescriptive specifications. Items crucial to the design will be specified prescriptively (such as external cladding) whilst less critical items are specified only by performance (such as service lifts).

Key to deciding whether to specify a building component prescriptively or not, is considering who is most likely to achieve best value, the client, the designers or the contractor:

- Large clients may be able to procure certain products at competitive rates themselves (for example the government).
- Some designers may have particular experience of using a specific product (although some clients may not allow designers to specify particular products as they believe it restricts competition and innovation and may relieve the contractor of their liability for 'fitness for purpose').

The contractor may be best placed to specify products that affect buildability.

Specifications should be developed alongside the design, increasing in level of detail as the design progresses.They should not be left until the preparation of production information. By tender they should describe every aspect of the building in such a way that there is no uncertainty about what the contractor is pricing.

Aspects of the works are generally specified by:

- Products (by standard, a description of attributes, naming (perhaps allowing equivalent alternatives) or by nominating suppliers).

- ™ Workmanship (by compliance with manufacturers requirements, reference to a code of practice or standards, or by approval of samples or by testing).
- ™ It should be possible to verify standards of products and workmanship by testing, inspection, mock-ups and samples, and documentation such as manufacturers certificates.
- ™ Specifications should be structured according to work packages mirroring the separation of the works into sub-contracts. This makes it easier for the contractor to price and so may result in a more accurate tender. A standard classification system should be followed such as Uniclass.

The Building Sequence

It's fairly self-evident that to successfully build a home, you need to know not only the parts involved, but just as important, how they all go together . . . and in what order!

Here then is a description, in broad terms, of the actual construction sequence for a typical home.

An important disclaimer is in order here.

Many things including, among others, the area of the country where it is being built, the design of the home, the availability of subs and materials, and the preference of the contractor, i.e. you, determine the actual sequence of construction. Here's an example:

> Many builders prefer to delay pouring the driveway until the end of the project.
>
> This is to prevent damage by heavy equipment like the drywall delivery truck, and to conserve construction loan interest, since concrete is fairly expensive.
>
> There is a builder in Atlanta who likes to pour his driveway as soon as the foundation is in. When you go to his site, you are always able to stay out of the mud!

In addition, as you will discover in the pages on planning your construction schedule, frequently more than one construction activity can be going on at the same time!

With all that in mind, here is a general construction sequence with a brief explanation where terms may be unfamiliar. You will get greater detail on all of these as you link to their own page.

1. STAKE LOT 2. TEMPORARY UTILITIES 3. CLEAR AND ROUGH GRADE 4. WELL 5. EXCAVATE 6. FOOTINGS 7. FOUNDATION 8. WATERPROOF AND FOUNDATION DRAIN 9. SEWER AND WATER TAPS 10. BACKFILL 11. SLAB PLUMBING 12. SLAB OR BASEMENT FLOOR 13. FRAMING, WINDOWS, AND EXT DOORS 14. EXTERIOR SIDING AND TRIM 15. GARAGE DOOR AND EXTERIOR LOCKS 16. BACK-OUT FRAMING 17. FIREPLACE AND CHIMNEY 18. STAIRS 19. ROUGH HVAC 20. ROUGH PLUMBING 21. ROOFING 22. ROUGH ELECTRICAL 23. ELECTRIC & GAS METER SET 24. GUTTERS AND DOWNSPOUTS 25. EXTERIOR PAINT	26. INSULATION 27. TEMPORARY HEAT 28. DRYWALL 29. CABINETS 30. INTERIOR DOORS AND TRIM 31. PAINT AND WALLPAPER 32. WOOD FLOORS 33. COUNTER TOPS 34. VINYL AND CERAMIC TILE 35. SAND AND FINISH WOOD FLOORS 36. APPLIANCES & SPECIAL EQUIPM'T 37. FINISH ELECTRICAL 38. FINISH PLUMBING 39. FINISH HVAC & FINAL HEAT 40. SHOWER DOORS AND MIRRORS 41. CARPET 42. HARDWARE AND SCREENS 43. DRYWALL REPAIRS 44. CLEAN UP 45. FINAL PAINT 46. FINAL WOOD FLOOR FINISH 47. RETAINING WALLS 48. WALKS, DRIVES, AND PATIOS 49. SEPTIC TANK AND DRAIN FIELD 50. FINISH GRADING & LANDSCAPING

1. STAKE LOT

This will usually involve a surveyor who will come out and accurately drive stakes to locate your home on the lot. They will be used by the excavators and foundation subcontractors to guide their work.

2. TEMPORARY UTILITIES

You will need to have water, electric power, and toilet facilities available during the construction process.

Temporary Electric "Saw Service"

3. CLEAR AND ROUGH GRADE

Clearing is the removal of trees and undergrowth from the actual construction site and yard areas.

Rough grading is moving the dirt around to establish the approximate drainage patterns, yard areas, drive and walk levels, etc. that you hope to achieve.

Clearing the Lot

Excavation for a basement home. Notice the temporary ramp that has been constructed so that the dozer can get down in the hole.

4. WELL

If you are going to have a well, you might as well dig it up front so that you will have the water available for construction.

5. EXCAVATE

This is where a piece of earth-moving equipment digs the hole for your foundation, and, if you will have one, your basement.

6. FOOTINGS

This is the structure where the house interfaces with the earth that supports it. All of the weight of the home rests on the footings.

This sub is drilling a hole to pour a "caisson" - a special type of footing used in areas with highly active soils.

7. FOUNDATION

The foundation is the wall on which the first floor rests. It may be short - if you will have a crawl space, or tall - if you will have a basement.

8. WATERPROOFING AND FOUNDATION DRAIN

A waterproofing material or membrane (or both) is applied to the foundation walls which will be below grade to minimize water accumulating in the basement or in the crawl space. Foundation drains run along the footings and remove water accumulating in that area.

This is a water meter pit. One copper pipe is coming from the city supply line in the street. The other pipe will supply the new home with water. A meter to supply billing information to the city will connect the two.

9. SEWER AND WATER TAPS

If you are connecting to municipal water and sewer, this is where the pipes are laid to the house and actually connected (tapped into) the water and sewer mains.

10. BACKFILL

Pushing the excavated dirt into the hole next to the foundation wall around the house (inside and out). This is a good time to establish the necessary drainage away from the house at the foundation wall.

This plumbing will be beneath and poking through a floor slab.

11. SLAB PLUMBING

Any plumbing that needs to go into the basement floor is installed here.

12. SLAB OR BASEMENT FLOOR

The “slab” is the concrete basement floor. It is poured at this point. In some parts of the country, plans may call for a “structural wood floor” (more on this later). Now is when it would be installed.

13. FRAMING, WINDOWS, AND EXTERIOR DOORS

This is where it starts to look like a house! The floors, walls, ceiling, and roof are the focus of this construction activity. The framer usually installs the windows and exterior doors.

Applying a brick veneer to wood frame construction.

14. EXTERIOR SIDING AND TRIM

Whatever you‟re using - brick veneer, siding, stucco, etc.- here is where it gets done.

15. GARAGE DOOR AND EXTERIOR LOCKS

Some people wait until the end to get the garage door in. But we think having it in place creates a good place to store materials and equipment during construction. Installing the exterior locks means that the wholehouse is secure.

16. BACK-OUT FRAMING

This is a general category that includes partition walls that have not been installed, pillars, soffits for wall cabinets, and drywall nailers.

17. FIREPLACE AND CHIMNEY

A prefabricated fireplace should be installed before the roughs (below). A prefab will have a framed chimney. A masonry fireplace and chimney can be installed before the brick veneer (see “Exterior Siding and Trim” above).

This is an insulated duct board that can be cut with a knife, which makes installation easier.

18. STAIRS

Get these in now so that the subs working inside can get from one floor to the other without depending on ladders.

19. ROUGH HVAC

The HVAC (heating, ventilation, air conditioning) sub is the first of the three "mechanical" subs (plumbing, electrical, HVAC) to come to the job. He will install the duct work for your HVAC system and possibly the furnace. He comes first because the stuff he puts into the walls is the biggest and most inflexible.

20. ROUGH PLUMBING

Next comes the plumber to install his pipes.

21. ROOFING

With plumbing and HVAC vent pipes through the roof, the roofer can install the roofing.


The Electrician.

22. ROUGH ELECTRICAL

Codes call for the house to be "dried in" before the wiring is installed. With the exterior windows and doors in place and the roof on, it‟s time. For roughs, the electrician will put in the boxes (switch, outlet, and lighting) and will pull the wires into them. Cable, telephone, speakerwires, etc. are also installed at this point.

23. ELECTRIC & GAS METER SET You‟ll need these in place to get some heat in the house for the drywall installation.

24. GUTTERS AND DOWNSPOUTS

It‟s good to get the water away from the house as soon as possible.

25. EXTERIOR PAINT

Many surfaces on the outside need to be protected from the elements. So you‟ll want to paint as soon as is practical.

Insulated Basement.

26. INSULATION

Once everything else is in the walls and rough inspections are completed, it‟s time to insulated your home.

27. TEMPORARY HEAT

With the meters set (above), the HVAC sub can get some temporary heat in the house. This will be critical for getting the drywall joint compound (mud) to dry in a timely fashion. The carpet sub also needs a warm home so that the carpet is installed at a temperature comparable to normal living conditions.

28. DRYWALL

Sometimes called “Sheetrock®.” This will be “hung” (nailed or screwed to the wall studs and ceiling joists), taped (at the joints), and “mudded” (joint compound applied) . . . after the in-wall plumbing, HVAC, electricals, and insulation have been inspected!

29. CABINETS

Base and wall.

30. INTERIOR DOORS AND TRIM

The trim materials installed here may include the door casing, base mould, window stool and apron, window casing, chair rail, crown mould, built-in cabinets, stair railing parts, and others.

31. PAINT AND WALLPAPER

The first coat of paint is usually sprayed. Get it in before the hard wood floors are installed.

32. HARDWOOD FLOORS

Now it‟s time to install your hardwood floors.

33. COUNTER TOPS

Counter tops are next. this may involve a different sub than the one who installed the cabinets.

34. VINYL AND CERAMIC TILE
Vinyl floor coverings and ceramic tile are installed. Two different subs. Probably should have made these two different steps, but I was trying to make it come out to an even 50!

35. SAND AND FINISH WOOD FLOORS
This is the first of two finishes. The last is done just before you move in.

36. APPLIANCES AND SPECIAL EQUIPMENT
This would include all of your major appliances - washer, dryer, range, oven, refrigerator, as well as any other special equipment you have specified.

37. FINISH ELECTRICAL
Here is where the electrician comes back to install the switches, outlets, light fixtures, ceiling fans, door bells, etc. He will also hook up the appliances, furnace, air conditioner, doorbell, and so forth.

38. FINISH PLUMBING
The plumber will install the sinks, lavatories, toilets, and all the faucets.

39. FINISH HVAC & FINAL HEAT
Your heating sub will install the registers and get the furnace and air conditioning running properly.

40. SHOWER DOORS AND MIRRORS
Install shower doors. Hang mirrors.

41. CARPET
Now it‟s starting to feel like home!

42. HARDWARE AND SCREENS
Typically, this is door, window, and closet hardware. Window screens.

43. DRYWALL REPAIRS
You may need to get the drywall subcontractor back out to patch some dings caused by the other subs‟ work. This is normal.

44. CLEAN UP
This is the final interior clean up.

45. FINAL PAINT
Touching up drywall repairs and so forth.

46. FINAL WOOD FLOOR FINISH
This should be your last inside job before moving in.

47. RETAINING WALLS
These outside jobs can be going on while the work proceeds inside. You should not have these going on while the outside is being painted.


Retaining wall, steps, and walk.

48. WALKS, DRIVES, AND PATIOS You should wait until the drywall has been delivered to the home, because the drywall truck is VERY heavy, and could damage your flat work

49. SEPTIC TANK AND DRAIN FIELD Same as above on the timing with regard to the drywall delivery. The tank holds the waste and allows microbic action on the solids. The drain field is where the effluent leaches into the soil.

50. FINISH GRADING AND LANDSCAPING The final finished grades are established to ensure proper drainage away from the home, and to prepare the yard for landscaping. Trees, shrubs, grass, etc. are installed.

CONSTRUCTION CO ORDINATION:

Coordination can be seen as a process of managing resources in an organized manner so that a higher degree of operational efficiency can be achieved for a given project.

Two coordination methods have been identified as appropriate to be used in the design process, namely, direct contact and meetings.

Direct contact

Direct contact has been identified as the simplest form, and one that involves minimal cost among the methods of coordination .Two types of direct contacts are used in projects: direct formal contact and direct informal contact. Each method encompasses different approaches in gathering useful information. A combination of these methods could send reasonably accurate messages quickly in all directions, and could be able to deal with all the major uncertainties that arise within the project organisation. Because of the iterative nature of the design process, the number of participants and the fragmentation of building systems, the increased use of direct contact is critically required.

Direct formal contact

Direct formal contact refers to the documented information that could be obtained by letters, memos and reports. This approach is more formal, and is widely used as a means of communication among the different organisations that are involved in a project. Direct formal contact has been identified as one of the means used by designers for obtaining design information.

In managing a risky project, proper documents are always needed to protect the participants involved. Formal documents could be used for litigation or as evidence in any contract dispute, such as variation claims in projects. Therefore, it is important to use direct formal contact in handling uncertainty in the refurbishment design, such as in design changes.

Direct informal contact

Any information obtained using informal conversations such as telephone calls or discussions is categorised under direct informal contact (Bennett, 1991). As the design process has a large number of participants and a high degree of interdependence of building design, the demand for informal contact is increased (Pietroforte, 1997). The uncertain nature of refurbishment projects requires an approach that is more flexible.

One of the advantages of using direct informal contact is that information can be gathered quickly without the need for any formal procedure. Informal contact provides clearer information in a short time, and hence is useful in confirming certain issues pertaining to the design process. The refurbishment design process involves a large amount of information flow. Therefore, direct informal contact could resolve the problem of inefficiency in flow of design information, especially when design changes occur during the construction stage.

Meeting

The purpose of meetings is to keep key participants informed, and to handle shared problems arising in the projects (Laufer *et al*, 1992). Meetings are one way to increase the amount of information in construction projects, as a meeting mostly covers the current issues of the design. All the feedback and comments from the design team's participants could be discussed instantly in the meeting. The design process normally involves participants from different organisations, who form a group known as a design team. Meetings are seen as a medium to increase interaction among the design team members. There are two types of meetings in construction projects: scheduled and unscheduled meetings (Conhenca-Zall *et al*, 1994). Both types are important in achieving better integration in the management of the refurbishment design process.

