

Construction Technology



Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
Sanathimi, Bhaktapur

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Technical and Vocational Stream
Learning Resource Materials

Construction Technology
(Grade 9)

Secondary Level
Civil Engineering



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Preface

The curriculum and curricular materials have been developed and revised on a regular basis with the aim of making education objective-oriented, practical, relevant and job oriented. It is necessary to instill the feelings of nationalism, national integrity and democratic spirit in students and equip them with morality, discipline and self-reliance, creativity and thoughtfulness. It is essential to develop in them the linguistic and mathematical skills, knowledge of science, information and communication technology, environment, health and population and life skills. It is also necessary to bring in them the feeling of preserving and promoting arts and aesthetics, humanistic norms, values and ideals. It has become the need of the present time to make them aware of respect for ethnicity, gender, disabilities, languages, religions, cultures, regional diversity, human rights and social values so as to make them capable of playing the role of responsible citizens with applied technical and vocational knowledge and skills. This Learning Resource Material for Civil Engineering has been developed in line with the Secondary Level Civil Engineering Curriculum with an aim to facilitate the students in their study and learning on the subject by incorporating the recommendations and feedback obtained from various schools, workshops and seminars, interaction programs attended by teachers, students and parents.

In bringing out the learning resource material in this form, the contribution of the Director General of CDC Dr. Lekhnath Poudel, Dr. Jagatkumar Shrestha, Dr. Kamal Thapa, Dr. Bharat Mandal, Purushotam Chapagai, Anil Phuyal, Kedarnath Dahal, Manoj Pujara, Anil Phuyal, Arjun Basnet is highly acknowledged. The book is written by Jagadishchandra Karki and the subject matter of the book was edited by Badrinath Timalsina and Khilanath Dhamala. CDC extends sincere thanks to all those who have contributed in developing this book in this form.

This book is a supplementary learning resource material for students and teachers. In addition they have to make use of other relevant materials to ensure all the learning outcomes set in the curriculum. The teachers, students and all other stakeholders are expected to make constructive comments and suggestions to make it a more useful learning resource material.

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Unit: 1

Construction Materials

1.1. Objective

- To develop the understanding about the material used in construction, its properties and importance
- To familiarize with student with different type of mortar
- To compare with clay mortar and cement mortar and lime mortar
- To list out other different mortar construction material
- To gather information about glass, plastics, bitumen, timber

1.2. Content

Introduction to construction material

Construction Technology

Construction technology refers to the study of methods, techniques, applications, tools and equipment used for different civil engineering construction.

Materials : The substance by which a thing is made or composed.

1.3 Types of Materials

- Brick
- Sand
- Stone
- Cement, etc.

Engineering Materials

- It deals with the study of engineering materials with respect to the following:
 1. Physicals and chemical composition, mineral
 2. Different properties of materials: physical, chemical, mechanical, thermal properties.
 3. Use of the materials as per the technology.
 4. System arrangement : Effective, economic and long lasting methodology of section and handling of the engineering material.

5. Method of manufacturing and quality testing.

Brick

● **What is brick?**

Brick is a type of material used in various constructions, made by moulding the tampered clay to suitable shape and size. It is one of the oldest and most a tensely used materials.

● **Composition of Brick**

It consists of silica, lime, iron oxide, ammonia, alkalies, magnesia, etc.

● **Harmful things**

- Excess of lime
- Pebbles and gravel
- Organic matters
- Roots and plants

● **Characteristics of Brick**

1. Uniform textures of brick.
2. It should not absorb more than 15% of it's dry wet, when we keep it in cold water for 24 hours.
3. Uniform burnt with deep red color.
4. If we strike 2 brick then the sound must be metallic.
5. The shape and size of the brick should be true to design.
6. The edge must be sharp.

● **Uses of Brick**

1. It is used in soling the foundation of building on other things.
2. Brick masonry in building construction.
3. Compound wall around house, field, etc.
4. Soling of brick in street or foot path, etc.

Sand

Sand is material used during construction of various civil work which is in small

loose granular material consisting of rock particles and minerals grain. More or less they are in round shape which are found in river bank and sand quarry.

Characteristics of Sand

- It must be free from soil which could make mort's weak.
- It must be round in shape, hard ion strength and good appearance with shining character.

Uses of Sand

- It is used for drying brick soling in footing and in foot path.
- It is used for making cement mortar.
- It is used in constructing block and other compost materials.
- It is also used for plaster work, PCC work and RCC work.

Importance of Sand

- It is used as filling materials.
- It is used in all civil construction.

Cement

Cement is the binding material which is obtained by the combination of line stone, clay, silica and other different materials which are burnt in clinker and grinding to fine particles.

- **Composition of cement**
 - Lime
 - Silica
 - Alumina
 - Magnesium oxide
 - Sulphatic oxide, Sulpher dioxide
 - Potash and other hardening materials

Properties of Cement

- Cement is the cementitious binding materials.
- It has the capacity of adhesive.
- It also has the property of air entrapping agent.

Uses of cement

- Cement is used throughout the construction.

Types of Cement

- OPC = Ordinary Portland Cement.
- PPC = Pozzolona Portland Cement
- Ultra- Cement
- Rapid Hardening Cement
- Water Cement.
- Quick setting Cement, etc.

OPC = It consists of lime particles more than other composition. It starts hardening after 30 minutes.

PPC = It is made only for plastering. It has only 50 mpa. They are weak in Strengthen. But they make smooth surface. They are good in hardening.

PPC = Plain Cement Concrete

= It is done without steel

RCC = Reinforcement Cement Concrete

= It is done using rod.

Stone

Stone is a natural material which is generally obtained from a quarry which is used for various construction works. Stone are usually solid, compact and hard material which is used since from prehistoric days.

Characteristics of stone

Appearance = Stone are also used for face work so the stone should be fine, compose good texture and light colour.

Structure = Stone should have uniform texture and homogenously compacted.

Weight = Weight of stone should be enough to resist load on it.

Hardness = It must be tough enough so that doesn't get wear and tear due to different water condition.

Porosity and absorption = Stone having more porous absorb more water so it is not suitable for building construction.

Uses of stone

- It is used as stone aggregate.
- It is used as beam, slab, and lintel on building.
- It is also used in retaining wall on road side.
- It is used for stone block in the area where brick are not easily available.
- Stone sheet are also used for roofing, flooring and pavement on the road
- It is also used for architectural purposes.

Importance of stone

- Due to the high strength of stone it is used in retaining wall, beam, slab and for other heavy load resisting condition.
- Its is more important on the hilly region where brick and other material are not easily available, but it is unsafe for building purpose.
- Dry walls in river side stop soil erosion.

Block

Blocks are mixture of cement and stone chips or stone aggregate which are solid and usually hollow in shape of rectangular cross section or area. It is used for different purpose in civil construction. It is made for light density material. So, it is light in weight in comparison to other materials (Brick, stone) and it improves insulation of sound and heat.

Characteristics of block

- It is well shaped and completely dry for good character.
- It must have uniform texture and smooth surface as possible.
- For the good strength, curing must be done for one week.
- It should be strong enough to resist load on it.
- It has better insulating properties of heat, sound and dampness.
- It is light and carries to handle.

Uses of block

- It is widely used in construction of school, compound wall, partition of room, etc.
- Because of lightness, it is used in building construction, so that less load is transferred for foundation.
- It is used to reduce layer and joint in masonry work.
- It is also suitable where bearing capacity of soil is low.

Mortar

Mortar is the workable paste used to bind all construction work in a block or one isolated form. Mortar makes a bind together to a stone work, brick work and block masonry and other works. It fills and seals for the regular gap between joints. It is also added for the decoration work and for coloring and for different pattern work in the masonry wall. Mortar are typically made up of mixture binder (lime, clay, cement) with water.

Type of Mortar

- Clay Mortar
- Cement mortar
- Lime mortar
- Composite mortar

Clay Mortar

It is the mortar which is mixture of earth's mud with water for wetness and better adhesiveness between mortar and masonry. These types of mortar are used for different purpose of construction and where other types of mortar are not easily available. However they are not suitable for different climatic condition.

Properties of clay mortar

- It has good binding properties and it will make the masonry strong enough.
- As clay has more adhesive character, it will bind masonry work very tightly.
- It should not get more percentage of water. It is more difficult to use in masonry work, if it gets in liquid.

Uses of clay mortar

- It is used to construct building with good binding capacity.
- It is used in other place where cement is not available.
- It can be done in very low budget project.
- It can fill mountainous sides.

