

## Section A: Institute Based Training (15 Academic Weeks)

### Part 1: Construction Materials

#### Module I: Construction Materials

#### Task 1: Construction Materials:

Construction materials are materials that are used for construction works in construction site. They may be natural or man-made (artificial). Some commonly used construction materials are as follows:

निर्माण सामग्रीहरू निर्माण स्थलमा निर्माण कार्यका लागि प्रयोग गरिने सामग्रीहरू हुन् । यी सामग्रीहरू प्राकृतिक वा मानव निर्मित (कृत्रिम) हुन सक्छन् । सामान्यतया प्रयोग गरिने केही निर्माण सामग्रीहरू निम्नानुसार छन्:

- |   |   |
|---|---|
| i. Mud (माटो)   | xiii. Steel (स्टील )  |
| ii. Stones (ढुङ्गा)                                   | xiv. Rebar (फ्लामे डण्डी)   |
| iii. Aggregate: Sand and Gravel<br>(बालुवा र ग्राभेल) | xv. Aluminium (एल्युमिनियम)   |
| iv. Cement (सिमेन्ट)                                  | xvi. Timber (काठ)   |
| v. Water (पानी)                                       | xvii. Plywood (प्लाई)   |
| vi. Lime (चुना)                                       | xviii. Artificial wood (कृत्रिम काठ )   |
| vii. Plastic (प्लास्टिक)                              | xix. Bamboo and cane (बाँस र वेत)   |
| viii. Glass (सिसा)                                    | xx. Roofing materials (छत बनाउने सामग्री) (Khar, Straw (पराल), Slate, Khapada, Tiles, Corrugated Galvanized Iron CGI sheet) |
| ix. Asbestos Sheet (एस्बेस्टोस पाता)                  | xxi. Partition blocks/boards (विभाजन ब्लक/बोर्डहरू)   |
| x. Fiberglass/sheet (फाइबरग्लास/ पाता)                |   |
| xi. Blocks (ब्लक)                                     |   |
| xii. Bricks (ईँटा)                                    |   |

i. Mud (माटो)



ii. Stones (ढुङ्गा)



iii. Aggregate: Sand and Gravel (बालुवा र ग्राभेल)



Very coarse soils	Boulder size		> 300 mm
	Cobble size		80 - 300 mm
Coarse soils	Gravel size (G)	Coarse	20 - 80 mm
		Fine	4.75 - 20 mm
	Sand size (S)	Coarse	2 - 4.75 mm
		Medium	0.425 - 2 mm
Fine		0.075 - 0.425 mm	
Fine soils	Silt size (M)		0.002 - 0.075 mm
	Clay size (C)		< 0.002 mm

iv. Cement (सिमेन्ट)



v. Water (पानी)



vi. Lime (चुना)



vii. Plastic (प्लास्टिक)



viii. Glass (सिसा)



ix. Asbestos Sheet (एस्बेस्टोस पाता)



x. Fiberglass/sheet (फाइबरग्लास/ पाता)



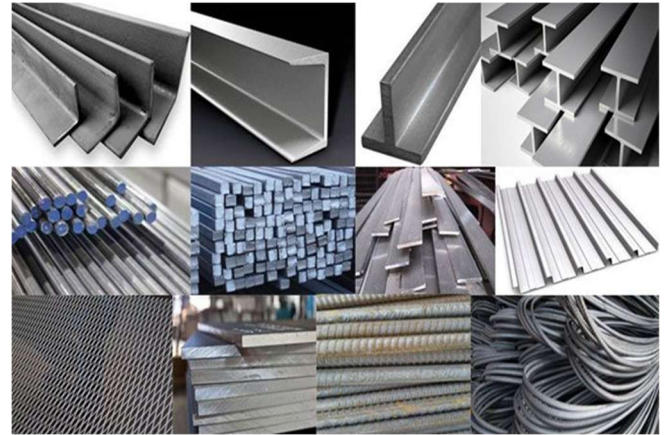
xi. Blocks (ब्लक)



xii. Bricks (ईंटा)



xiii. Steel (स्टील)



xiv. Rebar (फलामे डण्डी)