Scheduled meeting

Scheduled meetings for the design process are conducted at intervals of one a week to report on the progress of the design work and to discuss any issues that arise. The scheduled meeting for design diminishes slowly once the construction stage starts. A scheduled meeting can transform into an unscheduled meeting if any problems crop up during the construction stage. The functions of a scheduled meeting are to coordinate and to act as a means of conveying information about current progress of work and recent design changes (Perry and Sanderson, 1998). In a construction project, the scheduled meeting is an appropriate venue and suitable time for the project participants to discuss any issues related to the project. Problems in design could be discussed and finalised during the meeting, which could lead to a reduction in design errors during the construction stage.

Unscheduled meetings in the design process

An unscheduled meeting would be held if there was any urgent need to solve current issues related to design. This type of meeting normally takes over from a scheduled meeting in the design process when work has started onsite or between the intervals of scheduled meetings. Problems arising onsite, such as discrepancies in drawings that need to be solved urgently, are typical situations when an unscheduled meeting would be called. However, the need to attend unscheduled meetings requires the participants in refurbishment projects to be flexible and responsive (Rahmat, 1997). They may need to forgo their routine activities in order to attend unscheduled meetings for refurbishment projects. The allocation of time and overhead cost for refurbishment design works tends to increase if there are many unscheduled meetings during the construction stage. The need for unscheduled meetings increases during the construction stage, as many unknown items start to be discovered. The unscheduled meeting is probably suitable to cater to the uncertainty of design information in refurbishment projects. The unscheduled meeting would be least important if there were no urgent decisions to be confirmed. Minor design problems that arise could be discussed at the next scheduled meeting of the project.

Site clearance

Site clearance involves the removal of walls, hedges, ditches, and trees, other vegetation and services from the site. It can also involve the clearance of fly-tipped materials.

Carbon reduction and business efficiency

- Buying sustainable goods & services

Emergency response

- Environmental Damage
- Spills at construction sites

Land: Construction

- Archaeology at construction sites
- Nature conservation and affecting public rights of way in construction
- Site investigation and sampling to assess contamination
- Soils and soil stripping at construction sites

Land: General

- Contaminated Land
- Japanese knotweed, giant hogweed and other invasive weeds

Materials and equipment: Construction

- Generators at construction sites
- Plant maintenance at construction sites
- Road sweepers at construction sites

Materials and equipment: Hazardous

- Chemical storage
- Fuelling and fuel storage
- Oil storage

Nuisances

- Dust from construction sites
- Noise from construction sites
- Noise, odour and all nuisances

Permits and licences

- Permits and licences - an overview

Trade associations and BSOs

- Construction trade associations

Transport

- Vehicle movements and deliveries at construction sites

Useful links

- Construction resources

Waste: Storage handling and transport

- Duty of care – your waste responsibilities
- Site waste management plans
- Waste storage and transport

Waste: Waste materials

- Asbestos
- Fly-tipped material
- Hazardous/special waste
- Tyres
- Waste oil

Waste: Waste treatment

- Burning construction and demolition wastes
- Chipping wood and other plant material
- Crushing bricks, tiles, concrete and other materials
- Recycling construction materials

Water

- Bunds at construction sites
- Controlling surface water run-off
- Dewatering during construction
- Discharges to water and sewer
- Settlement tanks
- Trade effluent – discharges to sewers
- Water use and abstraction
- Wheel washing at construction sites
- Working close to rivers - const

What is setting out?

A definition of setting out, often used, is that it is the reverse of surveying. Whereas surveying is a process for forming maps and plans of a particular site or area, setting out begins with plans and ends with the various elements of a particular plan correctly positioned on site.

However most techniques and equipment used in surveying are also used in setting out i.e. while surveying may be the opposite of setting out, the processes and instruments are almost identical.

The International Organisation for Standardisation (ISO) define setting out as:

Setting out is the establishment of the marks and lines to define the position and level of the elements for the construction work so that works may proceed with reference to them. This process may be contrasted with the purpose of surveying which is to determine by measurement the position of existing features. Setting out is one application of surveying

-Most of the techniques and equipment used in surveying are also used in setting out

-Mistakes in setting out can be costly -For setting out to be undertaken successfully good work practices should be employed

-There are three parties involved in the construction procedures: the employer, the engineer and the contractor -Although the engineer checks the work, the setting out is the responsibility of the contractor

-The cost of correcting any errors in the setting out has to be paid for by the Contractor, provided the engineer has supplies reliable information in writing

Earthworks are engineering works created through the moving or processing of parts of the earth's surface involving quantities of soil or unformed rock. The earth may be moved to another location and formed into a desired shape for a purpose. Much of earthworks involves machine excavation and fill or backfill

Types of excavation

Excavation may be classified by type of material:

- Topsoil excavation
- Earth excavation
- Rock excavation
- Muck excavation - this usually contains excess water and unsuitable soil
- Unclassified excavation - this is any combination of material types

Excavation may be classified by the purpose:

- Stripping
- Roadway excavation
- Drainage or structure excavation
- Bridge excavation
- Channel excavation
- Footing excavation
- Borrow excavation
- Dredge excavation
- Underground Excavation

Masonry:

It is the building of structures from individual units laid in and bound together by mortar; the term *masonry* can also refer to the units themselves. The common materials of masonry construction are brick, stone, marble, granite, travertine, limestone, cast stone, concrete block, glass block, stucco, tile, and cob. Masonry is generally a highly durable form of construction. However, the materials used, the quality of the mortar and workmanship, and the pattern in which the units are assembled can significantly affect the durability of the overall masonry construction. A person who constructs masonry is called a **mason** or **bricklayer**.

Applications

Masonry is commonly used for the walls of buildings, retaining walls and buildings. Brick and concrete block are the most common types of masonry in use in industrialized nations and may be either weight-bearing or a veneer. Concrete blocks, especially those with hollow cores, offer various possibilities in masonry construction. They generally provide great compressive strength, and are best suited to structures with light transverse loading when the cores remain unfilled. Filling some or all of the cores with concrete or concrete with steel reinforcement (typically rebar) offers much greater tensile and lateral strength to structures.

Advantages

™ The use of material such as bricks and stones can increase the thermal mass of a building and can protect the building from fire.
™ Most types of masonry typically will not require painting and so can provide a structure with reduced life-cycle costs.
™ Masonry is non-combustible product.
™ Masonry walls are more resistant to projectiles, such as debris from hurricanes or tornadoes.
™ Masonry structures built in compression preferably with lime mortar can have a useful life of more than 500 years as compared to 30 to 100 for structures of steel or reinforced concrete.[*citation needed*]

Disadvantages

™ Extreme weather, under certain circumstances, can cause degradation of masonry wall surfaces due to frost damage.
™ Masonry tends to be heavy and must be built upon a strong foundation, such as reinforced concrete, to avoid settling and cracking.
™ Other than concrete, masonry construction does not lend itself well to mechanization, and requires more skilled labor than stick-framing.
™ Masonry consists of loose components and has a low tolerance to oscillation as compared to other materials such as reinforced concrete, plastics, wood, or metals.

Stone Masonry and brick stone masonry

Definition:

The art of building a structure in stone with any suitable masonry is called stone masonry.

Types of Stone Masonry:

Stone masonry may be broadly classified into the following two types:

1. Rubble Masonry
2. Ashlar Masonry

1. Rubble Masonry:

The stone masonry in which either undressed or roughly dressed stone are laid in a suitable mortar is called rubble masonry. In this masonry the joints are not of uniform thickness. Rubble masonry is further sub-divided into the following three types:

1. **Random rubble masonry**
2. **Squared rubble masonry**
3. **Dry rubble masonry**

1. **Random rubble masonry:** The rubble masonry in which either undressed or hammer dressed stones are used is called random rubble masonry. Further random rubble masonry is also divided into the following three types:
    a. **Un coursed random rubble masonry:** The random rubble masonry in which stones are laid without forming courses is known as un coursed random rubble masonry. This is the roughest and cheapest type of masonry and is of varying appearance. The stones used in this masonry are of different sizes and shapes. before lying, all projecting corners of stones are slightly knocked off. Vertical joints are not plumbed, joints are filled and flushed. Large stones are used at corners and at jambs to increase their strength. Once "through stone" is used for every square meter of the face area for joining faces and backing. **Suitability:** Used for construction of walls of low height in case of ordinary buildings.

    b. **Coursed random rubble masonry:** The random rubble masonry in which stones are laid in layers of equal height is called random rubble masonry. In this masonry, the stones are laid in somewhat level courses. Headers of one coursed height are placed at certain intervals. The stones are hammer dressed. **Suitability:** Used for construction of residential buildings, go downs, boundary walls etc.

        1. Squared rubble masonry: The rubble masonry in which the face stones are squared on all joints and beds by hammer dressing or chisel dressing before their actual laying, is called squared rubble masonry.
        2. There are two types of squared rubble masonry.
        3. Coursed Square rubble masonry: The square rubble masonry in which chisel dressed stones laid in courses is called coarse square rubble masonry. This is a superior variety of rubble masonry. It consists of stones, which are squared on all joints and laid in courses. The stones are to be laid in courses of equal layers. and the joints should also be uniform.

4. Suitability: Used for construction of public buildings, hospitals, schools, markets, modern residential buildings etc and in hilly areas where good quality of stone is easily available.

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In brick masonry, there are many techniques to stack bricks. These different arrangements are known as bricks bonds. Each bond has its own characteristics. Following are the commonly used bricks bonds.

1. Stretcher Bond
2. English Bond
3. Flemish Bond
4. Common/American/English Garden Wall Bond
5. Flemish Garden Wall Bond
6. Herringbone Bond
7. and there are many other brick bonds which a designer can design for custom requirements

1. Stretcher Bond

™ Easiest bond to lay & it minimizes the amount of cutting required.
™ Originally used for single brick walls.
™ It is used for cavity walls as less cutting is required.
™ Walls are half brick wide.
™ No two adjacent vertical joints should be in line.

2. English Bond

™ Alternative courses of headers and stretchers.
™ One header placed centrally above each stretcher.
™ This is a very strong bond when the wall is 1 brick thick (or more thicker).
™ One of the strongest brickwork patterns.

3. Flemish Bond

- Alternate bricks are placed as header and stretcher in every course.
- Each header is placed centrally between the stretcher immediately above and below. This is not as strong as the English bond at 1 brick thick .
- It can be successfully applied in cavity wall.

4. Common/American/English Garden Wall Bond

- A pattern made like Stretcher bond but with a row of headers replacing every nth course (n is usually odd).

5. Flemish Garden Wall Bond

- In this variant of Flemish bond, one header is placed at every third stretcher.

6. Herringbone Bond

- It is a purely decorative bond. It is used in floor and wall panels

Concrete Masonry Blocks

Concrete masonry blocks have been in existence for centuries. Revolutionary changes in manufacturing technology and material sciences have made multi sized, shaped, colours and textured blocks a reality. They are used as both structural and non-structural components and have been the preferred building blocks in the western world. They are fast replacing traditional bricks and other masonry products in India too.

Concrete Masonry Blocks can either be

- Hollow or Solid
- Load Bearing or Non-load Bearing
- Light weight or Dense

Shieeld concrete blocks are used in low and high rise buildings, for basements, exterior and interior walls and partitions.

Applications

- Shopping Malls, Multiplexes
- Multifunctional Complexes such as IT Parks
- Institutional Building
- Independent Residences
- Farmhouses, Villas
- Residential Complexes
- Hotels, Resorts

- Schools, Colleges
- Hospitals
- Ports, Airports, Mass Transport Stations
- Factory Buildings
- Warehouses
- Sports Stadiums

SHIEELD - CONCRETE PRE – ENGINEERED HOLLOW BLOCKS

BOTTOM OPEN TYPE
SIZE IN MM
390 x 190 x 190
400 x 100x 200

BOTTOM CLOSE TYPE
SIZE IN MM
390 x 190 x 190
390 x 125 x 190
390 x 90 x 190

ISOLATION BLOCKS
SIZE IN MM
400 x 200 x 200

SHIEELD - CONCRETE PRE – ENGINEERED SOLID BLOCKS

SIZE IN MM
390 x 190 x 190
390 x 140 x 190
390 x 90 x 190
400 x 200 x 200
230 x 74 x 109

LINTEL BLOCK (U CHANNEL)

SIZE IN MM
390 X 190 X 190

Shieeld Concrete Blocks advantage

Precision

- Excellent Dimensional Tolerance Modular
- Range of Architectural Forms
- Excellent Finish
- Even Textures

Protection

- High Compressive Strength High Flexural Strength
- High Lateral Modulus of Rupture HighBond Strength
- Earthquake Resistant

Economy

- Ease and Speed of Construction
- Low Onsite Wastage
- Low Labour Cost
- Consumes Less Cement
- Low/ No Plastering Cost
- Low/ No Painting Cost

- ™ Variety of Structural Forms
- ™ Control on Bonding Dimensions and Quality
- ™ High Precision Moulds from Rampf Germany

Durable

- ™ Excellent Fire Rating Good Thermal Insulation
- ™ Good Acoustic Insulation High Weathering Resistance
- ™ Low Water Absorption Low Permeability
- ™ Low Coefficientof Expansion Low Coefficient of Contraction
- ™ Negligible Efflorescence High Abrasion Resistance
- ™ Resistant to Salt Attack
- ™ Low Maintenance Cost
- ™ Minimal Steel Reinforcement in case of Load Bearing Structure
- ™ Additional Floor Space

Concrete Flooring & floor finishes

Concrete floor finishes are typically only used in basements and garages. The floor should slope down to a floor drain in basements and other areas where water may accumulate.

In modern construction, a four to six inch gravel base below the 3-inch thick floor slab allows water below the slab to drain away. Moisture barriers (plastic sheets) may also be provided under the slab, and in energy efficient construction or slab-on-grade construction, rigid insulation may be used below the floor. In older construction, concrete floor slabs were as thin as 1/2 inch. These are prone to impact damage, heaving and break-up.

This is a cosmetic issue and may be a trip hazard. Most concrete floors are not part of the structure. Basement floors are typically installed after the home is completed, and their main function is to keep our feet out of the mud.

Concrete basement floors can be overlaid with finished flooring. Since almost every house with a basement has water on the basement floor at some point, water-resistant floors make sense. In slab-on-grade construction, the concrete floors provide a substrate for floor finishes. - Citation: Carson Dunlop Associates, *Home Reference Book* , quoted with permission.

Concrete Floor details are in these articles

- ™ FLOOR, CERAMIC TILE
- ™ FLOOR, CONCRETE SLAB CHOICES
- ™ FLOOR DAMAGE DIAGNOSIS
- ™ FLOOR, ENGINEERED WOOD, LAMINATES INSTALL
- ™ FLOOR FRAMING & SUBFLOOR for TILE
- ™ FLOOR, KITCHEN & BATH OPTIONS

- FLOOR, LAMINATE PLASTIC
- FLOOR, CONCRETE POURED FINISH

Cork Flooring - Details about cork flooring are at these articles

- CORK FLOORING & FLOOR TILES
- FLOORING COMPANIES

FLOOR TILE HISTORY & INGREDIENTS - history, dates, and description of the production process and ingredients in asphalt floor tiles, asphalt-asbestos floor tiles, & vinyl-asbestos floor tiles 1900 to present.