Characteristics of clay mortar

- It is hard shaped.
- It makes wall beautiful.
- It is used to add decorative characteristics
- It is used for protecting ancient building repairing

Lime mortar

Lime mortar is a types of mortar consisting of lime and aggregate such as sand, gravel (stone chip) mixed with water. Lime is a oldest type of mortar and it softly binds material in compared to cement mortar but lime mortar can be prepared for better binder on mixing with brick, dust, clay, and other chemical composition for lime Shurki.

Properties of Lime Mortar

- It has soft and porous property.
- It has property of stabilizing the internal humidity and absorbing moisture contained inside the room.
- It has good finishing like smooth surface and easily removable and has long lasting durability.
- It contributes to a healthy ownself.

Uses of Lime Mortar

- It is used for the construction of building masonry compound wall and other different structures.
- Due to its smoothness in finishing and better binding properties, it is widely used in construction of different buildings

- It is used in hilly region and mountainous region mostly due to the better characteristics of healing properties.

Importance of Lime Mortar

- Limes contribute the health environment.
- It heals ownself.

Cement Mortar

It is the mortar which consists of the cement and sand with water for mixing and it binder. A substance that sets and binds with cement as a binder and it also reacts with carbon dioxide and binds aggregate along with masonry units. Mixing cement with sand and water will result a paste more commonly known as cement mortar.

Properties of Cement Mortar

- It should provide strength and fill in air in sand
- It should be free from crack
- It has high strength binding properties than other mortar
- It has quick setting character
- It gets solidified during setting times

Uses of Cement Mortar

- It is used to construct the building and other civil work.
- It is mostly useful where lime mortar and clay mortar are not easily prefer as design.
- It is used for long project and in large scale project for good strength.

Composite mortar

It is a type of mortar where cement and lime both are used as binding material. Basically, it is a lime mortar where cement is added to gain higher strength. It is also called gauged mortar.

1.4 Other materials

3. Learning process and support materials

Teaching learning process should be facilitated through different methods, techniques and strategies that fit to the subject content and students needs. It's the

teacher who can bring variety to the teaching learning process through various methods and strategies. In particular, the teacher can make use of the following strategies in teaching learning process :

- a. Group discussion
- b. Drawing presentation
- c. Site visit nearby school

Similarly with reference to the support materials, the teachers can make use of this resource material and other relevant materials as per content and learners' need.

4. Assessment

a. Very Short Questions

- 1. What do you mean by construction material?
- 2. What is building stone?
- 3. Define brick with figure.
- 4. Define block.
- 5. What is timber?
- 6. What is mortar?
- 7. Write the size of brick according to Nepal Standard (NS) .
- 8. What is cement?
- 9. What is lime mortar?
- 10. What is cement mortar?

b. Short Questions

- 1. What are the characteristics of brick?
- 2. What are the characteristics of good building stone?
- 3. What are the characteristics of mortar?
- 4. What are the uses of brick?
- 5. What are the uses of stone?
- 6. What are the uses of block?
- 7. What are the uses of sand?
- 8. Write the composition of brick?
- 9. What are the uses of timber in civil engineering works?

c. Long Questions

1. What is mortar? What are their types? Explain.
2. What is cement? What are their compositions?
3. Explain the major types of cement.
4. What is stone? What are the characteristics of Stone?

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Unit: 2

Masonry Works

1. Objective

- To familiarize students about different masonry component.
- To give basic idea about dressing of stone.
- To provide basic idea about terminology of brick .
- To help students to supervise stone and brick masonry works.

2. Content

Masonry work

Stone Masonry

Types of Stone

There are 3 types of rocks :

- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

Some of the special stones properties, classification of stone or geographical stone

Types	Stone	Nature	Color	Uses
Igneous Rock	Granite, trap	Hard and strong Heavy and hard	Grey, Green, Browns to Black Grey Blueish and Black	Heavy engineering work like pier, bridge, abutment, lighthouse, road pavement Road metal, paving concerting
Sedimentary Rock	Lime stone sandstone	Stratified soft	White, grey yellow, black	General building work
Metamorphic Rock	Marble slate	Stratified Laminated	White grey Mizing blueish black purple	Ornamental works finishing work Roofing D.P.C, flooring in bathroom

Other purposes of masons work

1. Face work of Building, Marble, Granite, stone, Paving floor.
2. Steps, Staircase, Land, stone, marble
3. Fire resistance masonry, Compacted sand stone

Physical Classification

- a. Stratified, it can be split along distinct layer.
- b. Unstratified: it cannot be split along distinct layer.
- c. Foliated: Heavy tendency to split in certain direction.

Classification of Stone masonry

- The block of stone that are used either undressed or comparatively rough dress.
- The masonry has white joints since stone in irregular size are used.

1. Random Rubble Masonry

1. Uncoursed: It is the roughest and cheapest form of stone masonry where of stone are of widely different size stone are not in uniform shape and size and irregularity have to be exercised in arrangement them in such a way that they adequately distribute the pressure and continuously vertical joint are avoided.

2. Built to coursed

This method of construction is same as uncoursed except the work is roughly level of two form course carrying from 30-45 cm thick. The entire courses are at same of masonry. The quoins are built first and a line stretch between the top of quoin are leveled. This form of masonry is better than uncoursed Random Rubble Masonry.

3. a) Brick is the oldest and most intensively used material that is made by moulding of tempered clay with suitable shape and size, which is in plastic condition, heated in sunlight and burnt in kiln.
 - b) Brick should not absorb water more than 15% or less than 15% then, it is not suitable for building construction, Some other characteristics of brick are:
- Uniform in texture.

- Burnt with deep red colour.
 - If we strike two bricks the sound must be metallic.
 - Frog is depression on the top of the brick.
 - The shape and size should be true to design.
 - The edge must be sharp.
4. Cement binder has better bonding than other mortar.
 5. a) "Quoin" word play vital role in masonry work. Quoin is the part of a brick. If we cut a brick in 2 halves, it is half quoin. If we cut a brick in $\frac{3}{4}$ halves, it is quarter quoin. We use quoin to make the vertical joint in different place, If the vertical joint is in different place then the masonry becomes strong. If we don't use quoin, the vertical joint lie in same place, which make the masonry weak. So, quoin play vital role in masonry work.
 - b) Built to course also use the same stone as used for uncaused square rubble but the work is labeled up to the course to varying depth. Each course may contain quoin and through stone and with small stone used in between them make masonry strong.
 - c) Block are the mixture of cement and stone chips that are used in different civil construction hollow in shape at rectangle which is light in weight in compare to other materials like brick, stone etc.
 - d) Properties of block that make useful in civil engineering are :
 - Light in weight
 - Less requirement of block
 - Insulation of heat and sound.
 - Easy to handle.

Uses of block are

- Used in construction of school compound, field compound, etc.
- Used to reduce layer and joint in masonry work.
- Used in building constructions.

3. Flint walling

The stone used in the masonry are finished cobbles with varying in width and thickness from (7.5 to 15cm) and its length is form (15 to 30cm) . These stone are in irregular shape and extremely hard which are battle in character. So, they can easily break down, the face arrangement of cobble may be either coursed or uncoursed or built to course. The strength may be increased by introducing lasing coursed pf either thin, long stone or brick at vertical interval of 2 meter.