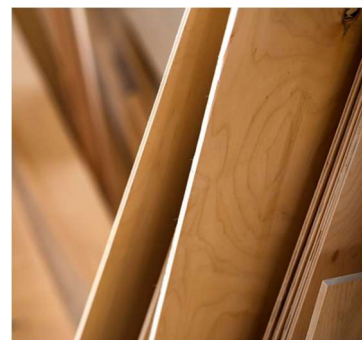
xv. Aluminium (एल्युमिनियम)



xvi. Timber (काठ)



xvii. Plywood (प्लाई)



xviii. Artificial wood (कृत्रिम काठ )

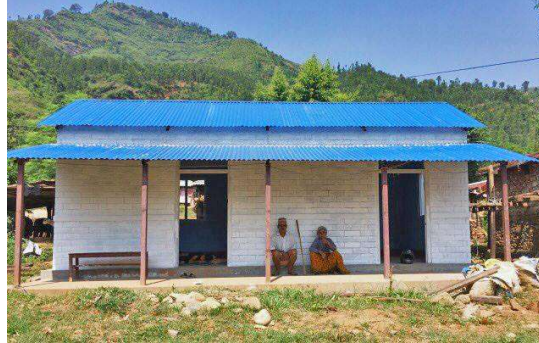


xix. Bamboo and cane (बाँस र वेत)



xx. Roofing materials (छत बनाउने सामग्री) (Khar, Straw (पराल), Slate, Khapada, Tiles, Corrugated Galvanized Iron CGI sheet)





xxi. Partition blocks/boards (विभाजन ब्लक/बोर्डहरू)



## Task 2: Stones:

### 1. Introduction (परिचय)

The hard, solid substance found in the ground that is often used as a building material, or a small piece of this substance is called stone. Stones have been considered as one of the popular building material from the olden days due to their availability in abundance from the natural rocks. Building stones should possess enough strength and durability. The stones which are suitable for the construction of the structures such as retaining walls, abutments, dams, barrages, roads etc are known as building stones.

जमिनमा पाइने कडा, ठोस पदार्थ जुन प्राय निर्माण सामग्रीको रूपमा प्रयोग गरिन्छ, वा यस पदार्थको सानो टुकुरालाई पत्थर वा ढुङ्गा भनिन्छ । प्राकृतिक चट्टानहरूबाट प्रशस्त मात्रामा उपलब्ध भएका कारण ढुङ्गाहरू पुरातन कालदेखिका लोकप्रिय निर्माण सामग्रीहरू मध्ये एक मानिन्छन् । निर्माण कार्यमा प्रयोग हुने ढुङ्गामा पर्याप्त शक्ति र टिकाउपन हुनुपर्छ । रिटेनिङ वाल, एबुटमेन्ट, बाँध, ब्यारेज, सडक आदि संरचना निर्माणका लागि उपयुक्त हुने ढुङ्गालाई बिल्डिङ स्टोन भनिन्छ ।

### 2. Source: River boulders, Stone Quarry (श्रोत : नदीजन्य ठुला ढुङ्गाहरू, ढुङ्गा खानी)

We can get stones from two sources: (हामी दुई स्रोतहरूबाट पत्थरहरू प्राप्त गर्न सक्छौं:)

- i. River Boulders (नदीजन्य ठुला ढुङ्गाहरू)
- ii. Stone Quarry (ढुङ्गा खानी)

#### i. River Boulders (नदीजन्य ठुला ढुङ्गाहरू)

As water flows downstream, it carries along sediment like sand and smaller rocks. When these particles collide with larger boulders in the river, they start wearing away the surface of the boulder through a constant process of abrasion. Over time, the constant rubbing and grinding cause the boulders to break down into smaller and smoother stones. This process not only shapes the stones but also gives them their characteristic rounded edges.