- FLOORING MATERIALS, Age, Types - Age of Building Flooring Materials - A Guide to Estimating Building Age, This article describes types and ingredients in flooring materials: Asphalt floor tile, Cork floor tile or planks, Laminate flooring (modern), Linoleum & older sheet flooring (painted canvas), Vinyl-asbestos floor tiles, Wood flooring.

FLOOR TYPES & DEFECTS - Asphalt floor tiles, asphalt-saturated asbestos felt, carpeting, cork floor tiles & planks, laminate flooring (modern), linoleum (sheet flooring) & earlier painted fabric floor coverings, vinyl-asbestos tile floors, wood flooring.

- Resilient Floor List
  - Asphalt Tile
  - Cork Flooring Tiles
  - LINOLEUM & Other Sheet Flooring
  - Sheet Flooring Materials
  - Vinyl Asbestos Tiles
- Non-Resilient Floor Coverings
  - Carpeting
  - Laminate Flooring Products
  - Tile Floors
  - Wood Flooring
- Properties of Flooring Types, Table of

Hardwood Flooring, the Basics

Hardwood floors are traditionally oak, although other woods such as cherry, walnut, birch, beech, mahogany, elm and maple, are also used. Bamboo is not technically wood, but is also used as flooring. Hardwood flooring may be in the form of strips or parquet, which often consist of six inch squares with each square made up of six one-inch strips. The squares are laid with the grain in adjoining squares at right angles, giving a checkerboard effect. Parquet flooring may be nailed or glued down. There are several different types and installation techniques. Parquet flooring can also be made up of a combination of rectangles, triangles and lozenges and can be very decorative and very expensive.

Strip flooring is typically tongue and groove, secured with nails driven diagonally through the tongues into the subfloor. Hardwood flooring in modern construction is typically 3/8 inch to 3/4 inch thick and may be pre-finished or finished on site. Hardwood flooring is a high quality and durable floor system. It can be mechanically damaged, attacked by termites, rot and fire, or damaged by water.

Wood flooring is not ideally suited to kitchen and bathroom areas, since it is susceptible to water damage. Nonetheless, hardwood flooring is regularly found in kitchens. Individual boards can be replaced, but matching can be tricky. Worn 3/8 inch thick hardwood flooring can be sanded once to provide a new wood surface. 3/4 inch hardwood flooring can be sanded several times before the tongues are exposed. Wood flooring can be covered with carpeting or other flooring materials. -Citation: Carson Dunlop Associates, *Home Reference Book* , quoted with permission.

Kitchen & Bath Floor Options - Table comparing properties of different flooring materials See FLOOR, KITCHEN & BATH OPTIONS

Laminate Flooring, (Plastic Laminate Floors and Engineered Wood floors)

In recent years, laminate flooring has become very popular, especially among do-it-yourselfers. Laminate floor planks (or tiles) have several layers. The top layer is generally a clear laminate that is bonded to a decorative layer below, often creating the look of a wood floor. These layers are bonded to a wood- or fiber-based core. The bottom layer may be a paper or melamine backing. The product is similar to resilient countertops. A complete floor is created by either snapping planks together with specially-designed fasteners along the edges, or by gluing planks together along traditional tongue and groove edges.

Laminate flooring is not secured to the subfloor beneath it. Instead, it is installed as a floating floor, allowing it to expand and contract. A sheet of cushioning foam is installed between the laminate flooring and the subfloor. There may also be a sheet of plastic below the foam to act as a moisture barrier and to allow the floor to slide as it expands. A gap is required between the flooring and the walls to allow for expansion. This gap is covered by trim. Laminate flooring cannot be sanded, stained, or otherwise refinished, although damaged planks can be replaced.

Laminate flooring is resistant to small amounts of water, such as quickly wiped-up spills, but precautions should be taken in kitchens or bathrooms including applying a sealant around the perimeter. This is not visible during a home inspection. Laminate flooring should not be installed in damp basement areas. - Citation: Carson Dunlop Associates, *Home Reference Book* , quoted with permission.

See these detailed articles on laminate floor materials:

- LAMINATE PLASTIC FLOORING
- LAMINATE WOOD & Other Laminate Floors
- WOOD FLOORING & Engineered Wood Floors

Linoleum Flooring articles

- LINOLEUM & Other Sheet Flooring shown at left, Congoleum sheet flooring
- also see Congoleum Flooring History

Mold on or hidden in flooring

- FLOOR & SUBFLOOR MOLD, HIDDEN

Non-Resilient Floor Coverings - article list

- Non-Resilient Floor Coverings
- Laminate Flooring Products
- Wood Flooring
- Tile Floors
- Carpeting
- Properties of Flooring Types, Table of

- **Peel and Stick** / Self-Adhesive Floor Tiles - types of self-adhesive floor tiles and peel and stick tiles intended for consumer installation

Resilient Flooring - see details at FLOOR, RESILIENT VINYL or CORK

Resilient floor coverings include vinyl-asbestos, solid vinyl, vinyl faced, rubber, cork, asphalt and linoleum. It is installed in sheets or tiles. More expensive products include a cushioned backing material and a no-wax surface. In modern construction, these materials are typically applied over a 1/4 inch plywood underlayment. These thin, flexible materials will show through any irregularities in the floor surface. - Citation: Carson Dunlop Associates, *Home Reference Book*

Also see:

- Asphalt Tile
- Cork Flooring Tiles
- LINOLEUM & Other Sheet Flooring
- Vinyl Asbestos Tiles
- Resilient Floor List
- Sheet Flooring Materials

Sheet Flooring see sheet linoleum & vinyl flooring

- FLOOR TILE ASBESTOS IDENTIFICATION
- FLOOR TILE HISTORY & INGREDIENTS
- Sheet Flooring Materials

Stone Floors - Slate, Granite, Limestone, Marble

These are natural materials cut into flooring tiles. Terrazzo is made of marble chips set in concrete, usually laid in squares defined by lead beading. The surface is polished to give a smooth floor. Terrazzo is more common in commercial buildings, hospitals and schools than in homes.

Stone and terrazzo are good flooring materials because of their strength, appearance and durability. Installation considerations are similar to ceramic and quarry tile, in that the weight of the material itself may deflect conventional flooring systems. Joints on stone floors are grouted. - Citation: Carson Dunlop Associates, *Home Reference Book*

Tile Flooring - ceramic

Generally considered high quality, ceramic or quarry tiles are hard, fired-clay products that may be glazed or unglazed. These materials stand up well to heat, water and normal wear and tear, and have good resistance to stains and cuts. These brittle floor systems will crack if not well supported.

A conventional wood flooring system often has too much flex to support ceramic or quarry tile. Better installations include a concrete base for the tile, typically one to five inches thick. Tiles may be pressed into the concrete while it is setting. Joints are then grouted. Tiles are typically 1/16-inch to 1-inch thick and are commonly from one inch by one inch to 24 inches by 24 inches. Many shapes, colors, patterns and finishes are available.

In modern construction, a thin mortar base or adhesive is used over a thick subfloor. If well installed, this can be satisfactory. Again, joints have to be appropriately grouted. It is common for ceramic or quarry tile floors to be cracked where floor joists deflect, or in heavy traffic patterns. Tiles can be damaged by dropping tools, pots, pans or other heavy objects.

Traditionally, ceramic tile floors were used in bathrooms and vestibules, because of their natural resistance to moisture. Ceramic or quarry tile floors are used in kitchens, for the same reason, although they are unforgiving if one drops glass on them, and they are also more tiring to stand on because of their hard surface. Wet floors can be slippery. - Citation: Carson Dunlop Associates, *Home Reference Book*

See details about ceramic tiles at

- FLOOR, CERAMIC TILE
- CERAMIC TILE, ASBESTOS in?

Also see tile flooring discussed at FLOOR RADIANT HEAT Mistakes to Avoid

Tile Flooring - resilient, vinyl, vinyl-asbestos

- FLOOR TILE HISTORY & INGREDIENTS
- **Vinyl Asbestos Flooring Information: Tiles & Sheet Flooring**
  - Vinyl Asbestos Floor Tile Age
  - Vinyl-Asbestos Floor Tile History
  - Vinyl Asbestos Floor Tile Packaging
  - Vinyl Asbestos Floor Thickness & Dimensions
  - Vinyl Asbestos Sheet Flooring

Wood Flooring & Engineered Wood Floors

- **Engineered wood flooring** is similar to laminate flooring, except the thin top layer is actually hardwood that is bonded to a base that may be hardwood, plywood, or high-density fiberboard. The hardwood layer is usually pre-finished. The floor may be sanded and refinished, depending on the thickness of the hardwood layer. Engineered wood flooring may be installed as a floating floor, or it may be glued, stapled, or nailed in place. - Citation: Carson Dunlop Associates, *Home Reference Book* , quoted with permission.
- **Softwood Wood Flooring**: Pine is the most common softwood flooring. Fir and cedar are also used. Pine floors were typically used as a subfloor or as finish flooring in a 1x4 tongue-and-groove configuration. When used as a subfloor below hardwood, the softwood was typically laid in 1x4 or 1x6 planks, perpendicular or diagonal to the floor joists. The boards were typically separated slightly to allow for expansion.
- Softwood subflooring used under linoleum or other thin kitchen floor coverings was usually tongue-and-groove and tightly fit to provide a smooth, continuous surface to support the flexible flooring system. Modern construction often includes 1/4 inch plywood underlayment between the subfloor and finish flooring to provide a smooth surface for the finishing material. - Citation: Carson Dunlop Associates, *Home Reference Book* ,
- Laminate Wood & Other Laminate Floors

- ™ Also see Laminate Flooring where we describe plastic laminate floors in this article
- ™ FLOOR WOOD AGE TYPES HISTORY
- ™ FLOOR WOOD, DAMAGE DIAGNOSIS
- ™ FLOOR, WOOD ENGINEERED, LAMINATE, INSTALL
- ™ FLOOR, WOOD FINISHES
- ™ FLOOR, WOOD INSTALLATION GUIDE
- ™ FLOOR, WOOD MOISTURE
- ™ FLOOR, WOOD RADIANT HEAT
- ™ FLOOR, WOOD SOLID STRIP, PLANK
- ™ FLOOR, WOOD TYPES
- ™ Also see FLOOR TILE HISTORY & INGREDIENTS and
- ™ see FLOOR, CONCRETE SLAB CHOICES,
- ™ and SLAB INSULATION, PASSIVE SOLAR for examples of discussion of energy-efficient floor designs and passive solar floor systems.

Guide to Inspection & Diagnosis of Flooring Materials in buildings

List of Non-Resilient & Resilient Floor Coverings Used in buildings. Definitions of Non-resilient Flooring & Resilient Flooring

Non-resilient floor coverings used in buildings that can assist in determining the age of a structure include bamboo, brick, concrete, stone, slate, and a wide variety of wood products.

Definition of non-resilient flooring:

"Non-resilient" flooring is defined as hard surfaced flooring material such as stone, brick, slate, or ceramic tile.

Definition of resilient flooring

"Resilient flooring" is defined as materials softer than the non-resilient materials we just listed (stone, slate, brick, ceramic tile), and includes organic types of flooring: asphalt based floor tiles, cork floor tiles, cork floor planks, linoleum sheet flooring (antique & modern), plastic floor tiles, rubber floor tiles, vinyl-asbestos floor tiles.

So what's "wood flooring" ? After all, it is organic too. Is a wood floor non-resilient, resilient, or just "wood"?

Non-resilient.

See Asphalt & Vinyl Floor Tile History - history, dates, and description of the production process and ingredients in asphalt floor tiles, asphalt-asbestos floor tiles, & vinyl-asbestos floor tiles.

Asphalt Tile Flooring - 1920 - 1960 (est)

Asphalt floor tiles are 9" square (or other sized) tiles which used asphalt as the main binding material. the original asphalt tiles were produced only in dark colors because asphalt was a main ingredient.

The black tiles shown at left were not dated and may be a newer product, but in general, if you find very old black floor tiles they are probably an asphalt-asbestos product.

Rosato indicates that the first publicized asphalt tile installation was in 1920 in New York City's Western Union office. The product was very successful and by 1936 over four million square yards of asphalt floor tiles were being sold annually.

By 1940, 5% of floor coverings sold in the U.S. were asphalt tile. -- Rosato In 1920 asphalt roofing manufacturers, who had been using asphalt and fiber binders to make asphalt roofing shingles for some time, tried to develop a rigid product that could be a substitute for (more costly) slate roofing. The material did not perform acceptably as a roof covering, but it led to the development of asphalt floor tiles.

At AGE of a BUILDING - how to determine in our section titled Flooring Materials we discuss the eras during which various flooring materials were first used in modern buildings and how to use these to help identify the age of a building.

Asphalt Floor Tiles Pose an Asbestos Risk

Asphalt-asbestos floor tiles were produced at first in dark colors using a heavy asphalt binder combined with a very high percentage of asbestos filler fibers. It would be uncommon to find these floors still in use today, but if you encounter black or very dark asphalt floor tiles they are probably very high in asbestos fibers. We discuss floor tiles as an asbestos fiber source in buildings in more detail at ASBESTOS FLOOR TILE IDENTIFICATION where we elaborate the concerns about asbestos used in the manufacture of asphalt-based floor tiles.

Colors & Composition of Asphalt Asbestos Floor Tiles

Asphalt -asbestos tiles manufactured early in their life (1920's) were either black, near black, brown, or a gray-brown tone. Brown asphalt-asbestos tiles were made by substituting gilsonite as a binder. In both cases the tiles were hardened by evaporating a solvent used in the fabrication process, or by cooling of hot asphalt used in the mixture.

Gilsonite could be used to produce a wider range of mixtures, but required some asphalt as a softener. Dark vinyl-asbestos tiles used, for example, a mixture of 40 parts asphalt or gilsonite, 60 parts asbestos floats, 30 parts powdered limestone, and pigments (parts by weight). Another typical mixture cited by Rosato contained 70% asbestos fiber.

See these articles on asphalt and vinyl-asbestos floor tile identification:

™ ASBESTOS FLOOR TILE IDENTIFICATION - How to Identify Floor Tiles That May Contain Asbestos
™ ASBESTOS FLOOR TILE IDENTIFICATION PHOTOS by YEAR - detailed photo guide to asphalt asbestos and vinyl asbestos floor tiles, 1900 -1986
™ FLOOR TILE HISTORY & INGREDIENTS - history, dates, and description of the production process and ingredients in asphalt floor tiles, asphalt-asbestos floor tiles, & vinyl-asbestos floor tiles 1900 to present.
™ FLOORING MATERIALS, Age, Types - Age of Building Flooring Materials - A Guide to Estimating Building Age, This article describes types and ingredients in flooring materials: Asphalt floor tile, Cork floor tile or planks, Laminate flooring (modern), Linoleum & older sheet flooring (painted canvas), Vinyl-asbestos floor tiles, Wood flooring.
™ FLOOR TYPES & DEFECTS - Asphalt floor tiles, asphalt-saturated asbestos felt, carpeting, cork floor tiles & planks, laminate flooring (modern), linoleum (sheet flooring) & earlier painted fabric floor coverings, vinyl-asbestos tile floors, wood flooring.
™ ASBESTOS FLOOR TILE LAB PROCEDURES - photos of how vinyl asbestos flooring is analyzed in the lab.