4. Day Rubble

It is made to course in which mortar are not used to join the joints. This type of construction is the cheapest due to its material required. It also requires skill manpower. This may be used for non-loading wall such as compound wall, on river training wall, retaining wall, etc.

ii. Ashlar masonry

Ashlar is thinly dressed either an individual stone that has be worked until square in shape and good finish. It is the finest stone masonry until generally cuboid in shape or less frequently in trapezoid in shape. It consists of block composite of accurate dressed stone which can be easily, laid out on the level course. The block in each caused is kept equal but it isn't necessary to keep all the course of same height. It is sub divided into :

- a. Ashlar fine tool.
- b. Ashlar rough tool.
- c. Ashlar rock faced
- d. Ashlar chamfered
- e. Ashlar block in course.
- f. Ashlar facing.

a. Ashlar Fine Tool

This is the finest type of masonry work where each stone are dressed to regular shape and size so that it makes the masonry work perfectly horizontal and vertical levelled surface. In this masonry joint are also in horizontal and vertical straight line with adjoining stone which gives good appearance on elevation. The bed joint

and face is chisel such that all unevenness is completely removed and a fairly smooth surface is obtained. The top and bed is also dressed roughly so that it creates a friction between mortar and stone. The side surfaces which are joints in vertical are also dressed and edge must be straight. In this masonry the exposed joints are finally fine pointed.

b. Ashlar Rough Tool

In this types of masonry, the bed and size of each stone are finely chisel dressed by rough tool as a strip about 25mm wide and made by the means of chisel. The size, angle, edge, etc. are maintained order similar to fine dressed. The thickness of mortar joint should not be more than.

c. Ashlar Rocked Face

In these types of masonry, the exposed face of stone is not dressed but it is kept as such to give rough facing however strip is about 25mm wide made by the means of chisel. Each stone block however maintained fine to its size with perfectly straight edge. These types of masonry give massive appearance on edge. This type of masonry is mostly useful in staining wall and where face surface is exposed.

d. Ashlar Chamfered

This is the special form of rock faced Ashlar masonry in which the strip is provided by the perimeter of exposed face and chamfered or beveled at the angle of 45 on the every corner of stone block by the means of chisel on the depth of 25mm due to which it gives special appearance on it's joint.

e. Ashlar Flushing Block

This type of masonry is provided along with brick or complete block masonry to give better accusation. The size and breadth of each block are properly dressed so as to make them true to shape. The exposed faces of stone are roughly tooled and sometime some layers (coursed) are chamfered.

Dressing of stone

The surfaces of stone obtained from quarrying are rough. The blocks are irregular in shape and non-uniform in size. Hence, dressing is essential. Dressing is the process of making irregular stone block in its required shape and size and dressed

on face with the help of different tools and equipment manually.

Stone are soft due to the moisture. Therefore most experience worker is needed while dressing if the stone are dressed at the quarry side, it may reduce the transportation cost because of reduction of weight due to dressing.

Dressing tool

- i. Club hammer
- ii. Dummy hammer
- iii. Hand saw
- iv. Plane chisel
- v. Tooth chisel and other tools.

Types of Bonds in brick masonry

1. Stretcher bond
2. Header bond
3. English bond and
4. Flemish bond

1. Stretcher bond

Longer narrow face of the brick is called stretcher as shown in the elevation of figure below. Stretcher bond, also called as running bond, is created when bricks are laid with only their stretchers showing, overlapping midway with the courses of bricks below and above. Stretcher bond in the brick is the simplest repeating pattern. But the limitation of stretcher bond is that it cannot make effective bonding with adjacent bricks in full width thick brick walls. They are suitably used only for one-half brick thick walls such as for the construction half brick thick partition wall.

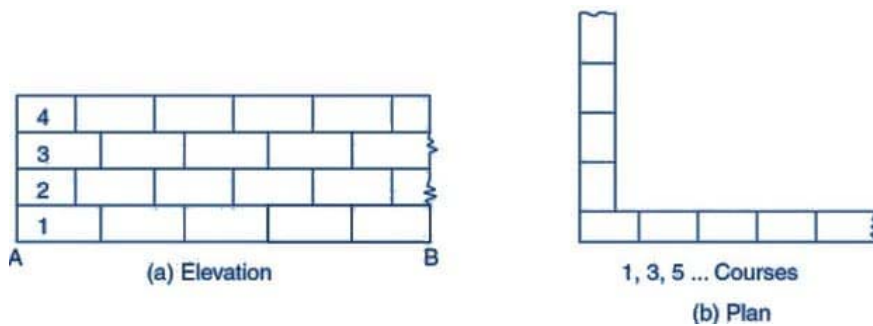


Fig-1: Stretcher Bond

2. Header bond

Header is the shorter square face of the brick which measures 9cm x 9cm. Header bond is also known as heading bond. In header bonds, all bricks in each course are placed as headers on the faces of the walls.

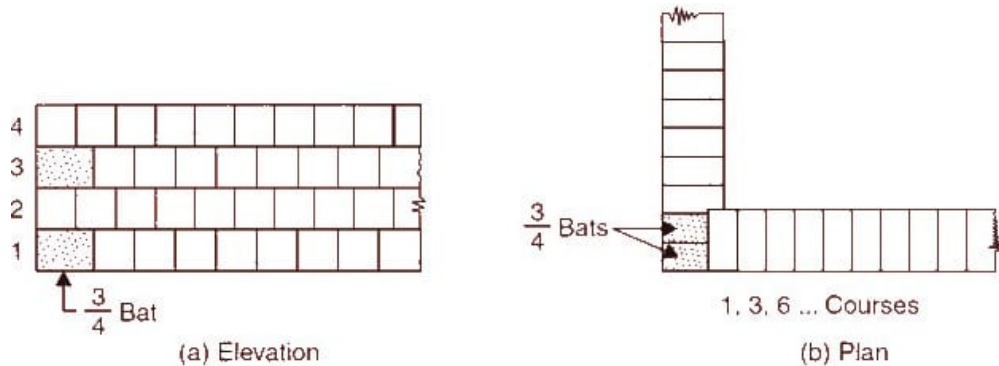


Fig-2: Header Bond

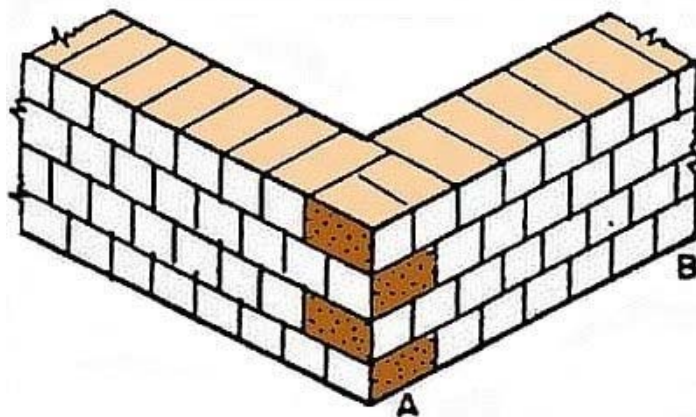


Fig-3: Header Bond Isometric View

3. English Bond

English bond in brick masonry has one course of stretchers only and a course of header above it, i.e. it has two alternating courses of stretchers and headers. Headers are laid centered on the stretchers in course below and each alternate row is vertically aligned.

To break the continuity of vertical joints, quoin closer is used in the beginning and end of a wall after first header. A quoin close is a brick cut lengthwise into two halves and used at corners in brick walls.

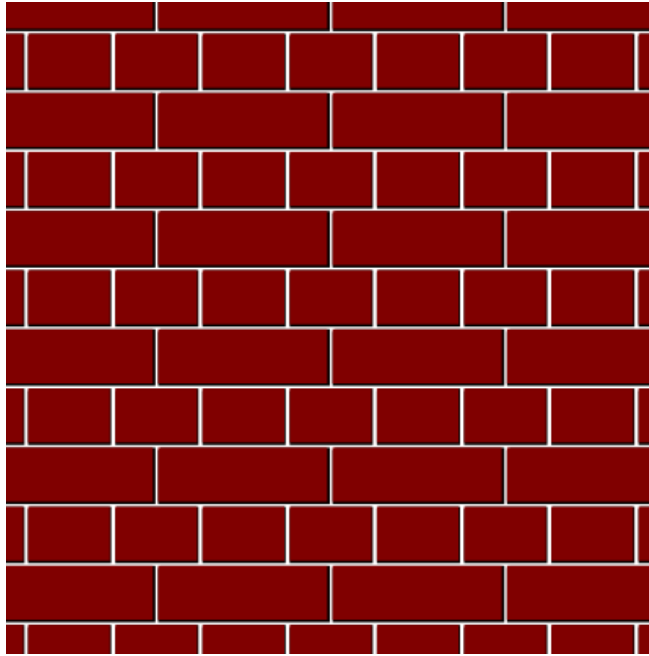


Fig-4: English Bond

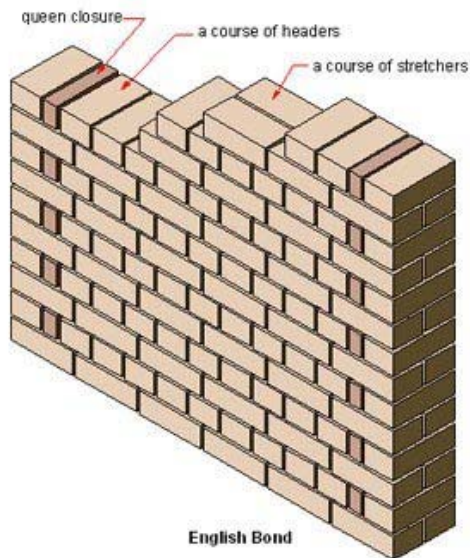


Fig-4: English Bond – Isometric View

4. Flemish Bond

For the breaking of vertical joints in the successive courses, closers are inserted in alternate courses next to the quoin header. In walls having their thickness equal to odd number of half bricks, bats are essentially used to achieve the bond.