Cork Flooring Tiles

Cork floor tiles were considered a warm, quiet, but less durable resilient floor covering than some of its competitors. It was sold often for use in residential dens, family rooms, or other warm, low-traffic areas, and it may have been popular (research needed) for use in areas where workers had to spend long periods standing - where it would have competed with rubber floor coverings. In 1952 cork flooring sales made up 2% of total floor tile sales. -- Rosato p88.

Details about cork flooring are at CORK FLOORING & FLOOR TILES

and also at FLOORING COMPANIES (see Armstrong Corporation).

Vinyl Asbestos Floor Tiles - 1930 - 1976 (est)

Vinyl floor tiles, including vinyl-asbestos floor tiles and homogenous vinyl floor tiles (non-asbestos product) are almost as old as asphalt floor tiles. By the early 1950's in the U.S. vinyl tile floor products were more popular than asphalt-based flooring. The reason is pretty obvious.

Asphalt-based flooring as it was originally produced used heavy asphalt products which meant that the floor tiles could be made in dark colors only. Soon after asphalt-asbestos floor tiles were marketed manufacturers heard from their buyers that consumers wanted lighter floor tiles and tiles of varying color and pattern.

Organic resin vinyl increased in popularity for this reason, but slowly. By 1952, the production of vinyl plastic floor tile sales in the U.S. was about half the volume of asphalt floor tiles, selling 35 million square yards.

We discuss vinyl-asbestos floor tiles as an asbestos fiber source in buildings in more detail at ASBESTOS FLOOR TILE IDENTIFICATION where we elaborate the concerns about asbestos used in the manufacture of vinyl based floor tiles that used high levels of asbestos fibers as a filler material and to provide other properties to that product. More photos of vinyl asbestos floor tiles, including microphotographs of vinyl-asbestos floor tiles can be seen at that article.

See these articles on asphalt and vinyl-asbestos floor tile identification:

™ ASBESTOS FLOOR TILE IDENTIFICATION - How to Identify Floor Tiles That May Contain Asbestos
™ ASBESTOS FLOOR TILE IDENTIFICATION PHOTOS by YEAR - detailed photo guide to asphalt asbestos and vinyl asbestos floor tiles, 1900 -1986
™ FLOOR TILE HISTORY & INGREDIENTS - history, dates, and description of the production process and ingredients in asphalt floor tiles, asphalt-asbestos floor tiles, & vinyl-asbestos floor tiles 1900 to present.
™ FLOORING MATERIALS, Age, Types - Age of Building Flooring Materials - A Guide to Estimating Building Age, This article describes types and ingredients in flooring materials: Asphalt floor tile, Cork floor tile or planks, Laminate flooring (modern), Linoleum & older sheet flooring (painted canvas), Vinyl-asbestos floor tiles, Wood flooring.

- FLOOR TILE / SHEET FLOORING PHOTO GUIDES - list of photo guides
- FLOOR TYPES & DEFECTS - Asphalt floor tiles, asphalt-saturated asbestos felt, carpeting, cork floor tiles & planks, laminate flooring (modern), linoleum (sheet flooring) & earlier painted fabric floor coverings, vinyl-asbestos tile floors, wood flooring.
- ASBESTOS FLOOR TILE LAB PROCEDURES - photos of how vinyl asbestos flooring is analyzed in the lab.

Sheet Flooring Materials That Indicate Age of a Building

Here is a photograph of an early (pre-vinyl) continuous floor covering, ca 1900, in an 1840 historic Vermont house.

Note the fabric backing of the flooring material. This article explains various common flooring materials (rough wood, finished wood, parquet, carpeting, linocrusta, sheet vinyl, and other items as they assist in determining the age of a house or other building.

Details about sheet flooring are at SHEET FLOORING MATERIALS

and at LINOLEUM & Other Sheet Flooring.

Linoleum Sheet Flooring As an Indicator of Building Age - 1890 - 1960 (est)

At LINOLEUM & Other Sheet Flooring we describe the history and properties of linoleum sheet flooring using the Congoleum-Nairn corporation history to obtain some useful dates on when different sheet flooring products were produced.

The resilient flooring product shown at left was made in the late 1990's and is not an asbestos concern, though in this case the flooring was damaged by water and movement of a cabinet.

According to Rosato, "The original resilient floor coverings were developed during the latter part of the Nineteenth Century by Frederick Walton.

The original covering was linoleum for use as a floor decking on British naval ships." The composition of the original products included asphaltic binders to which an asbestos filler was added by mixing on a rubber mill.

Details are at LINOLEUM & Other Sheet Flooring and at Congoleum Flooring History.

List of Non-Resilient Floor Coverings Used in buildings

Non-resilient floor coverings used in buildings that can assist in determining the age of a structure include bamboo, brick, concrete, stone, and a wide variety of wood products.

Laminate Wood & Plastic Flooring Products

The laminate wood flooring shown at left was buckled and destroyed by flooding caused by a leaky heating pipe. As we discussed with traditional wood flooring above, severe flooding or installation errors can lead to total loss of the finish floor system.

Contemporary snap-together flooring products that resemble wood or other surfaces, but are made of plastic, and other pre-finished and ready-to-assemble wood flooring products are a much more modern product.

Pergo (TM) laminate flooring, for example, was developed by Pergo AB, a Swedish company founded around 1890 as a vinegar manufacturer. Product development for Pergo laminate flooring began in 1977 and was first brought to the market in 1984. Pergo laminate flooring was first sold in the U.S. in 1994.

It's safe to say that if you see a Pergo product in building in U.S. the flooring was installed no longer ago than 1994. But because this product is has been widely used as a renovation material installed atop older pre-existing finish floor surfaces, one should not presume that the product age is the same as the building age unless the floor was installed as original material - that is, unless it was not installed over an older floor covering.

Just seeing Pergo TM laminate flooring over a plywood subfloor is not sufficient data to conclude the age of a home. Older carpeting may have been removed to expose a plywood subfloor over which the laminate flooring was then installed.

Wood Flooring Inspection, Diagnosis, Repair

Wood flooring, one of the most warm and beautiful materials that can be placed in a home (OPINION-DF) needs to be installed following proper practices.

The gaps that appeared in the wood floor shown at left were caused by installation of the floor in a new home, over radiant heat tubing, and without allowing the flooring to reach a proper moisture level before it was nailed in place.

Extreme buckling can cause an upwards explosion of a wood floor when flooring is exposed to flooding or prolonged leaks.

This severe buckling wood floor damage can occur even at much smaller increases in interior moist sure if a tongue and groove wood floor is improperly installed - leaving inadequate free space margin around the floor perimeter.

See Wood Floor Types for a catalog of types and ages of wood flooring.

See WOOD FLOOR DAMAGE REPAIR for details of types of damage to wood flooring and for a description of wood floor repair approaches.

Tile Floor Inspection, Diagnosis, Repair

Cracked floor tiles like this can be diagnosed in order to decide if the cracking shows a serious structural problem, inadequate floor support, mechanical damage, or as in this case, damage from a loose, rocky toilet.

More Places to Look for Hidden Mold in buildingsincludes a discussion of how even a slight slope in a tile bathroom floor leads to bath leaks under and behind bathroom vanity cabinets and floor trim, and we discuss how to prevent this problem

Wall-to-wall Floor Carpeting Inspection, Diagnosis, Repair

See these articles about diagnosing stains, mold, and allergens in carpeting

- CARPET DUST IDENTIFICATION
- CARPET MOLD CONTAMINATION
- CARPET PADDING ASBESTOS, MOLD, ODORS
- CARPET STAIN DIAGNOSIS
- CARPET & other STAIN TESTS
- CARPET TEST PROCEDURE
- CABINETS & COUNTERTOPS
- CARPETING & INDOOR AIR QUALITY
- CARPETING, SELECTION & INSTALLATION
- Thermal Tracking: How to Diagnose Indoor Carpeting Stains Due To Building Air Leaks
- How to Find and Test for Moldy Carpeting in buildings
- Carpet Test for Mold: How to Collect Test Samples from Carpets & Soft Surfaces

Damp proofing in construction is a type of moisture control applied to building walls and floors to prevent moisture from passing into the interior spaces. Damp problems are one of the most frequent problems encountered in homes.

Different types of damp proof course

Damp proof courses (DPC"s) are types of barriers designed to span across the length or width of your walls to prevent the onset of rising or penetrating damp; there are various options to choose from, including:

- **Solid DPC** – a solid DPC is made of some kind of waterproof material – such as bituminous felt, copper sheet or polythene – and is fitted either horizontally or vertically on the exterior or interior of the wall, at least six inches above ground level (in accordance with the *British Standard Code of Practice for Installation of Damp Proof Courses* BS 6576:1985). Solid DPC"s are considered the most reliable form of preventing groundwater ingress, but are really only suitable for newly erected walls; fitting them onto already built walls adds the risk of cutting through pipe work or wiring, which could cost you more money later on.
- **Chemical DPC** – this involves drilling holes 10-12mm in diameter into the wall (also at least 6in above ground level), and injecting liquid silicone-based chemicals into the holes using a high pressure pump to create a water repelling layer in the wall. This often proves a more practical and less obtrusive DPC for home owners, but it can take a few months for results to emerge and the effectiveness will vary as the chemicals won"t pass through the walls evenly. This method won"t work on breeze block walls, as they are non-porous and thus won"t allow the chemicals to permeate properly.
- **Porous tube DPC** – this DPC involves fitting small clay tubes into closely spaced rows along the wall, also into the mortar at least 6in above ground level; these tubes then allow moisture to locate an outlet that allows it to evaporate more freely and therefore limits the amount of water that can rise above them. This is a relatively simple and cheap method but it doesn"t always produce effective results.
- **Electro osmotic DPC** – if you want a more scientific based DPC, electricity can even be utilised to help prevent the onset of damp. Titanium cathodes and anodes are fitted into the interior of the wall and power is drawn from the mains supply, usually by using a standard 13amp socket. The entire system is professionally earthed and the subsequent injected electricity creates an electric field, whereby the water molecules are naturally drawn downwards toward the negative electrodes and away from the bulk of the wall. The system is specifically designed to counteract the rising water that causes damp.

JOINTS IN CONCRETE CONSTRUCTION

Squared rubble masonry: The rubble masonry in which the face stones are squared on all joints and beds by hammer dressing or chisel dressing before their actual laying, is called squared rubble masonry.

There are two types of squared rubble masonry.

Coursed Square rubble masonry: The square rubble masonry in which chisel dressed stones laid in courses is called coarse square rubble masonry. This is a superior variety of rubble masonry. It consists of stones, which are squared on all joints and laid in courses. The stones are to be laid in courses of equal layers. and the joints should also be uniform.

Suitability: Used for construction of public buildings, hospitals, schools, markets, modern residential buildings etc and in hilly areas where good quality of stone is easily available.

Why Precast?

Faster Construction

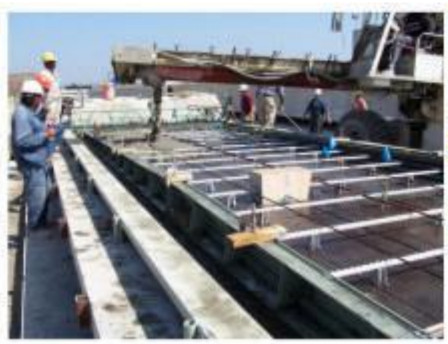
What do we mean by faster construction? We‟re not necessarily talking about how fast the pavement can be constructed, but rather how fast it can be opened to traffic. Conventional cast-in-place pavement requires several days of additional curing time after the concrete is placed before it is strong enough to withstand traffic loading. While "fast-setting" concrete mixtures have been developed for this purpose, these can be cost-prohibitive for large-scale pavement construction.

Reduced User Delay Costs

What are user delay costs? These are costs to the drivers of the roadway that are directly attributable to congestion caused by construction activities. Increased fuel consumption, lost work time, increased vehicle wear and tear, and increased air pollution are just a few of these costs. The savings in user delay costs realized through limiting construction to only off-peak travel times (at night or over a weekend) can be substantial. This is where the primary economic benefit of precast pavement will be realized.

Improved Durability and Performance

Precast concrete has a proven track record as a durable high-performance product for bridge and commercial building construction. This is the result of a high degree of quality control that can be achieved at a precast fabrication plant. High strength, low permeability concrete mixtures with a low water-cement ratio and uniform aggregate gradation are used routinely by precast fabrication plants. At most plants concrete batching and quality control is done on-site and the concrete is transported only a short distance from the batch plant to the forms, minimizing changes in concrete properties between the mixing and placing operations. What‟s more, precast fabrication plants offer tremendous flexibility over the curing operation. Precast concrete elements can be fabricated indoors, they can be wet-mat cured, steam cured, and curing can be maintained as long as necessary after casting. Problems that can plague cast-in-place pavement construction such as surface strength loss, "built-in" curling, and inadequate air entrainment, can all be eliminated with precast concrete.

Why Prestressed Precast Pavement?

Prestressing has a proven track record for enhancing the performance and durability of concrete structures. And though it has seen very limited use in pavements, there are clearly benefits of prestressed concrete pavement, such as reduced cracking, reduced slab thickness, and bridging capability.

Reduced Cracking

While conventional pavements are “designed” to crack at specific locations (at sawcut joints for JCP) or at regular intervals (CRCP), in general cracking is not desirable. Cracks can spall, they can permit water to penetrate the underlying base, they can fault, and they can eventually lead to severe pavement failures such as punchouts. Prestressing helps to minimize or even eliminate cracking. By putting a pavement in compression there is less likelihood of cracking due to tensile stresses. What‟s more, the so-called “elasto-plastic” behavior of prestressed concrete will help keep any cracks that do form tightly closed.

Reduced Slab Thickness

While the underlying pavement structure is also a factor, the primary controlling factor in pavement thickness design is the magnitude and number of wheel load repetitions on the pavement over its expected design life. For a given pavement support structure and a given wheel load, tensile stresses in a thinner pavement will be higher than those in a thicker pavement. These higher stresses wear out or fatigue a concrete pavement faster. Prestressing can be used to reduce the tensile stresses in a thinner pavement slab to those of a much thicker pavement slab, increasing the design life of the pavement.