Flemish bond, also known as Dutch bond, is created by laying alternate headers and stretchers in a single course. The next course of brick is laid such that header lies in the middle of the stretcher in the course below, i.e. the alternate headers of each course are centered on the stretcher of course below. Every alternate course of Flemish bond starts with header at the corner.

The thickness of Flemish bond is minimum one full brick. The disadvantage of using Flemish bond is that construction of Flemish bond is difficult and requires greater skill to lay it properly as all vertical mortar joints need to be aligned vertically for best effects.

Flemish bonds have better appearance but are weaker than English bonds for load bearing wall construction. Thus, if the pointing has to be done for brick masonry walls, then Flemish bond may be used for better aesthetic view. If the walls have to be plastered, then it is better to use English bond.

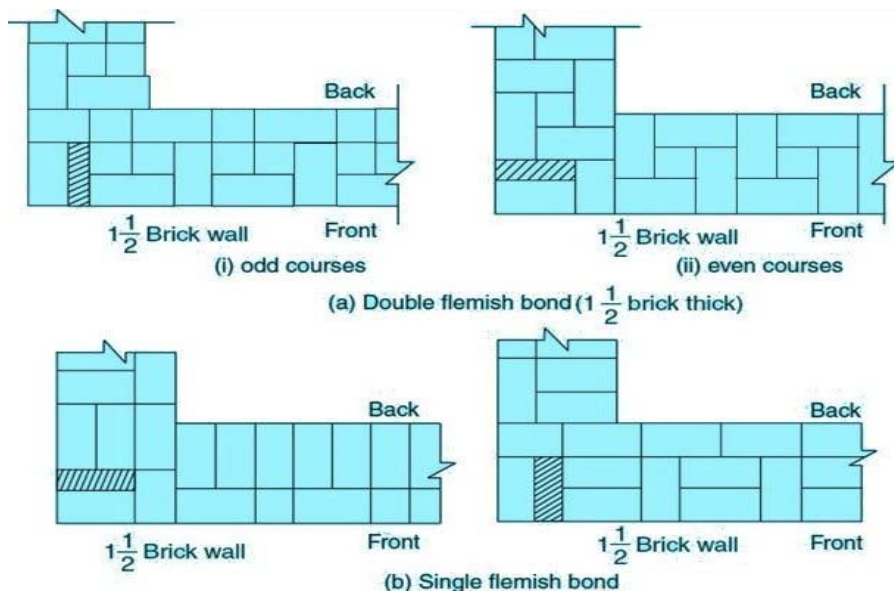


Fig-5: Flemish Bond

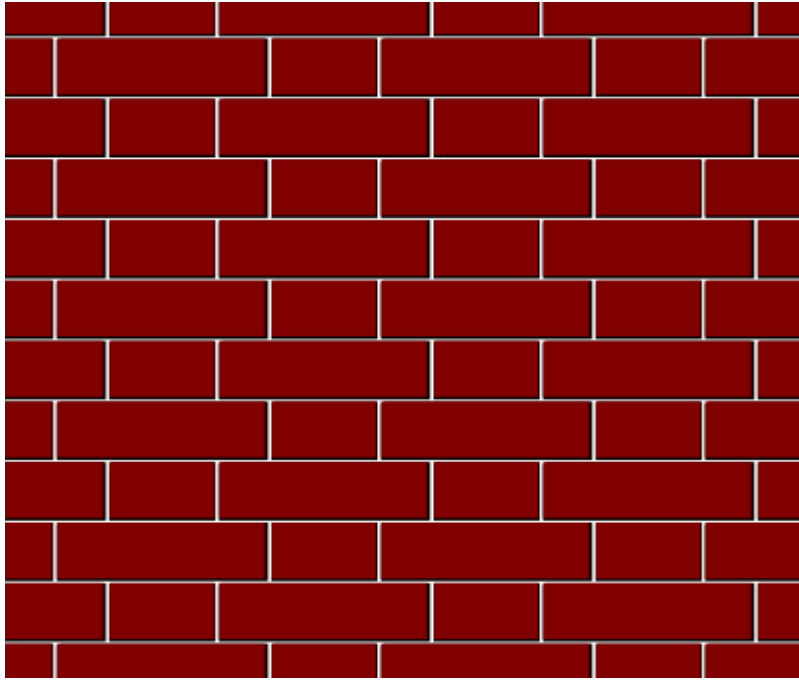


Fig-6: Flemish Bond Front Appearance

Difference between English bond and Flemish bond are as follows:

1. English bond is much stronger than Flemish bond for the walls thicker more than $1\frac{1}{2}$ brick.
2. Flemish bond shows more attractive and pleasing appearance of masonry work.
3. Flemish bond is economical as it uses broken brick bats, although it requires some extra mortar for additional joints.
4. Uses of Flemish bond is a bit difficult than English bond. Flemish bond requires more skilled labour and supervision.

Supervision of brick masonry

1. The brick to be used for the site should be of specified required design and should be the property of hardness, strong, well-burned and should be uniform $\overline{\text{N}}\overline{\text{N}}$ shape and size with smooth and plain surface.
2. The brick should be soaked in water for 24 hours before use. But in case of mud mortar brick shouldn't be soaked for 24 hour.
3. The brick should be properly laid on the bed with fig on the top surface and

the mortar should be completely filled and next brick should be laid lightly pressed to make uniform joint.

4. All joints should be properly flushed and filled with mortar at great consistency. So, that no cavity is laid between them.
5. The brick work should be carried out perfectly at the end and corner of wall and should be perfectly levelled and must be truly in plumb bod.
6. The brick work should be done in proper bond suggested by designer.
7. The mortar should be used of specified quality and must be in proportion.
8. Old mortar should not be used in masonry work.
9. Where cross wall should be in-sorted for lateral extension or joint the toothing should be provided and steps should be provided for continuous brick work.
10. If plastering of pointing is not done in brick masonry then the mortar joint should be flushed and finished at the same time of lying.

Supervision of stone masonry

The following principles should be followed during construction of stone masonry:

1. The stone used in masonry should be durable and strong.
2. All stones should be well watered before laying to avoid absorption of moisture from mortar.
3. All stones should be properly dressed.
4. The stones should be laid on their natural bed so that pressure acts normal to their bed.
5. The different sized stones should be placed so that continuity of vertical joints is broken in the structure.
6. The stones from opposite faces should make proper bond with each other.
7. The height of stone should never be greater than their minimum horizontal dimension.
8. Small stone chips should never be used in bed joints.
9. Quoins should be laid as stretcher and header in alternate courses.
10. Large flat stones used as bed plates should be provided under the ends of beams, girders etc.

11. The hearting of the masonry should be properly packed with stone chips to avoid hollows.
12. The upper surface of old structure must be cleaned before placing fresh mortar.
13. The joints on the surface should be raked at least 2.5 cm deep and pointed with rich cement mortar.
14. Double scaffolding should be used.
15. After masonry is laid, it should be cured for a period of 2 to 3 weeks.

3. Teaching learning process and support materials

Teaching learning process should be facilitated through different methods, techniques and strategies that fit to the subject content and students needs. It's the teacher who can bring variety to the teaching learning process through various methods and strategies. In particular, the teacher can make use of the following strategies in teaching learning process :

- a. Group discussion
- b. Drawing presentation
- c. Site visit nearby school

Similarly with reference to the support materials, the teachers can make use of this resource material and other relevant materials as per content and learners' need.

2. Assessment

a. Very Short Questions

1. What is brick masonry?
2. What is stone masonry?
3. Define dressing of stone.
4. What is quarry sap?
5. What is English bond?
6. What is header bond?
7. What is queen closer?
8. What is Flemish bond?
9. Why is English bond stronger than Flemish bond?

10. What is stratified rock?

b. Short Questions

1. Define dressing of stone. List out the dressing tools.
2. List out the types of stone masonry.
3. Differentiate between king closer and queen closer.
4. Define Rubble masonry and Ashlar masonry.
5. Differentiate between English bond and Flemish bond.

c. Long Questions

1. What are the defects in brick masonry? Explain.
2. Describe the supervision procedure of brick masonry.
3. If you are appointed as a site supervisor in construction site of stone masonry and you are requested to supervise the stone masonry work, what do you suggest them? Explain.
4. What is brick masonry? What are the types of bonds used in brick masonry?
5. What is stone masonry? What are the types of ashlar masonry? Explain.

Glossary

Header: header brick which is laid with its length perpendicular to the face of the wall.

Stretcher: Stretcher brick which is laid with its length parallel to the face of the wall.

Bond: The bond in brick masonry is developed by the mortar filling between layers of bricks and in grooves when bricks are laid adjacent to each other and in layers in walls.

Supervision:

Defects:

Reference materials

Galami T.B., A Text Book of Construction (Part -I), CTEVT.

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Unit: 3

Concrete Works

1. Objective

- To familiarize students about concrete works .
- To explain about factor affecting the strength of concrete works.
- To describe different technique of formwork.

2. Content

Concrete Work

Concrete work is defined as a solid rigid isolated form of mixture of sand, cement, aggregate with admixture of different properties with water on drying property gain hardness to tough as smooth surface in finish work on doing construction work the essential part is concrete work and it's uses throughout the civil work.

Formworks

A formwork is the temporary structure used to support reinforcement of wet concrete, work man during construction of different types of structure in civil construction of civil work.

Removal of formwork

- vertical Side
- Beam
- Column

Item	Normal Cement	Rapid Cement
Vertical side of foundation beam wall	(2-3) days	1 days
Slab, Soffit	14 days	7 days
Slab props	14 days	7 days
Complete removal of beam/ slab	28 days	8 days

A formal should be removed in such way that concrete is not damaged due to the soft vibration, then wedges are slowly gradually and carefully removed in other ton prevent from other damage. The load should not transfer suddenly to the concrete

by removing formwork. In the slab, beam construction stripping a formwork should be done in a following way:

- Side of beam, Slab should be first.
- Under the sides of slab should be strip and beam to lastly.
- The normal temperature for stripping the formwork should be 20°C cool temperature.
- The stripping time is longer in generally 20 days of casting.
- After removal of formwork concrete work should be repair if it is defective.

Material in formwork

- Plywood
- Timber
- Wood
- Steel
- Ammonium
- Plastic

Requirement in Formwork

- Strength
- Low Cost
- Finish
- Formwork True To Design
- Proper Material

Strength

Formwork is a temporary structure but also should be made in such way that carry the load of materials labors and other equipment used in construction.

Low Cost

The formwork should be made in low cost but should be quality.

Finish

The formwork should be finished in proper way for the betterment of work.

Formwork True To Design

Formwork should be designed in true manner that there is no any deflection. It should be in proper shape and size.

Proper Material

The material used in formwork should be proper specified so that the quality gives well.

Characteristics of Formwork

- It must be strong enough to carry weight of concrete.
- It should resist and carrying the load by workers.
- It should be strong enough to withstand to load coming on it such as, dead load of concrete, live load during and after casting of concrete.
- It should be stiff enough so that the deflection compacted by tamping or vibrating.
- It should have tight enough between adjacent panels to prevent escape of liquid concrete.
- The formwork should be constructed in such a manner that it may permits the removal of various part in design sequent without damaging the concrete the material of formwork should be easily available and should be suitable for reused several time.
- The surface of formwork should be smooth and it should be easily stripping.
- The material of formwork should not be unripe when exposed to sun, rain or water during construction.

Construction of formwork (technique of formwork)

- Propping and centering
- Shuttering
- Provision of camber
- Cleaning and surface treatment
- Propping and Centering

Props used for centering may be steel or timber, bamboo, pillar made up of brick

masonry with mortar are also used as crops. If wood post are used then its base should be rest on square wood plate lead of ground. The plate should be at least of 0.1 meter square and 40mm thick with double way wedge are provided between the plate and the timber crops to permit the accurate adjustment of shuttering and to allow easily removable.

Shuttering

They are either timber planks plywood fixed to the timber frame and shuttering should be continuous so that the joint should be tight enough to prevent from the lockage of cement mortar. Shuttering is done on slab, beam, column as per required. Similarly the opening for other fittings should be provided as per detail drawing.

Provision of camber

The certain amount of deflection in the structure is not available. So it is required to give upward and camber in the horizontal member of concrete the structure usually in the long span while fixing the formwork provisional camber at the rate of 4mm per meter per span. In the cantilever the camber at the free end should be normally taken as $\frac{7}{5}$ of the projection of cantilever.

Cleaning the surface treatment

The surface of formwork should be clean and it should be have smooth surface.

Compaction

It is the process of making concrete work in each definite shape and size and removing air from after placement of concrete in a formwork doing remaining, tamping or vibrating to made homogeneous ratio in a concrete work.

Curing

It is the process of gaining strength to the concrete by providing water for the chemical reaction between cement, sand and concrete to make hydrate to the concrete.

Types of curing

- Mechanical Curing

- Steam Curing
- Chemical Curing

Water Curing

- Ponding
- Cover with weight sack
- Sprinkle of water

Component of concrete work

- Material
- Cement
- Sand
- Aggregate- Fine and Course
- Water
- Admixture
- Aggregate

It is the form of small size particles from the stone which is obtained directly from the crushes.

Types of aggregate

- Rounded
- Irregular
- Angular

Rounded

It seems like rounded. If we use rounded aggregate there will be minimum (32-33) % void. It is not suitable for large scale work and high strength.

Irregular

Minimum void (35-38)%. It is not suitable for high strength work.

Angular

Minimum (38-40) % it is suitable for high strength work due to good bond between the sand, cement and aggregate. Angular aggregate can be obtained from only

crushes. So, it is expensive also.

Grading of Aggregate

It is the process of making the aggregate homogeneous of different qualities of aggregate for used in construction work.

Admixture

It is the material other than cement, water, aggregate which is used as ingredient of concrete.

Aggregate is added before mixing their types and it is highly modified properties of ordinary cement by chemical reaction admixture the improved strength work ability.

- Air enter trapping agent
- Damp proofing agent
- Grounding agent
- Bonding agent

Water

Water is most essential component in the civil construction which will make the other component wet and make moisture. It also helps to became bonding between them by any through of chemical reaction.

Concrete Preparation

In the concrete work it has cement, sand and aggregate with other components which are prepared for the specific work with required quantity in its proportion.

While making concrete proportion

- Help to improve the properties of concrete 1:2:4

Where

1. Cement
2. Sand
3. Aggregate

Which is mixed homogeneously by manually or mechanically and it is ready for the

concrete work.

Properties of concrete

1. Hardness

It is rough finishing properties of concrete it caused due to the improper proportion less compaction large shape and size of coarse aggregate, low water contained and deficiency of sand.

2. Segregation

Separation of component of heterogeneous mixture so that these distribute no longer uniform when the coarse aggregate settle down the parties from plate. It is caused due to improper gradient water cement ratio (WCR) improper placing and vibration.

Bleeding

It is the phenomena to come out water from the concrete with cement paste of concrete and surface wall coming out water paste. It is also taken out sand and cement particle which caused shrinkage and task occur and also reduce bond among aggregate and reinforcement.

Factor affecting strength of concrete

Concrete strength is affected by many factors, such as quality of raw materials, water/cement ratio, coarse/fine aggregate ratio, age of concrete, compaction of concrete, temperature, relative humidity and curing of concrete.

Quality of Raw Materials

- 1. Cement:** Provided the cement conforms with the appropriate standard and it has been stored correctly (i.e. in dry conditions), it should be suitable for using in concrete.
- 2. Aggregates:** Quality of aggregates, its size, shape, texture, strength etc determines the strength of concrete. The presence of salts (chlorides and sulphates), silt and clay also reduces the strength of concrete.
- 3. Water:** Frequently the quality of the water is covered by a clause stating

“..the water should be fit for drinking..”. This criterion though is not absolute and reference should be made to respective codes for testing of water construction purpose.

Water/Cement Ratio

The relation between water cement ratio and strength of concrete is shown in the plot as shown below:

The higher the water/cement ratio, the greater the initial spacing between the cement grains and the greater the volume of residual voids not filled by hydration products.

There is one thing missing on the graph. For given cement content, the workability of the concrete is reduced if the water/cement ratio is reduced. A lower water cement ratio means less water, or more cement and lower workability.

However if the workability becomes too low the concrete becomes difficult to compact and the strength reduces. For a given set of materials and environment conditions, the strength at any age depends only on the water-cement ratio, providing full compaction can be achieved.