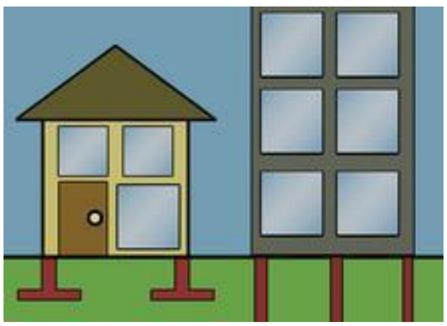
Why is this important? First is the savings in concrete material. Constructing an 8-inch thick pavement slab instead of a 12-inch-thick pavement slab will save more than 780 cubic yards of concrete per lane-mile. Secondly, for removal and replacement it is generally necessary to match the existing slab thickness. Most existing pavements that are in need of replacement are on the order of 8-10 inches thick. Prestressing permits in-kind replacement of the existing pavement with a pavement slab that will have a design life of a much thicker slab. Finally, slab thickness can often times be governed by overhead clearance constraints. When replacing a pavement under a bridge overpass, for example, it is often not possible to construct a thicker pavement than what was in place already without having to excavate base material.

Bridging Capability

Prestressing gives the pavement a certain "bridging" capability that permits the pavement slab to span small voids and "soft" base materials beneath the pavement. This is critical for pavement removal and replacement operations that are limited to short (overnight) construction windows when it is often not possible to recondition or replace the underlying base material.

Foundation (engineering)

From Wikipedia, the free encyclopedia



Shallow foundations of a house versus the deep foundations of a skyscraper.

FOUNDATIONS

The foundations of the building transfer the weight of the building to the ground. While 'foundation' is a general word, normally, every building has a number of individual foundations, commonly called footings. Usually each column of the building will have its own footing.

Since the weight of the building rests on the soil (or rock), engineers have to study the properties of the soil very carefully to ensure that it can carry the loads imposed by the building. It is common for engineers to determine the ***safe bearing capacity*** of the soil after such study. As the name suggests, this is the amount of weight per unit area the soil can bear. For example, the safe bearing capacity(SBC) at a location could be 20 T/m2, or tonnes per square metre.

This capacity also changes at different depths of soil. In general, the deeper one digs, the greater the SBC, unless there are pockets of weak soil in the earth. To properly support a building, the soil must be very firm and strong. It is common for the soil near the surface of the earth to be loose and weak. If a building is rested on this soil, it will sink into the earth like a ship in water. Building contractors will usually dig until they reach very firm, strong, soil that cannot be dug up easily before constructing a foundation.

To study the properties of the soil before designing foundations, engineers will ask for a ***soil***

investigation to be done. A soil investigation engineer will drill a 4" or 6" hollow pipe into the ground, and will remove samples of the earth while doing so. He will then send these samples to a lab to find out the detailed properties of the soil at every depth. Soil is usually composed of *strata*, or different layers, each with its own set of properties. Drilling technology today makes it easy and economical to drill to great depths, easily several hundred metres or more, even in hard rock.

The soil investigation team will then prepare a *soil investigation report* that lists the engineering properties of the soil at regular intervals, say every 2 meters. Based on this deport, engineers designing the structure can decide at what depth of soil to provide the foundations, the type of foundations they should provide, and the size of the foundations.

Every once in a while, engineers will find ***fill*** at a site. This occurs when humans have previously dug up the earth there, and then filled it back in. This happens if a quarry was dug or a building built there previously. Since fill is loose and soft and cannot support weight, engineers will dig to a depth below that of the fill, where strong soil is found, and construct foundations there.

TYPES OF FOUNDATIONS

Read our introduction to foundations if you have missed it.

In this article we will discuss the common types of foundations in buildings. Broadly speaking, all foundations are divided into two categories: shallow foundations and deep foundations. The words shallow and deep refer to the depth of soil in which the foundation is made. Shallow foundations can be made in depths of as little as 3ft (1m), while deep foundations can be made at depths of 60 - 200ft (20 - 65m). Shallow foundations are used for small, light buildings, while deep ones are for large, heavy buildings.

SHALLOW FOUNDATIONS

Shallow foundations are also called spread footings or open footings. The 'open' refers to the fact that the foundations are made by first excavating all the earth till the bottom of the footing, and then constructing the footing. During the early stages of work, the entire footing is visible to the eye, and is therefore called an open foundation. The idea is that each footing takes the concentrated load of the column and spreads it out over a large area, so that the actual weight on the soil does not exceed the safe bearing capacity of the soil.

There are several kinds of shallow footings: individual footings, strip footings and raft foundations.

In cold climates, shallow foundations must be protected from freezing. This is because water in the soil around the foundation can freeze and expand, thereby damaging the foundation. These foundations should be built below the *frost line*, which is the level in the ground above which freezing occurs. If they cannot be built below the frost line, they should be protected by insulation: normally a little heat from the building will permeate into the soil and prevent freezing.

individual footings

Individual footings awaiting concreting of the footing column.

Individual footings are one of the most simple and common types of foundations. These are used when the load of the building is carried by columns. Usually, each column will have its own footing. The footing is just a square or rectangular pad of concrete on which the column sits. To get a very rough idea of the size of the footing, the engineer will take the total load on the column and divide it by the safe bearing capacity (SBC) of the soil. For example, if a column has a vertical load of 10T, and the SBC of the soil is 10T/m2, then the area of the footing will be 1m2. In practice, the designer will look at many other factors before preparing a construction design for the footing.

Individual footings connected by a plinth beam. Note that the footings have been cast on top of beds of plain cement concrete (PCC), which has been done to create a level, firm base for the footing.

Individual footings are usually connected by a *plinth beam*, a horizontal beam that is built at ground or below ground level.

strip footings

Strip footings are commonly found in load-bearing masonry construction, and act as a long strip that supports the weight of an entire wall. These are used where the building loads are carried by entire walls rather than isolated columns, such as in older buildings made of masonry.

raft or mat foundations

Raft Foundations, also called Mat Foundations, are most often used when basements are to be constructed. In a raft, the entire basement floor slab acts as the foundation; the weight of the building is spread evenly over the entire footprint of the building. It is called a raft because the building is like a vessel that 'floats' in a sea of soil.

Mat Foundations are used where the soil is week, and therefore building loads have to be spread over a large area, or where columns are closely spaced, which means that if individual footings were used, they would touch each other.

DEEP FOUNDATIONS

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pile foundations

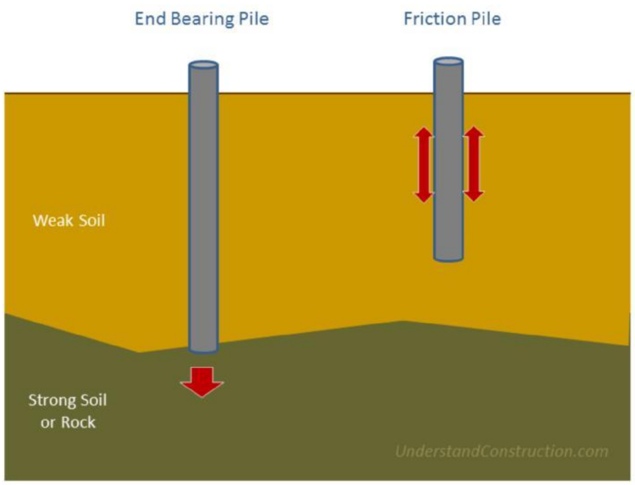
A pile is basically a long cylinder of a strong material such as concrete that is pushed into the ground so that structures can be supported on top of it.

Pile foundations are used in the following situations:

1. When there is a layer of weak soil at the surface. This layer cannot support the weight of the building, so the loads of the building have to bypass this layer and be transferred to the layer of stronger soil or rock that is below the weak layer.
2. When a building has very heavy, concentrated loads, such as in a high rise structure.

Pile foundations are capable of taking higher loads than spread footings.

There are two types of pile foundations, each of which works in its own way.



End Bearing Piles

In end bearing piles, the **bottom end of the pile rests on a layer of especially strong soil or rock**. The load of the building is transferred through the pile onto the strong layer. In a sense, this pile acts like a column. The key principle is that the bottom end rests on the surface which is the intersection of a weak and strong layer. The load therefore bypasses the weak layer and is safely transferred to the strong layer.

Friction Piles

Friction piles work on a different principle. The pile transfers the load of the building to the soil across the full height of the pile, by friction. In other words, the entire surface of the pile, which is cylindrical in shape, works to transfer the forces to the soil.

To visualise how this works, imagine you are pushing a solid metal rod of say 4mm diameter into a tub of frozen ice cream. Once you have pushed it in, it is strong enough to support some load. The greater the *embedment depth* in the ice cream, the more load it can support. This is very similar to how a friction pile works. In a friction pile, the amount of load a pile can support is directly proportionate to its length.

A **foundation** (or, more commonly, **foundations**) the element of an architectural structure which connects it to the ground, and transfers loads from the structure to the ground. Foundations are generally considered either shallow or deep.[1] Foundation engineering is the application of soil mechanics and rock mechanics (Geotechnical engineering) in the design of foundation elements of structures.

Basement

An unfinished basement used for storage and exercise

Chillon Castle (Château de Chillon) basement

Old Town medieval basements in Warsaw

A Stasi basement hallway

A **basement** or **cellar** is one or more floors of a building that are either completely or partially below the ground floor. Basements are generally used as a utility space for a building where such items as the boiler, water heater, breaker panel or fuse box, car park, and air-conditioning system are located; so also are amenities such as the electrical distribution system, and cable television distribution point. However in cities with high property prices such as London, basements are often fitted out to a high standard and used as living space.

Construction of basement in Top-Down method

Technology particulars:

™ Top-down technology (downward) is the advanced method employed to substructure construction, other than the conventional method (upward).

™ In this method, basement concrete slabs act as lateral bracing for the perimeter wall system. Ground level and first basement slabs are poured, with access holes left to allow excavation beneath. As each subsequent subgrade level is completed, the floors act as lateral bracing for the perimeter wall system.

Advantages:

™ Working space and construction duration: it is not required a large working space for foundation excavation and saving cost by eliminating to construct the retaining wall. Especially for public transport works as traffic tunnels, this method helps to soon re-established trafffic road. And the top-down method of construction enables a high-rise superstructure and its sub-basement to be built simultaneously (popularly for civil works have basements) ----> accelerate construction.

™ It is not required of the temporary strutting system (Bracsing System) to support the basement walls during excavation and construction of basement. That is cost-saving for constructiion. Temporary strut system is often very complex problems of space and very expensive construction.

™ Construction schedules can be compressed by saving time in construction of substructures and high-rise superstructure at the same time (of course, we have increase the cost of strengthening the lower part, and if the "savings" schedule can not cover the "cost" for safety strengthening, it's not necessary to do quick, top-down first and then the high-rise superstructuresthe as seen in Hanoi. After construction of the ground floor, we can separate completely superstructure and underground construction. You can construct simultaneously the basements and the superstructure.

™ Foundation problems (the phenomenon of sludge, groundwater ...): attention that in dense urban areas of high-rise buildings, if open excavation (open cut) with diaphragm wall, deep foundation and water table to be lowered in the construction of the underground structures, adjacent buildings are not assured. (easily occur sliding roof excavation, subsidence, cracking ...), Top-down construction method to solve this problem.

™ Construction of the basement with groud floor was constructed at first can partly reduce the impact of bad weather.

Construction of basement in Bottom-Up method

Technology particulars - Construction Sequence:

™ Under this method, after the construction of pile and diaphragm wall, slurry pile or sheet pile surrounding the construction works, the contractor will conduct open-cut excavation to certain depth and then proceed installation of the strutting system (Bracsing System) to support the basement walls during excavation and construction of the basement. Depending on the depth of foundation mat, structure design may require one or more different layers of struts to ensure sufficient resistance against pressure of soil + ground water outside the project impact on the basement walls.

™ After installation of strutting system is completed and ground is excavated to bottom level of foundation, the contractor will construct foundation,basement, superstructure of the building upward from the bottom in accordance with normal procedures.

™ Strutting system can be used as hard core for structural beams / floor of the basement or will be removed after the basement floor shall afford all the pressure exerted on the basement walls.

™

Projects using Bottom-Up method in construction of basement: Using steel struts

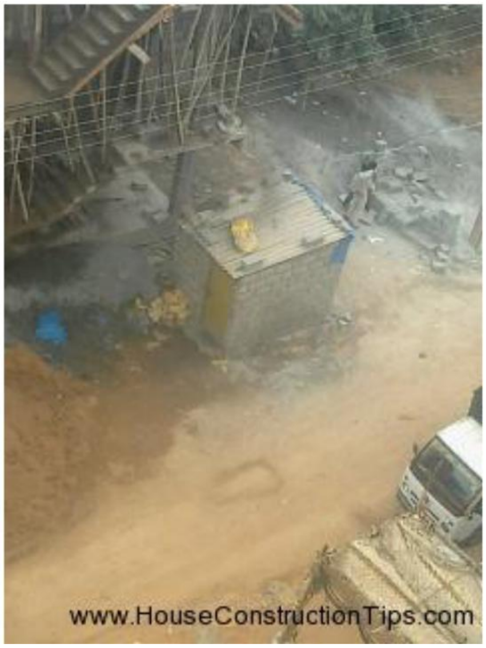
™ Oriental Hotel, No. 26-28 Tran Phu Str., Nha Trang; East Sea Tourism Company as real estate investor: Construction of 03 basement.

™ Kinh Do Building, No. 93 Lo Duc, Ha Noi; Kinh Do Hotel Company Limited as investor: Construction of 03 basement.

™ Business Center of Techcombank, No. 70-72 Ba Trieu Street, Hoan Kiem District, Hanoi; Viet Thanh Co Branch as investor: Construction of 02 basement.

™ Treatment Building of central maternity hospital maternity; No. 43 Trang Thi Street, Hanoi, by central maternity hospital as investor: Construction of 02 basements with sheet piling and steel strut.

Temporary Shed



Temporary shed construction will be the first step before you bring your material near your site.