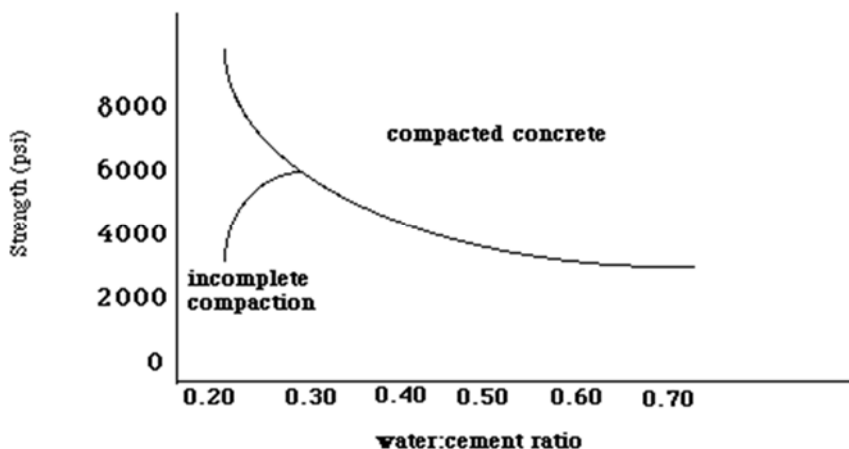


Fig. Water Cement Ration Graph

Coarse/fine aggregate ratio

Following points should be noted for coarse/fine aggregate ratio:

- If the proportion of fines is increased in relation to the coarse aggregate, the

overall aggregate surface area will increase.

- If the surface area of the aggregate has increased, the water demand will also increase.
- Assuming the water demand increases, the water cement ratio will increase.
- Since the water cement ratio has increased, the compressive strength will decrease.

Aggregate/Cement Ratio

Following points must be noted for aggregate cement ratio:

- If the volume remains the same and the proportion of cement in relation to that of sand is increased the surface area of the solid will increase.
- If the surface area of the solid has increased, the water demand will stay the same for the constant workability.
- Assuming an increase in cement content for no increase in water demand, the water cement ratio will decrease.
- If the water cement ratio reduces, the strength of the concrete will increase.

Age of concrete

The degree of hydration is synonymous with the age of concrete provided the concrete has not been allowed to dry out or the temperature is too low.

In theory, provided the concrete is not allowed to dry out, it will always be increasing albeit at an ever reducing rate. For convenience and for most practical applications, it is generally accepted that the majority of the strength has been achieved by 28 days.

Compaction of concrete

Any entrapped air resulting from inadequate compaction of the plastic concrete will lead to a reduction in strength. If there was 10% trapped air in the concrete, the strength will fall down in the range of 30 to 40%.

Temperature

The rate of hydration reaction is temperature dependent. If the temperature increases the reaction also increases. This means that the concrete kept at higher

temperature will gain strength more quickly than a similar concrete kept at a lower temperature.

However, the final strength of the concrete kept at the higher temperature will be lower. This is because the physical form of the hardened cement paste is less well structured and more porous when hydration proceeds at faster rate.

Relative humidity

If the concrete is allowed to dry out, the hydration reaction will stop. The hydration reaction cannot proceed without moisture. The three curves shows the strength development of similar concretes exposed to different conditions.

Curing

It should be clear from what has been said above that the detrimental effects of storage of concrete in a dry environment can be reduced if the concrete is adequately cured to prevent excessive moisture loss.

3. Teaching learning process and support materials

Teaching learning process should be facilitated through different methods, techniques and strategies that fit to the subject content and students needs. It's the teacher who can bring variety to the teaching learning process through various methods and strategies. In particular, the teacher can make use of the following strategies is teaching learning process :

- a. Group discussion
- b. Drawing presentation
- c. Site visit nearby school

Similarly with reference to the support materials, the teachers can make use of this resource material and other relevant materials as per content and learners' need.

2. Assessment

a. Very Short Questions.

1. What do you mean by concrete?
2. What do you mean by formwork?

3. What do you mean by compaction of concrete?
4. What is curing of concrete?
5. What is admixture?
6. What is grading of aggregate?
7. What are the components of concrete works?
8. Why is curing necessary in concrete works?
9. Why is compaction necessary in concrete works?
10. What do you mean by segregation of concrete?
11. What do you mean by bleeding in concrete?
12. What is the mix proportion of M20 grade of concrete?

b. Short Questions

1. What are the characteristics of concrete? List them out.
2. What are the characteristics of formwork? List them out.
3. What is reinforcement ? Why is it used in construction?
4. Write the procedure of hand mixing of concrete.
5. What is the factor affecting strength of concrete?

c. Long Questions

1. What are the methods of concrete mixing? What are the properties of concrete?
2. What are the construction techniques of formwork ? Explain.
3. Why is concrete and reinforcement necessary in building structure? Explain the procedure of placing of concrete.
4. Define formwork. Enlist its types. What are the requirements of good formwork?
5. What are curing of concrete? What are the types of curing? And why curing is necessary?

Glossary

Aggregate: The inert filler material that makes up the bulk of concrete. Usually sand, gravel, and rocks. Fibers and reinforcing bars are not considered aggregate.

Bleeding: An undesirable process of mix water separating from the fresh cement paste or concrete while it is being placed or consolidated.

Cement: This word is used colloquially to mean several very different things: the dry unreacted powder that comes in a sack, the sticky fluid stuff formed just after water is added, and the rocklike substance that forms later on. As noted above, people also tend to use it to refer to concrete. Obviously this won't work for people who want to have technical discussions. For our purposes, the word cement used by itself refers to the dry unreacted powder.

Cement paste: Cement (see above) that has been mixed with water. Usually the term implies that it has already become hard (see Fresh).

Concrete: A mixture of sand, gravel, and rocks held together by cement paste. The world's most widely-used man-made material.

Curing/Hardening: Essentially interchangeable terms that mean the process of continued strength gain after the cement paste has set due to chemical reactions between cement and water.

Fresh: Refers to cement paste or concrete that has been recently mixed and is still fluid. This is what those big trucks with the rotating container on the back are full of. (These are often called "cement mixers" but now you know why they should be called "concrete mixers").

Hardened: Refers to cement paste or concrete that has gained enough strength to bear some load.

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Unit: 4

Flooring Works

1. Objective

- To acquaint students with flooring work and explain its technique of floor construction.
- To develop floor finish material.

2. Content

Flooring Works

The floor resting directly on the ground surface is known as solid ground floor whereas other floor of each storey situated above the ground level are known as upper floor.

Types of Flooring

- Marble
- Mosaic
- Chips
- Tiles
- Current Punning
- Timber
- Terrazzo
- Timber Flooring

It is the simplest type of flooring used for building where span are short or moderate and made up wood. Lastly the floor is allowed to dry for two weeks.

DPC = Damp proof Course

Tile Flooring

It is constructed of square, hexagonal (polygonal) and other shape made of clay, cement concrete or terrazzo. These are available in different shape and size and commonly used in school, residential houses, hospital, office and other public building, stadium, prison, bathroom, etc. The flooring is done where the floor is to

be laid quickly. The method of laying tile flooring is similar to the mosaic flooring except in place of broken piece tile is laid over the concrete layer with great care. The joint of tile is filled by lime mortar 1:3 in ratio. (1= lime, cement) (3=sand, Shurki).

Tile flooring also can be done on the wall for example bathroom where cement slurry is used over the plaster and the tile is laid over it with gently pressing on it and the joint is filled by the cement mortar. the whole work must be cured for seven days for better strength and then grinding and polishing is done.

Marble Flooring

It's the superior types of flooring used in bathroom, kitchen, staircase of residential building, hospital and temple etc. where extra cleanliness is essential. Marble slope may be laid in different shape and size usually rectangular or square shape. The base concrete is prepared in the same manner.

Terrazzo Flooring

On account of its decorative and good wearing properties this type of floor is very popular on these days in offices, schools, residential area etc. Terrazzo is a concrete surface with especial aggregate of marble sheet (or other decorative material) mixed with white cement (or color cement) in proportion of 3:1 (3=marble sheet, 1=cement). The aggregate are exposed by grinding the surface mechanically and manually. The floor may be laid in different thickness generally of 40mm. The operation of preparation of sub-base course and carrying of base course are carried out in similar manner as described earlier in mosaic flooring and other flooring 40mm thick layer consists of a 6mm thick layer of terrazzo topping and 34mm thick under layer of 1:2:4. The surface of base course should be cleaned off and wet with water. Before carrying the cement concrete the wet surface must be spread with a coat of cement slurry to insure bond. The concrete under layer is leveled and finish to the slightly rough surface when the under layer has hardened sufficiently. Already prepared plastic terrazzo mixture is laid over the base course and compacted throughout by tamping or rolling. During temping or rolling, it should not be insured that at least 80% of finished surface should be exposed and marble

chips aggregate must be appeared on top and if necessary additional marble chips may be added during the process.

Techniques of floor Construction : concrete and timber floors

Concrete floor slab

1. Assemble and erect formwork
2. Prepare and place reinforcement
3. Pour, compact and finish concrete
4. Curing concrete and remove formwork

1. Assemble and erect formwork for slab

The formwork shall be designed to withstand construction loads such as fresh concrete pressure and weight of workers and operators and their machines. Guide to Formwork for Concrete ACI 347-04 shall be followed for the design of formworks.

Moreover, there are various construction aspects that need to be considered during the erection of formworks. For example, it should be positioned correctly, lined and levelled; joints sealed adequately, and prevent protruding of nails into the concrete etc.

Furthermore, different materials such as wood, steel, and aluminum can be used for the formworks of concrete floor slab. Finally, there are several common formwork construction deficiencies that site engineer needs to be aware of and prevent their occurrence otherwise formwork failure may occur.

2. Prepare and place reinforcement for slab

Prior to the placement of reinforcement for concrete floor slab construction, inspect and check forms to confirm that the dimensions and the location of the concrete members conform to the structural plans.

Added to that, the forms shall be properly cleaned and oiled but not in such amount as to run onto bars or concrete construction joints.

Design drawings provides necessary reinforcement details, so it only needs understanding to use designated bar size, cutting required length, and make

necessary hooks and bents.

After preparation is completed, steel bars are placed into their positions with the provision of specified spacing and concrete cover.

The concrete cover and spacing for floor slabs can be maintained by introducing spacers and bars supporters. Wires are used to tie main reinforcement and shrinkage and temperature reinforcement (distribution reinforcement).

Finally, after all requirements of reinforcement placements (positions, concrete cover, spacing, and correct bars size; length; hooks; and bending) are finalized, then site engineer can order concreting.

3. Pour, compact and finishing concrete floor slab

Mixing, transporting, and handling of concrete shall be properly coordinated with placing and finishing works. In floor slab, begin concrete placing along the perimeter at one end of the work with each batch placed against previously dispatched concrete.

Concrete should be deposited at, or as close as possible to, its final position in order to prevent segregation. So, Concrete placement in large and separate piles, then moving them horizontally into final position shall be prevented.

Moreover, site engineer shall monitor concreting properly, and look for signs of problems. For example, loss of grout is the indication of improper sealing and movement of joints. Added to that, cracking, excessive deflection, level and plumb, and any movement shall be checked and tackled to prevent further problems.

4. Curing concrete and remove formwork

After finishing ended, suitable technique shall be used to cure the concrete adequately. Slab curing methods such as water cure; concrete is flooded; ponded; or mist sprayed.

In addition to water retaining method in which coverings such as sand; canvas; burlap; or straw used to kept slab surface wet continuously, chemical Membranes, and waterproof paper or plastic film seal.

Regarding curing, it is recommended to remove formworks after 14 days.

3. Teaching learning process and support materials

Teaching learning process should be facilitated through different methods, techniques and strategies that fit to the subject content and students needs. It's the teacher who can bring variety to the teaching learning process through various methods and strategies. In particular, the teacher can make use of the following strategies in teaching learning process :

- a. Group discussion
- b. Drawing presentation
- c. Site visit nearby school

Similarly with reference to the support materials, the teachers can make use of this resource material and other relevant materials as per content and learners' need.

4. Assessment

a. Very Short Questions.

- 1. What do you mean by flooring works?
- 2. What are the different types of flooring?
- 3. What do you mean by punning?
- 4. Under what circumstance is timber flooring used?
- 5. What is terrazzo?
- 6. What is the full form of DPC?

b. Short Questions

- 1. What are the techniques of floor construction?
- 2. Discuss about marble and mud flooring.
- 3. Why is marble flooring preferred in hospitals?
- 4. Define Terrazzo Flooring.

c. Long Questions

- 1. What are the different types of flooring? Explain.
- 2. What are the floors finishing material ? Describe any four of them.
- 3. Write short notes on : a) Mosaic Flooring b) Terrazzo Flooring

Glossary

Above grade: Refers to the part of the building that is above ground level.

Air-dried: Wood flooring dried by an exposure to air without artificial heat.

Base shoe: A molding designed to cover expansion space.

Below grade: The portion of a building below ground level.

Custom floors: Floors made to order.

Engineered hardwood flooring: Layers of real hardwood with a plywood backing.

Cork flooring: Recyclable product generated from the cork oak tree; a durable and acoustical flooring type.

Decay: Wood decomposed by fungi.

Floating floor: This type of flooring floats above the sub-floor instead of being nailed or glued to it.

Grade: Wood is graded based on length, appearance and size of the knots.

Hand scraped: Smooth and flat distressed hardwood floors.

Hardness: The resistance of wood to wear dent or mar.

Laminate: A cost effective solution for parquet-like flooring constructed with a high density fiber board core.

On grade: Ground level portion of a building.

Plain sawn: The most common form of cutting wood flooring.

Solid hardwood flooring: Obtained from one single thick piece of wood that can be sanded and refinished several times.

Stability: Refers to the wood flooring's ability to expand and contract as a result of humidity.

Veneer: The top layer of wood.

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Unit: 5

Finishing works

1. Objective

- To develop knowledge about finishing work and wall finish.
- To give basic idea about paints, Varnishes.
- To provide basic idea about wall, roof and ceiling.
- To gather information about importance of finishing works.

2. Content

Plastering and Painting

Plastering

The process of covering rough surface of wall, column, beam, ceiling and other civil construction within coat of plastering mortar to form a smooth durable surface is called plastering.

Objectives of plastering

- To protect the external surface against penetrating and other atmospheric moistures.
- To give smooth surface in which dust and dirt can't stick.
- To give decorative effect on the wall inside the roof.
- To protect surface against roof water.
- To hide defect of workmanship.

Requirement of good plaster.

- It should be adhesive to background and should be strong in all season and other atmospheric condition.
- It should be smooth, hard and durable.
- It should possess good workability.

Defect in Plaster

- Cracking plaster
- Crazeing plaster

- Blistering of plaster
- Effervescency
- Popping
- Flaking
- Rust stain
- Uneven surface

1. Cracking plaster

Cracking consist of formation of crack due to ;

- The imperfect preparation of background.
- Structural defect in building.
- Movement of structure due to thermal expansion.
- Due to application of thick coat
- Faulty in workmanship.

2. Crazing plaster

It is a form of series of hair crack on the plaster surface due to the same reasonable reason of cracking.

3. Blistering of plaster

This is the form of small patches of plaster out beyond the plaster surface or rising out of plaster surface.

4. Effervescency

It is crystalline or whitest surface which appear on the plaster surface due to presence of salt on the brick work. This is the very bad appearance among the defect. It can be removed to some extent and brushing and washing to the surface and again plaster work can be done.

5. Popping

It is formation of conical hole in the plaster due to presence of some particles like plastic, organic matter, etc. which expand on setting.

6. Flaking

It is the formation of very loose mass of plaster due to the poor bonding between successive coats.

7. Rust Stain

These sometime appear due to the metal containing surface like at door window fixation, where metal get direct contact with plaster work.

8. Uneven Surface

This is due to inner or outer formation of brick work uneven in plaster work.

Method of plastering/preparation

1. Preparation of material
2. Preparation of mortar
3. Application of prime coat
4. Application of final coat
5. Finishing the smooth surface

1. Preparation at material

At first, prepare the appropriate material like washed sand, screening and fresh cement and drinking water.

2. Preparation of mortar

While preparing mortar for plastering, the ratio of cement sand should not be less than 1:4 and water must be drinking water.

3. Application of prime coat

After preparation of specified mortar, the prime coat is applied after cleaning the surface on the wall with the help of jewel.

4. Application of final cost

After the prime coat, final coat is applied where uneven surface appear after prime coat. While applying final coat, it should be kept in mind that the thickness of final coat must not be greater than 25mm or 1 inch.

5. Finishing the smooth surface

The plaster work must be smooth and even surface which is done with the help of flat smooth wooden or aluminum hand tool.