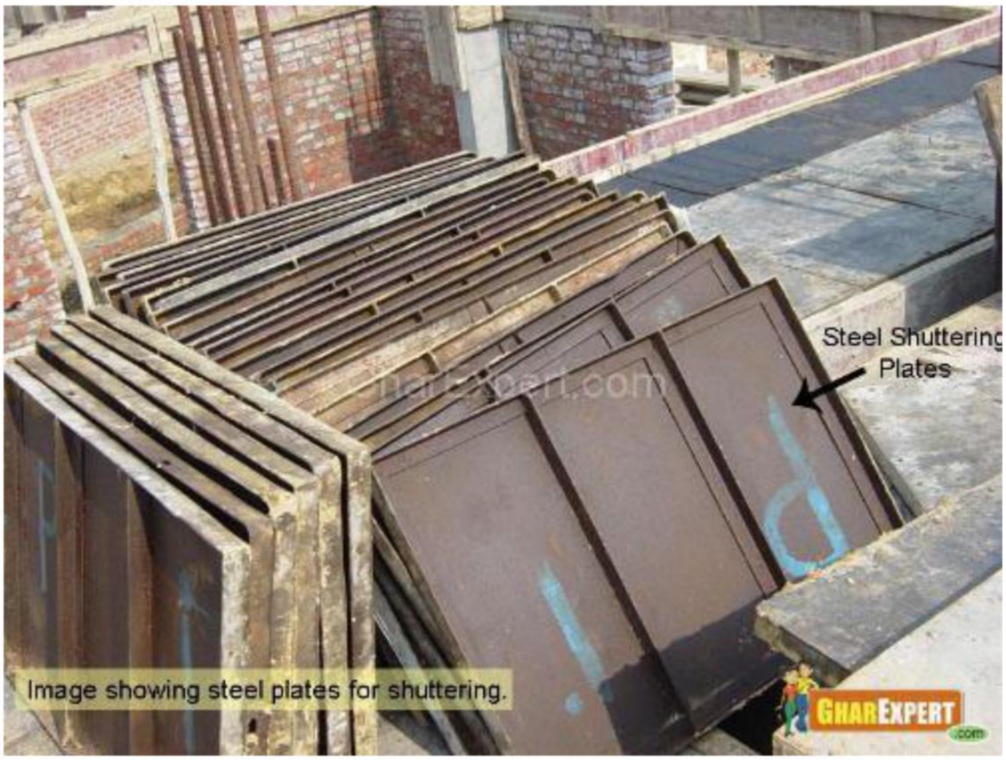
- You need to construct temporary Shed to keep your construction material and your watch men will stay there to look after your site and material
- You need to construct this in your neighbors site with their permission. So have a plan to contact them early
- Since it is temporary, you can consider using soil instead of cement.

Centering and Shuttering / Form Work

Shuttering or form work is the term used for temporary timber, plywood, metal or other material

used to provide support to wet concrete mix till it gets strength for self support. It provides supports to horizontal, vertical and inclined surfaces or also provides support to cast concrete according to required shape and size. The form work also produces desired finish concrete surface.

Shuttering or form work should be strong enough to support the weight of wet concrete mix and the pressure for placing and compacting concrete inside or on the top of form work/shuttering. It should be rigid to prevent any deflection in surface after laying cement concrete and be also sufficient tight to prevent loss of water and mortar form cement concrete. Shuttering should be easy in handling, erection at site and easy to remove when cement concrete is sufficient hard.



Steel plates for Steel Shuttering

Generally there are three types of shuttering.

- Steel Shuttering
- Wooden Planks Shuttering
- Temporary Brick Masonry Shuttering

Steel Shuttering

Steel shuttering plate is the best type of shuttering because this is water tight shuttering which can bear the load of cement concrete placed on it. This shuttering can be used for horizontal, vertical or any other shape required for the work. It gives leveled surface which has good appearance. This shuttering gives good appearance and pattern work according to architectural drawings. If the plaster is required, the thickness of plaster will be less. Being water tight

shuttering, the strength of concrete with steel shuttering is comparatively higher.

Shuttering with the help of Steel Plates.

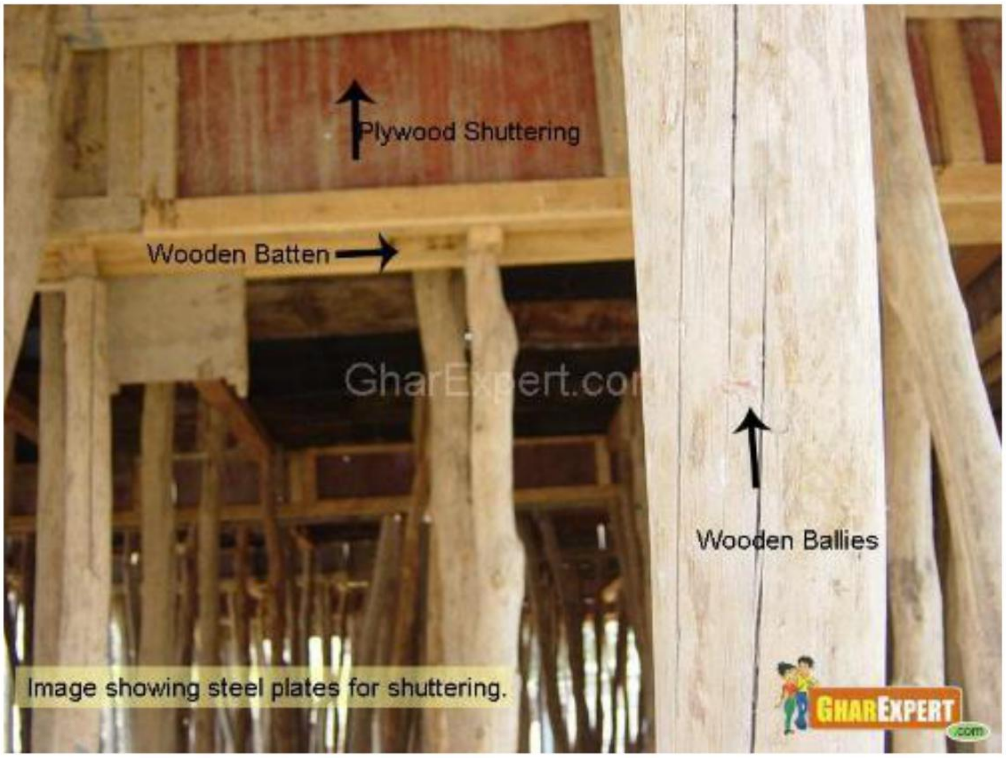
Note: As this is water tight shuttering, it is considered the best shuttering.

Wooden Plank Shuttering

Generally wooden planks shuttering is used by contractors because this shuttering is cheap and easily available. But this type of shuttering effects the strength of concrete and have some disadvantages which are given below.

Disadvantages

- This is not water tight shuttering as the size and thickness of planks differ and are not of same size. Due to this difference the water and cement flow to the ground from joints and reduce the strength of concrete.
- Bottom level of RCC slab is not in straight line and the surface being uneven, the thickness of plaster is more which remains weak.
- Due to leakage of cement slurry through joints, earth work below ‟'Ballies‟ may settle and create problems.
- In some cases wooden planks can not bear the weight of concrete. Due to low strength there is bending or deflection in wooden planks. Sometimes the planks may break.



Shuttering done with the help of wooden ballies and batten.

Temporary Brick Masonry Shuttering

In some cases labor contractor uses Temporary Brick Masonry in mud for vertical support of sides of beams, fascia etc. This shuttering should be avoided. This type of shuttering reduces the strength of cement concrete by soaking cement slurry. Also no proper compaction is made as this shuttering does not bear the pressure of vibrator. The surface of cement concrete given by this type of shuttering is uneven and the thickness of plaster is increased.

Precautions for Vertical Supports for RCC Beams, Slabs etc

- The ""Ballies" used for vertical support should not be less than 6" dia and these should be in one length without joints.
- Never allow bricks support of more than one or two bricks below a 'balli' to make required height.
- Cross Ballies or bracing should be done for better support to beam as well as slab.
- The wooden batten used below the plate should not be less than 5" in height.
- At the time of concreting one carpenter with helper having spare ballies, nails etc. should be deputed for watching any disturbances in ballies under shuttering.

Precautions for Cantilever slabs and Beams

- While doing shuttering of a cantilever part, outer edge of shuttering is 1" to 2" higher than inner edge with the wall.
- The bracing of vertical supports for cantilever portion should be tied to vertical supports of internal slab.
- The concrete should be laid on cantilever portion very gently.
- The shuttering should be removed after 28 days.

Recommended Period for Removal of Shuttering

- 48 hours for sides of foundations, columns, beams and walls.
- 7 days for underside of slab up to 4.5 meter span
- 14 days for underside of slab, beams, arches above 4.5 meter up to 6 meter span.
- 21 days for underside of beams arches above 6 meter span and up to 9 meter span.
- 28 days for underside of beams arches above 9 meter span.

Defects Found In Shuttering/Form Work

- The supports of form work are not in plumb and are not cross braced.
- The ground supports of ballies are poor and therefore settle the form work.
- There is insufficient thickness of shuttering plates/planks unable to bear lateral pressure imposed by wet concrete especially in columns.
- Shuttering plates are not cleaned and oiled or oiled with dirty oil.
- There are many insufficient and loose connections in centering and shuttering.
- The form work is removed before time. The work is not planned and designed properly.
- In case of beam shuttering proper provision for retaining side is not made. Hence the side of beam is not in proper line.
- The shuttering is poorly made with cracked and warped timber planks having lots of holes and knots.
- Through bolts for RCC walls form work for an underground tank is used. Later these holes made by bolts are not plugged.
- „Ballies‟ are resting on bricks or brick pillars
- Ballies are not in one piece. Small ballies are used and these are not properly jointed. Also no additional cross bracing is provided at the joint.
- The supports under shuttering plates are not properly tight.
- The earth work under supports is not properly compacted before starting shuttering work.
- The bottom of „ballies‟ are in wedge shape, not having proper base.

SLIPFORM CONSTRUCTION METHOD

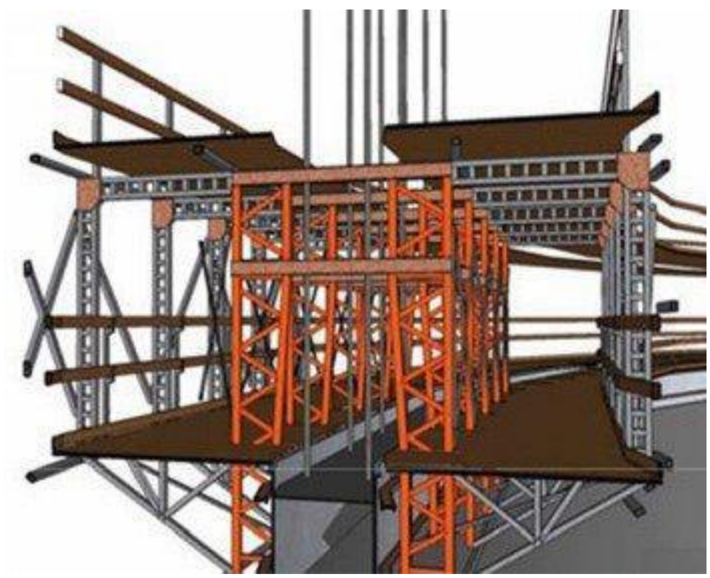
Slipform construction is a method for building large towers or bridges from concrete. The name refers to the moving form the concrete is poured into, which moves along the project as the previously poured concrete hardens behind it. The technique has also been applied to road construction.

The technique was in use by the early 20th century for building silos and grain elevators.

Vertical slipform relies on the quick-setting properties of concrete requiring a balance between early strength gain and workability. Concrete needs to be workable enough to be placed to the formwork and strong enough to develop early strength so that the form can slip upwards without any disturbance to the freshly placed concrete.

A notable use of the method was the Skylon Tower in Niagara Falls, Ontario, which was completed in 1965. The technique was soon utilized to build the Inco Superstack in Sudbury, Ontario and the CN Tower in Toronto. It is the most common method for construction of tall buildings in Australia.

From foundation to rooftop of even the very tallest projects, with the system‟s hydraulic jacks, installing steel reinforcement and pouring concrete become much easier and faster, plus can be more efficiently controlled to assure the highest quality finished cement structure. SLIPFORM technology virtually eliminates unnecessary waste and hazards, making this construction system even more efficient and economical.



Benefits

- Careful planning of construction process can achieve high production rates
- Slip form does not require the crane to move upwards, minimising crane use.
- Since the formwork operates independently, formation of the core in advance of the rest of the structure takes it off the critical path – enhancing main structure stability.
- Availability of the different working platforms in the formwork system allows the exposed concrete at the bottom of the rising formwork to be finished, making it an integral part of the construction process.
- Certain formwork systems permit construction of tapered cores and towers.

- Slip form systems require a small but highly skilled workforce on site.

Safety

- Working platforms, guard rails, ladders and wind shields are normally built into the completed system.
- Less congested construction site due to minimal scaffolding and temporary works.
- Completed formwork assembly is robust.
- Strength of concrete in the wall below must be closely controlled to achieve stability during operation.
- Site operatives can quickly become familiar with health and safety aspects of their job
- High levels of planning and control mean that health and safety are normally addressed from the beginning of the work.

Other considerations

- This formwork is more economical for buildings more than seven storeys high.
- Little flexibility for change once continuous concreting has begun therefore extensive planning and special detailing are needed.
- Setting rate of the concrete had to be constantly monitored to ensure that it is matched with the speed at which the forms are raised.
- The structure being slipformed should have significant dimensions in both major axes to ensure stability of the system.
- Standby plant and equipment should be available though cold jointing may occasionally be necessary.

Scaffolding

Scaffolding, also called **scaffold** or **staging**, is a temporary structure used to support a work crew and materials to aid in the construction, maintenance and repair of buildings, bridges and all other man made structures. Scaffolding is also used in adapted forms for formwork and shoring, grandstand seating, concert stages, access/viewing towers, exhibition stands, ski ramps, half pipes and even art projects .

There are four main types of scaffolding used worldwide today. These are Tube and Coupler (fitting) components, prefabricated modular system scaffold components, H-frame / facade modular system scaffolds, and timber scaffolds. Each type is made from several components which often include:

- A base jack or plate which is a load bearing base for the scaffold.
- The standard which is the upright component with connector joins.
- The ledger (horizontal brace).
- The transom which is a horizontal cross section load bearing component which holds the batten, board or decking unit.
- Brace diagonal and/or cross section bracing component.
- Batten or board decking component used to make the working platform.
- Coupler a fitting used to join components together.
- Scaffold tie used to tie in the scaffold to structures.

- Brackets used to extend the width of working platforms.

Types Of Scaffolding And Their Uses

There is a surprising range of scaffolding types that can be used in construction and for other purposes. The general principle of a scaffolding construction, whether it is a static, rolling, or any other type of construction, remains the same – to provide a platform for workers and materials while work takes place.

Most often seen in construction projects, scaffolding structures and other constructs can be used for a variety of purposes. It is common to see scaffolding being used for repair work, to access high objects, for window cleaning tall buildings, and more. Choosing the most appropriate form of scaffold structure is an important stage in the project that you are undertaking.

Supported Scaffolding

This is the most commonly used form of scaffolding and is the type that you will see being used in construction work and on most other forms of work where elevation is required. Extra support may be required if the scaffolding will be long or required to take a lot of weight.

Supported scaffolding is built from the base upwards, and will normally be used wherever possible. It is considered the easiest, most convenient, safest, and most cost effective form of scaffolding construct. Different forms of supported scaffolding are available, and each will serve a very specific purpose and used in specific circumstances.

Suspended Scaffolding

Suspended scaffolding is typically suspended from a roof or other tall construct. It is most commonly used when it is not possible to construct a base, or where access to upper levels may be required, and the building of scaffolding from floor to the required level would be impractical.

This type of scaffolding is commonly used by window cleaners on tall buildings, but may also be seen where repairs are needed to the exterior of upper levels of similarly tall buildings. Supported scaffolding is usually preferred where possible.

Rolling Scaffolding

Rolling scaffolding is a similar type of construct to supported scaffolding, but rather than offering a stable base, it uses castor style wheels that enable the base to be moved. This is a useful form of scaffolding when you need to complete work over a longer distance than a single scaffolding construction would permit.

The wheels should be locked when workers or materials are on the scaffolding, in order to ensure the safety of those using it, and those around it.

Mobile Scaffolding

There are a number of factors to consider when deciding whether to use static or mobile scaffolding. Ease of access is one such consideration, along with the amount of movement on the scaffolding itself. Where possible, you should rely on the use of a single scaffolding structure, or a number of structures, because mobile units, while perfectly safe when well-constructed and used properly, do pose more of a hazard than mobile constructs.

Most scaffolding is considered semi-permanent. Once used, it can be taken apart and moved to another location before it is constructed again. Fixed scaffolding can be left in position for longer periods of time, making it especially useful in those situations where permanent access may be needed to elevated positions.

Aerial Lifts

Aerial lifts should be used where workers need to be able to access a number of levels in order to be able to complete a construction. For example, if building work is being completed on the outside of a multi-storey property and both workers and materials will be needed to work outside two or more floors, at different times, then an aerial lift will make it easier and safer to lift even large amounts of material, and multiple workers to the levels required.

DESHUTTERING in simple means, the process of removing the shuttering (Formwork for Concrete).
Assuming standard conditions of workmanship and quality of materials, you can refer to the following time-frames for the removal of forms.

Walls/Columns & Vertical faces of structural members - 24 Hrs
Slab Spanning up to 4.5 m - 7 days
Slab Spanning more than 4.5 m - 14 days
Beams and arches spanning up to 6 m - 14 days
Beams and arches spanning more than 6 m - 21 days

SIMPLY SUPPORTED AND CONTINUOUS SPANS SHALL BE DESHUTTERED FROM MIDSPAN (CENTRE)

CANTILEVERS SHALL BE DESHUTTERED FROM FREE END TOWARDS SUPPORTS

*The above mentioned timeframe is excluding the day of casting

FABRICATION AND ERECTION OF STRUCTURAL STEELWORK

FABRICATION AND ERECTION OF STRUCTURAL STEELWORK

1.0INTRODUCTION

The steel-framed building derives most of its competitive advantage from the virtues of prefabricated components, which can be assembled speedily at site. Unlike concreting, which is usually a wet process conducted at site, steel is produced and subsequently fabricated within a controlled environment. This ensures high quality, manufacture offsite with improved precision and enhanced speed of construction at site. The efficiency of fabrication and erection in structural steelwork dictates the success of any project involving steel-intensive construction. Current practices of fabrication and erection of steel structures in India are generally antiquated and inefficient. Perhaps, this inadequate infrastructure for fabrication is unable to support a large growth of steel construction. In India, the fabrication and erection of structural steelwork has been out of the purview of the structural designer. Nevertheless, in the future emerging situation, the entire steel chain, i.e. the producer, client, designer, fabricator and contractor should be able to interact with each other and improve their efficiency and productivity for the success of the project involving structural steelwork. Hence it becomes imperative that structural designers also must acquaint themselves with all the aspects of the structural steel work including the “fabrication and erection,” and that is the subject matter of the present chapter to briefly introduce good fabrication and erection practices.

2.0 FABRICATION PROCEDURE

Structural steel fabrication can be carried out in shop or at the construction site. Fabrication of steelwork carried out in shops is precise and of assured quality, whereas field fabrication is comparatively of inferior in quality. In India construction site fabrication is most common even in large projects due to inexpensive field labour, high cost of transportation, difficulty in the transportation of large members, higher excise duty on products from shop. Beneficial taxation for site work is a major financial incentive for site fabrication. The methods followed in site fabrication are similar but the level of sophistication of equipment at site and environmental control would be usually less. The skill of personnel at site also tends to be inferior and hence the quality of finished product tends to be relatively inferior. However, shop fabrication is efficient interms of cost, time and quality.

Structural steel passes through various operations during the course of its fabrication.Generally, the sequence of activities in fabricating shops is as shown in Table1. These quence and importance of shop operations will vary depending on the type of fabrication required. All these activities are explained briefly in the subsequent parts of the section.

FABRICATION AND ERECTION OF STRUCTURAL STEELWORK

Sequence of activities in fabricating shops

Sequence of Operation

Surface cleaning

Cutting and machining

Punching and drilling

Straightening, bending and rolling

Fitting and reaming

Fastening (bolting, riveting and welding)

Finishing

Quality control

Surface treatment

Transportation

2.1 Surface cleaning

Structural sections from the rolling mills may require surface cleaning to remove millscale prior to fabrication and painting. Hand preparation, such as wire brushing, does not normally conform to the requirements of modern paint or surface protection system. However in some applications manual cleaning is used and depending on the quality of the cleaned surface they are categorised into Grade St-2 and Grade St

-

3. 1. Squared rubble masonry: The rubble masonry in which the face stones are squared on all joints and beds by hammer dressing or chisel dressing before their actual laying, is called squared rubble masonry.

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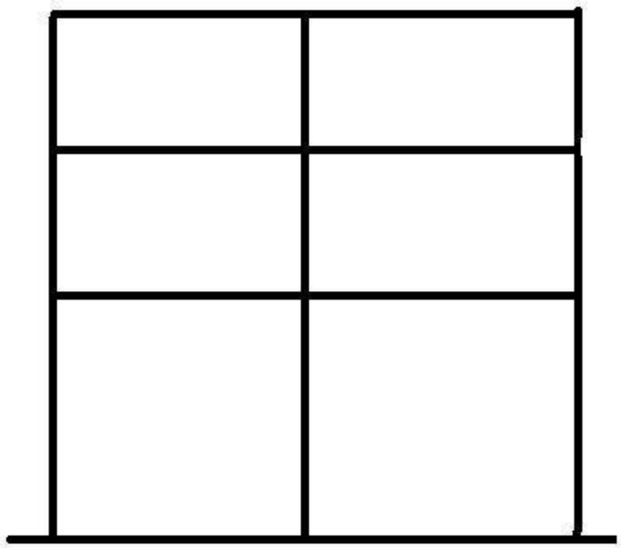
Suitability: Used for construction of public buildings, hospitals, schools, markets, modern residential buildings etc and in hilly areas where good quality of stone is easily available.

Frame Structures - Types of Frame Structures

Advertisements

Frame structures are the structures having the combination of beam, column and slab to resist the lateral and gravity loads. These structures are usually used to overcome the large moments developing due to the applied loading.

Types of frame structures



Frames structures can be differentiated into:

1. Rigid frame structure

Which are further subdivided into:

- ™ Pin ended
- ™ Fixed ended

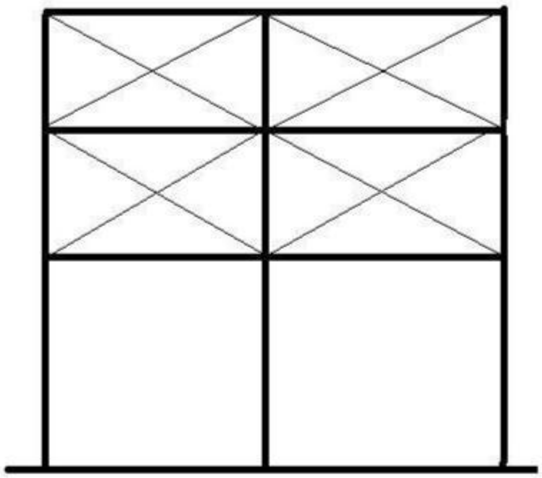
2. Braced frame structure

Which is further subdivided into:

- ™ Gabled frames
- ™ Portal frames

Rigid Structural Frame

The word rigid means ability to resist the deformation. Rigid frame structures can be defined as the structures in which beams & columns are made monolithically and act collectively to resist the moments which are generating due to applied load.



Rigid frame structures provide more stability. This type of frame structures resists the shear, moment and torsion more effectively than any other type of frame structures. That's why this frame system is used in world's most astonishing building Burj Al-Arab.

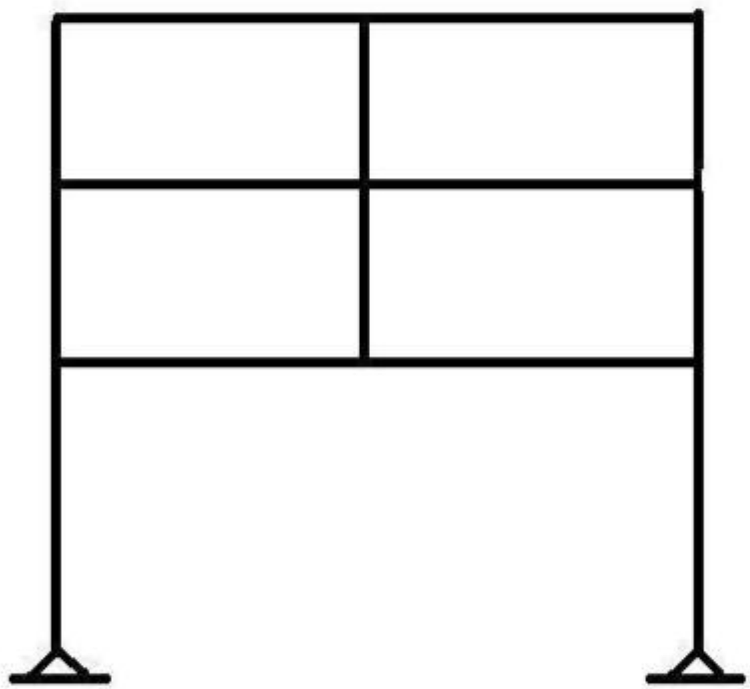
Braced Structural Frames

In this frame system, bracing are usually provided between beams and columns to increase their resistance against the lateral forces and side ways forces due to applied load. Bracing is usually done by placing the diagonal members between the beams and columns.

This frame system provides more efficient resistance against the earthquake and wind forces. This frame system is more effective than rigid frame system

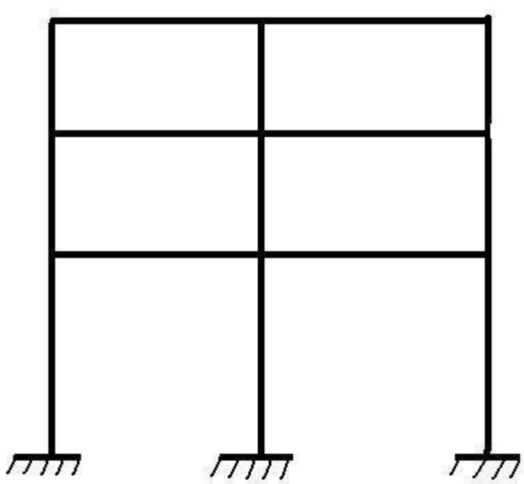
Pin Ended Rigid Structural Frames

A pinned ended rigid frame system usually has pins as their support conditions. This frame system is considered to be non rigid if its support conditions are removed.



Fix Ended Rigid Frame Structure:

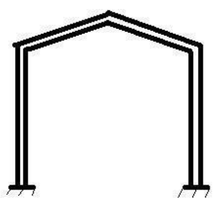
In this type of rigid frame systems end conditions are usually fixed.



Gabeled Structural Frame:

Gabled frame structures usually have the peak at their top. These frames systems are in use where there are possibilities of heavy rain and snow.

Portal Structural Frame

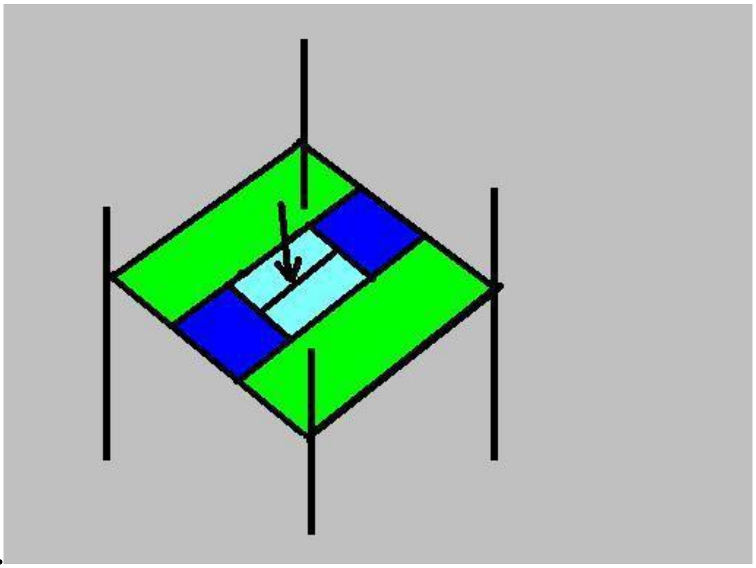


Portal structural frames usually look like a door. This frame system is very much in use for construction of industrial and commercial buildings

Load path in Frame Structure:

It is a path through which the load of a frame structure is transmitted to the foundations. In frame structures, usually the load path is:

Load first transfers from slab to beams then to from beam to columns, then from columns



it transfers to the foundation.

Advantages of Frame Structures

1. One of the best advantages of frame structures is their ease in construction. it is very east to teach the labor at the construction site.
2. Frame structures can be constructed rapidly.
3. Economy is also very important factor in the design of building systems. Frame structures have economical designs.

Disadvantages of Frames:

In frames structures, span lengths are usually restricted to 40 ft when normal reinforced concrete. Other wise spans greater than that, can cause lateral deflections.

Comparison of Frame structures with Normal Load bearing Traditional High Rise Building

Selection of frame structures for the high rise building is due to their versatility and advantages over the normal traditional load bearing structures. These include the following:

Actually the performance of load bearing structures is usually dependent on the mass of structures. To fulfill this requirement of load bearing structures, there is the need of increase in volume of structural elements (walls, slab).this increase in volume of the structural elements leads toward the construction of thick wall. Due to such a type of construction, labor and construction cost increases. in construction of thick wall there will be the need of great attention, which will further reduce the speed of construction.

If we make the contrast of load bearing structures with the framed structures, framed structures appear to be more flexible, economical and can carry the heavy loads. Frame structures can be rehabilitated at any time. Different services can be provided in frame structures. Thus the frame structures are flexible in use.