Various wall furnishes

1. Paint and varnishes

Paint are protective coating which are used in different element of building. Paint prevents from weather, heat, moisture, gas, rain, and dust. It can be easily applied on wall as well as in metallic surface timber work and other different element.

Varnishes is quite different from paint. It is generally used in wooden surface or part which make the wooden element well and smooth surface with attractive colour.

Ingredient of paint

1. Pigment
2. Solvent
3. Drier

Pigment is a coloring substance whereas solvent is a coloring in which pigment is added as a solvent and the drier is the medium as a dispersion of pigment which has suitable drying well in present and solvent are soluble for solution which can be easily applied on the smooth plaster surface.

Characteristics of good paint

1. Paint should be durable and have resistant to tear trim of drying.
2. Paint should not crack on gentle collides and on drying.
3. Paint should have good bodies on spreading power so that it seems uniform surface.
4. Paint should work like smooth thin layer on the wall.
5. Paint should give pleasant appearance throughout the time.
6. It should have characteristics like quick drying and less smell.
7. It should not damage other materials while removing from object or wall.
8. Paint should be dry and hard enough within 24 hours and color at paint should not change initially at 24 hours or drying completely.

Function of Pant

- Protect against atmospheric effect for attractive appearance.
- Prevent from dampness and dust.
- Prevent from harmful insect.

Varnish

It is a homogenous liquid containing substance dissolved in suitable oil or volatile liquid. Varnishes does not contain pigment. Varnishes bring out the grain at wood in a brilliant manner. It form a thin filled on drying which protect the surface froms dust moisture and other defects.

Composition of Varnish

1. Base
2. Solvent
3. Drier

Here, base are the different natural and artificial resin which are found in tree and in mine whereas solvent are soluble substance to make solution and drier is medium to dry. Hence, varnish contain no pigment but it contain polish substance which are dissolve in a suitable well or volatile substance.

Types of Varnish

1. Oil
2. Sprit
3. Water

1. Oil Varnish

Resin varnish is used as solvent. It forms hard and durable film. It is mainly used in external finish.

2. Sprit Varnish

It is mainly used in furniture and sprit is used as a solvent. It is made by dissolving resin by sprit. It gives transparent finish in surface showing grain of timber.

3. Water Varnish

It is made by dissolving resin in hot water with chemical composition like ammonia, soda, potash etc. It is used of painting wall and wall paper as well.

Terminology

1. Primer

It is an application of rough coat and it provides a smooth base for paint. It also form a platform for finish coat.

2. Enamel

It is a type of painting which is only used for small surface or in metal work. It is better and long lasting than other painting due to its hardening property smooth surface damp and water proof quality and dust free.

Pointing

The term pointing is applied to the finishing to a mortar joint in a masonry in expose area. Joint are considered to be the weakest part from the contest of rain water, dampness from which it can easily enter.

Pointing consist of cracking the joint to the depth of (10-12) mm and filling it with better quality and quantity of mortar in desire shape. Pointing can be done in new and old work. Lime mortar and cement mortar in proportion 1:2 and 1:3 respectively is used for preparation of pointing.

Types of Pointing

1. Flush pointing
2. Recessed pointing
3. Beaded pointing
4. V pointing
5. Rubbed pointing

3. Flush Pointing

It is formed by placing mortar in the joint by flushing old mortar (7-12)mm and again filling by pointing mortar at the wall level.

4. Recessed Pointing

This pointing is done by pressing the mortar in the joint 5mm back from the edge of wall in curve shape.

5. Beaded Pointing

It is special type of pointing formed by steel or concave edge and it gives good appearance with projecting in curve shaped outside the wall level.

6. V Pointing

It is formed by placing the mortar in the joint by flushing with fresh V shaped (3-5)mm rectangular which is done in both inner and outer side.

7. Rubbed Pointing

It is modified form of flush pointing by forming a groove at the middle of joint. It is rectangular in shape in both inner and outer side.

Various types of roofs

Tiling (glazed tiling)

Glazed tiles are manufactured from clay materials that are quarried, prepared, and then formed into a mould. They can be best characterised as either porcelain or non-porcelain.

Porcelain tiles are often extruded and have fewer impurities than non-porcelain ceramic tiles. Porcelain clays are denser and less porous than ceramic clays, making porcelain tile harder and more impervious to moisture than ceramic tile. It's considered more durable and better suited for heavy usage.

Non-porcelain ceramic tiles have their advantages too. They are one of the most economical ways to tile your home, coming in at about 60% of the price of porcelain tiles. They're also easier for DIY home owners to cut if you plan on doing any tiling yourself.

3. Teaching learning process and support materials

Teaching learning process should be facilitated through different methods, techniques and strategies that fit to the subject content and students needs. It's the

teacher who can bring variety to the teaching learning process through various methods and strategies. In particular, the teacher can make use of the following strategies in teaching learning process :

- a. Group discussion
- b. Drawing presentation
- c. Site visit nearby school

Similarly with reference to the support materials, the teachers can make use of this resource material and other relevant materials as per content and learners' need.

2. Assessment

a. Very Short Questions.

1. What do you mean by roofing?
2. What do you mean by punning?
3. Write the main advantage and disadvantage of thatch roof.
4. Write the main difference between flat and pitched roof.
5. What is plastering?
6. What is paint?
7. What is Pigment?
8. What is varnish?
9. What are the ingredients of paint?
10. What do you mean by pointing?
11. Why is finishing work necessary?

b. Short Questions.

1. Define flat roof and slope roof.
2. What are the different types of roof ?
3. Why thatch roof and CGI sheet roofing are more popular in context of Nepal?
4. What are the requirements of good plaster?
5. What are the functions of paint?
6. What are the types of varnishes?

c. Long Questions.

1. What is plastering? What are the objectives of plastering?
2. What are the various methods of wall finishes? Describe about painting and its type.
3. What are the different types of roof? What are the characteristics of ideal roof?
4. What are the defects in plaster? Explain.
5. How the material required for plastering is prepared? Explain.
6. What are the characteristics of good Paint?
7. What is pointing? What are the different types of pointing?

Glossary

Abrasion Resistance

The ability of a surface to resist being worn away by friction and rubbing. For floor tiles, this is graded using the PEI rating.

Absorption

The amount of water absorbed by a tile. This is described as the ratio of the weight of the water absorbed to the weight of the dry tile, expressed as a percentage.

Adhesive

An adhesive or glue is a material, usually in a liquid or semi-liquid state, that adheres or bonds items together. Adhesives come from either natural or synthetic sources.

Aggregate

Granular material, such as gravel, sand, iron blast-furnace slag and crushed stone, used with a cementing medium to form a hydraulic-cement, mortar or concrete.

Antique Finish

When a natural tile is first cut, it will have a given textured finish, either riven, bush-hammered or tumbled etc. Over the years through natural foot traffic or wear and tear, this texture will wear down. An antiqued finish tile goes through a grinding

down process that is specially done to simulate these effects.

Backer Board (Cement Board)

Normally, a 12mm thick cement backerboard for tile and stone, to be used as an alternative to plasterboard for tiling on walls.

HardieBacker 12mm is a water-resistant, cement backerboard for tiles that fastens directly to the wooden frame of a wall.

Bevelled Edge

A bevelled edge refers to an edge of a tile that is not perpendicular to the face of the piece. A bevel is typically used to soften the edge of a tile for the sake of safety, wear resistance, or aesthetics.

Biscuit

The main base structure of a glazed tile, generally made for clay or porcelain.

Blistering

The development of enclosed or broken bubbles in a body, glaze or other coating during firing.

Bonding Agent

A substance that is applied to a suitable substrate to create a bond between it and a succeeding layer.

Bowing

Bowing or warping in tiles is caused during the manufacturing and cooling process. It is important to realise that a certain amount of warping across a tile is acceptable under the standards. The calculation for acceptable warpage is related to the size of the tile and the degree of warp across the length of the tile. This will tend to be exposed in rectangular shaped tiles, laid in a brick-bond formation.

British Standards

There a number of British Standards that are used in the wall and floor tile industry, these include Standards which define ceramic and natural stone tiles, tile fixing, tile

adhesives and grouts. The British Standards are written by tile industry specialists and are available to purchase from British Standards Institution.

Brushed Finish

Most common with slate tiles or any tile that would normally have a riven finish which can sometimes be quite sharp or harsh under foot. “Brushing” a natural stone surface with a coarse wire rotary brush, will smooth down some of the rough texture, without losing the overall characteristics of the natural finish.

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