Braced domes may be fabricated in any of several common grid configurations. With different configurations, the dome performance varies considerably affecting both its competitiveness and suitability for specific applications. The study presented in this paper is an assessment of the most commonly adopted dome configurations and their effect on the dome characteristics such as the stiffness/weight value, member stress distribution, number of joints and members, degree of redundancy and cost. The study is parametric and covers wide variations of dome span/rise ratio and boundary conditions. The results of this study could be of significant value to the design of future braced dome structures.

How to Lay Brick

1. **Squared rubble masonry: The rubble masonry in which the face stones are squared on all joints and beds by hammer dressing or chisel dressing before their actual laying, is called squared rubble masonry.**
2. **There are two types of squared rubble masonry.**
3. **Coursed Square rubble masonry: The square rubble masonry in which chisel dressed stones laid in courses is called coarse square rubble masonry. This is a superior variety of rubble masonry. It consists of stones, which are squared on all joints and laid in courses. The stones are to be laid in courses of equal layers. and the joints should also be uniform.**
4. **Suitability: Used for construction of public buildings, hospitals, schools, markets, modern residential buildings etc and in hilly areas where good quality of stone is easily available.**

Step 1

Begin Laying Bricks

A mason's line acts as a guide for setting bricks in perfectly straight rows. It's made of two mason blocks with slots to hold a mason line.

Affix the blocks to either end of the row of bricks, with the line pulled tight. The top of each brick in the row should just touch the top of the line.

Step 2

Guide the Bricks

A story pole is a strip of wood that acts as a guide for laying bricks. Use a pencil to mark the height of each course of bricks, including the mortar joints, on the pole.

Step 3

Apply Mortar

Safety Tip: When working with mortar, always wear gloves and a mask or respirator.

Use a spade trowel to apply a generous amount of mortar to each layer of brick. Score a line through the center of the pile of mortar to allow it to spread. "Butter" the brick with mortar, spreading mortar on the sides that will affix to the bricks beside them. Use the handle of the trowel to knock each brick into place and to release any air bubbles that may be in the mortar underneath.

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Step 4

Remove Excess Mortar

Using the sharp end of the trowel, scrape off any excess mortar that spreads beyond the joint. Finish cleaning off any other debris with a brush. Holding a spade trowel at a 30-degree angle, carve small lines between the bricks and the mortar. The lines will help protect the wall from the effects of precipitation.

Step 5

Cut Bricks

Most walls require smaller bricks at their ends. Before cutting a brick, place it in a bed of sand or dirt to absorb the shock of the blow. Place the sharp end of a brick chisel at the line where you want to cut. Use a hammer to tap the end of the chisel, scoring lines on all four sides where the brick must be cut.

After scoring the lines, hold the chisel on one of them, slightly angled toward the side of the brick that will be kept and used on the wall. With your other hand, strike the handle of the chisel with a hammer. The blow should break the brick cleanly in two.

Top tips to optimally use conventional waterproofing techniques

While the first part of this two-part series examines conventional waterproofing systems and offers tips to use them for optimum effect, the second part will discuss modern waterproofing techniques.

Construction chemicals providing strength to construction industry

- ™ Waterproofing begins to fight weak monsoon
- ™ Chettinad Cement to acquire AP-based Anjani Portland Cement
- ™ Cement firms remain pessimistic after bad Q2 run
- ™ BASF to build centre for flooring and waterproofing systems in Germany

Waterproofing of building to prevent the ingress of water is an activity, which, perhaps is practiced in one form or the other, ever since the first building was built on earth. The methodology has been changing with the changes in the architectural designs and with the availability different building materials in construction.

In the initial stages when stone was the main building construction material placed in position with mud or lime mortar the emphasis used to be to make the construction in such a way that the rainwater does not collect on the roofs. Hence old architecture relied mainly on dome structures or slanting roofs. The slow speed of such construction and unaffordability of common man to build such structures for their own dwelling, made constant evolution and development in the construction material technology.

With these developments the concepts of waterproofing also changed. Now in present day construction wherein the ordinary portland cement and its blends with puzzolonic and slag materials has come to stay a lot of compatible alternatives are available for a builder to choose from various waterproofing systems. Some systems are old and conventional but still practiced successfully and some are modern systems designed taking the material and structural behaviour into consideration.

There are some compounds, which are used in plastic concrete to make it less permeable to water. These compounds are known as integral waterproofing compounds. They are based on plasticising and air-entrainment or water repellence principles. These are used as a good waterproofing precautions when other factors such as good mix-design, proper mixing/placing, compacting/curing etc are taken care of. This subject of integral waterproofing compounds requires in depth discussion hence will not be taken up here. Similarly there are some water proofing techniques for vertical surfaces. These techniques are also used for preserving heritage buildings by stopping/minimising the aging process of these buildings.

For solving water seepage problems, customers use both conventional as well as modern waterproofing techniques.

Some of the old and conventional waterproofing systems are as follows:

- ™ Brick bat coba system or lime terracing
- ™ Bituminous treatment
- ™ Metallic sheet wrapping
- ™ Polyurethane based waterproofing treatment
- ™ Epoxy based waterproofing treatment
- ™ Box-type waterproofing system

Brick bat coba system

This system was developed during the initial stages of flat roof construction with lime mortar burnt clay brick pieces. This system involved laying lightweight mortar on the roof and spreading it to give gentle slopes for draining away the rainwater immediately. The mortar consisted of lightweight brick pieces as aggregates and ground brick with lime as binding matrix.

During British rule this system became more popular not because of its waterproofing efficiency but because of its efficiency in keeping the interiors cool. Some applicators developed better skills in laying these systems, with neatly finished top with lines engraved on top of plastic mortar now known as IPS. Some practiced embedding broken tile or ceramic pieces in the plastic mortar and called it china mosaic.

This type of system remained most popular with multi-storeyed construction in all major cities. The system lasts up to 15 years if done by skilful applicators. This system may be considered more from its weather proofing abilities rather than its waterproofing qualities. Once water starts entering into the brickbat coba the brick pieces absorb too much of water and the roof becomes an invisible pond of water continuously causing leakage and increasing burden on the roof slab. It will be highly beneficial if brick-bat coba is laid on a flexible waterproofing membrane as water proofing as well as economical weather proofing can be achieved with this system.

Bituminous treatment

Discovery of petroleum and its products and by-products has given the construction industry an indispensable product in the form of bitumen. Bitumen is more commonly used in the form of felt or flexible membrane formed by sandwiching jute fabric or fibreglass/polypropylene mats with chemically modified bitumen. These membranes are laid on the roofing over a bitumen primer. There are two types of membranes one is cold applied and the other hot applied which means one needs to heat the edges of the felt with a torch so that they melt and stick to the second layer in the overlap area.

On the RCC flat roofs the bitumen felts have not been successful because of the unacceptable black appearance and inaccessibility of the terrace for other social uses. Technically it is not preferred because bitumen layer or felt on the terrace not only makes it watertight but also airtight. Concrete has the breathing property. It takes water/moisture and breathes out water vapour. Hindrance of this breathing property of concrete develops pore pressure, which causes blisters in the felt.

After a few seasons the blisters multiply and eventually delaminate the felt from the concrete surface. Hindrance of breathing property of concrete makes the concrete weak. But on the asbestos cement sheets and zinc sheets in factory roofs, this bitumen felt is the only dependable waterproofing system. Hence all factory roofs in India adopt this water proofing system.

Bitumen is very effective in waterproofing of basements from outside. Bitumen primers have very successfully been used as damp-proof course in earlier days. This practice is slowly discontinued for whatever reasons now very few engineers now believe that this was in practice once. As consequence of this absent DPC we have a lot of cases of rising dampness, which we tend to attribute to wrong reasons such as the quality or salinity of sand etc. Bitumen still is the product of first choice where it is commonly recommended, in areas such as industrial roof waterproofing, basement waterproofing, and damp-proof course. More over bitumen is the most economical product available for waterproofing.

Metallic sheet wrapping

Because of the non-existence of suitable expansion joint filling compounds before the discovery of poly-sulphides, a complex procedure used to be adopted to treat expansion joints, in concrete dams and such huge structures utilising thick copper sheets. An extension of this practice was to try thin foils of copper and aluminium for wrapping the concrete surfaces with nagging leakage problems.

Unavailability of common joining material for these metal foils and the concrete and mortar created weakness in the system at the joints. This discouraged the system in its infancy only. But there after the metal manufacturers have been trying to market this type of waterproofing system with improved adhesives as and when the metal market slumped.

Polyurethane based waterproofing treatment

Polyurethane consists of two liquid components one is called the base component and the other is called reactor or curing agent. Base is a polyol and the reactor is an isocyanide such as TDI or MDI. There are various grades of polyols and so also there are numerous isocyanides. The combination of these two ingredients results in a formation liquid applied rigid membrane or a foam depending upon the selection.

In waterproofing, this rigid liquid membrane was tried with fibreglass reinforcing mats. The systems failed because coefficients of thermal expansion of concrete and rigid PU membrane being different lateral movement or creep occurred with the passage on one working climatic cycle. When exposed to ultra violet rays or direct sunlight most polyurethane rigid membranes became brittle and crumbled.

Apart from this the application of polyurethane coating needed very rigorous surface preparation. The surface needed to be neutralised by removing alkalinity from the concrete surface through acid itching then washing and blowtorching to make the surface bone dry. This kind of surface preparation with acids angered the civil engineering community and the product ceased to be used as waterproofing material apart from its several failures. Never the less continuous research in the polyurethane technology gave the construction industry excellent sealant for glazing industry and foams for thermal insulations. The new generation polyurethanes, which are alkali stable and water-based, may find better applications in waterproofing industry.

Epoxy based waterproofing system

Like polyurethane is also a two-component system having a base resin and a reactor or curing agent. Base resin is obtained by dissolving bis-phenol A flakes in epichlorohydrin. This base is available in various viscosity ranges to suit different application conditions. The curing agent is an amine/polyamine aliphatic or aromatic, or an amine-adduct for general applications and polyamide or an amino-amide for coating purposes. After mixing base and reactor components the resultant viscous liquid or paste if some fillers are added to it can be brush applied like a paint or trowel applied like a mortar.

Here also epoxies not withstanding the alkalinity of concrete and the concrete needs to be acid washed and neutralised, which the civil engineers hated. Here again the coefficient of thermal expansion of concrete and epoxy being different the compatibility of epoxy in waterproofing exposed concrete surfaces such as roofs became limited. Later the use of epoxy in waterproofing was discarded. But epoxies have come to stay in civil engineering industry as bonding agents, floor & wall coatings, coatings for food processing units, operation theatres and computer and pharmaceutical industries.

Box type waterproofing

This type of water proofing system is used only for basement waterproofing or waterproofing structures below the ground level from outside to prevent leakages of subsoil water into the basement.

In this method, limestone slabs (Shahabad Stones) are first laid in the excavated pit over blinding concrete in a staggered joint fashion to avoid the continuity of the mortar joints. The joints are effectively filled with rich mortar admixed with integral waterproofing compound and cured. Over this the raft is laid and shear/brick walls constructed. The limestone slabs are erected around the walls in a similar fashion leaving a gap of one to two inches between the external surface of the wall and the inner face of the stone surface. The joints again effectively sealed with rich admixed mortar and the same mortar is filled in the gap between the wall and the stones. This stonework is continued up to ground level. In this system the raft and the sidewalls are protected from direct exposure to sub soil water.

This system works on two principles of common sense. First, the area exposed to subsoil water is only the area of the joint where as the whole stone is impervious to water, hence only a fraction of area, that is, that of the joint is exposed to subsoil water, when the joint itself is filled with rich and quality mortar. Second, the path of water to reach the raft or the sidewall is elongated. This elongated path is through quality mortar. This system seeks to delay the occurrence of leakages in the basements. A lot of building structures are waterproofed by this system. A few notable successes are to its credit especially in five star hotels and of-course there are a few failures as well.

5 Types Of Roofs To Consider

Editor's Picks

High Humidity Care for Your Outdoor Wood

Pool Safety Tips

Repairing a Winter-Damaged Deck in 3 Easy Steps

Top 5 Pinterest Shabby Chic DIYs

Terms of the Trade: What Is an Allen Wrench?

Several **types of roofs** are available for residential construction. Different materials are chosen according to their various qualities, advantages and disadvantages. Roofing a house is quite a cost-intensive affair and you need to be prepared with sound information prior to making your investment. Here‟s an overview of some of the most used types of roofing:

1. Wood Shingle Roofing

Wood shingles are also known as shakes and they are especially ideal if you appreciate naturally beautiful looks. They will gracefully age with your house while retaining their aesthetic appeal. Wood shingle roofing is quite expensive though it makes up for the cost with its durability. Most people have concerns with this type of roofing especially with issues like fire, splitting, rotting and molding. Always invest in shingles that have been treated with special protective glazes and finishes.

2. Slate Roofing

Another beautiful yet very costly roofing material is slate and is especially appropriate if your house is in the French or Colonial design style.

Slate roofing is ideally composed of thin layers of rock and as such the roof is bound to be quite heavy. For this reason it is advisable to first put in place adequate structural support. Laying this type of roof can be quite complicated for a DIY project and the installation is better off when done by a licensed contractor.

3. Tile Roofing

Tile roofing is an option that goes very well with your house if it is in the Spanish or Mediterranean design. There are two types of roofing tiles: clay tiles and concrete tiles.

Tiles are generally laid down on relatively new houses that have adequate structural support since tiles, like slates, are quite a heavy load. The services of a professional contractor will come in handy if you are not confident about taking on the task yourself.

Tile roofing is also quite costly but if properly maintained it can give proper service for up to 50 years.

4. Metal Roofing

Metal roofing options are fast gaining a good reputation in building circles despite their initially high costs. These roof types boast durability as well as low maintenance qualities that extend their life beyond other conventional roof types.

In terms of design and style you‟ll be glad to know that it‟s possible to get metal roofing that has been made to resemble different roofing types including slate, wood shingles and cedar.

5. Asphalt Roofing

Certainly the most affordable of roofing types has to be asphalt. Asphalt shingles that are made from the conventional highway asphalt are the least expensive. You can also invest in the costlier option that is known as architectural shingles.

Cheap asphalt shingles are not the best if you intend to have a stylish roof. They will also disappoint with their short lifespan. Architectural shingles are much more presentable.

Both of these options are quite prone to scarring and may also succumb to the occasional mildew depending on the weather. They are also not environmentally-friendly and upon replacing them you‟ll need to take the waste to a landfill.

Acoustic, Thermal, Fire and Safety

Acoustic, Thermal, Fire and Safety

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Noise reduction is an increasing priority in both new build and renovation projects. Isover offers a range of high performance acoustic installation solutions.

Our Acoustic Partition Roll (APR 1200) is the only acoustic insulation product that forms part of the British Gypsum SpecSure® Lifetime Warranty.

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With an impressive array of products, in both roll and batt formats, to suit every conceivable application and a wide range of lambda values the Isover thermal insulation range is second to none.

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Definition of lambda:
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