जब पानी बग्छ, यसले बालुवा र स-साना चट्टानहरू जस्ता sediment बोक्छ । जब यी कणहरू नदीमा ठूला ढुङ्गाहरूसँग ठोक्किन्छन्, तिनीहरू घर्षणको निरन्तर प्रक्रियामार्फत boulder को सतहलाई धुल्याउन थाल्छन्। समयबित्दै जाँदा, लगातार रगड्ने र पिस्ने कामले गर्दा ढुङ्गाहरू स-साना र चिल्लो ढुङ्गाहरूमा टुक्रिन्छन्। यो प्रक्रियाले ढुङ्गाहरूलाई आकार मात्र दिँदैन, ढुङ्गाहरूलाई गोलाकार किनाराहरू पनि दिन्छ ।

ii. Stone Quarry (ढुङ्गा खानी)

In a quarry, massive blocks or slabs of stone are extracted using a combination of drilling, blasting, and cutting techniques. Once these blocks are removed, they undergo further processing to achieve the desired shapes and sizes for various applications.

खानीमा ड्रिलिङ, ब्लास्टिङ र कटिङ प्रविधिको प्रयोग गरेर ढुङ्गाको ठुलो ब्लक वा स्ल्याब निकालिन्छ । ब्लकहरु निकालेपछि विभिन्न कामहरुको लागि चाहिएको आकारहरु दिनको लागि ती ब्लकहरु थप प्रक्रियाबाट गुज्रन्छन्।

**3. Characteristics of good building stones (भवन निर्माणमा प्रयोग हुने राम्रो ढुङ्गाको विशेषताहरु)**

- 1) Crushing – A good building stone should have better crushing strength i.e. greater than  $100 \text{ N/mm}^2$  . भवन निर्माणमा प्रयोग हुने राम्रो पत्थरमा राम्रो क्रशिंग शक्ति अर्थात्  $100 \text{ N/mm}^2$  भन्दा बढी हुनुपर्दछ ।
- 2) Hardness - A good building stone should have sufficient hardness. भवन निर्माणमा प्रयोग हुने राम्रो पत्थरमा पर्याप्त कठोरता हुनुपर्छ।
- 3) Durability - A good building stones must be durable long lasting nature. भवन निर्माणमा प्रयोग हुने राम्रो पत्थर टिकाऊ लामो स्थायी प्रकृति हुनुपर्छ।
- 4) Fire resistance - They should have good fire resistance properties. तिनीहरूसँग राम्रो आगो प्रतिरोधी गुणहरु हुनुपर्दछ।
- 5) Seasoning/weathering - They should also have good weathering resistance properties. तिनीहरूसँग राम्रो weathering प्रतिरोधी गुणहरु पनि हुनुपर्दछ ।
- 6) Water resistance - They should have less water absorption properties. तिनीहरूसँग कम पानी अवशोषण गुणहरु हुनुपर्दछ ।
- 7) Economy - They should be economical & easily available. तिनीहरु किफायती र सजिलै उपलब्ध हुनुपर्छ।
- 8) Attrition – A good building stone should have less wear & tear, abrasion & erosion properties. भवन निर्माणमा प्रयोग हुने राम्रो पत्थरमा कम wear र tear, abrasion र erosion गुणहरु हुनुपर्दछ।
- 9) Facing & dressing – A good building stones should be easily molded, carved & dressed. भवन निर्माणमा प्रयोग हुने राम्रो पत्थर सजिलै molded, carved & dressed हुनुपर्छ ।
- 10) Specific gravity - A good building stone should have higher specific gravity i.e. more than 2.7. भवन निर्माणमा प्रयोग हुने राम्रो पत्थरमा higher specific gravity अर्थात् 2.7 भन्दा बढी हुनुपर्छ।

11) Texture – The structure of the good building stone should be compact fine crystalline. They don't have any cracks, cavities & patches. भवन निर्माणमा प्रयोग हुने राम्रो पत्थर को संरचना compact fine crystalline हुनुपर्छ। तिनीहरूमा कुनै cracks, cavities र प्याचहरू हुनुहुदैन ।

12) Toughness - A good building stone should be strong & tough. भवन निर्माणमा प्रयोग हुने राम्रो पत्थर बलियो र कडा हुनुपर्छ।

#### 4. Selection and use of stones for various construction according to shape (आकार अनुसार विभिन्न निर्माणका लागि ढुङ्गाको छनोट र प्रयोग)

- i. Cubical Stones (घन ढुङ्गाहरू): These are well-shaped, cubic stones that are suitable for constructing corners, quoins, and pillars. They provide stability and a pleasing aesthetic. (यी राम्रो आकारका, घन पत्थरहरू हुन् जुन कुनाहरू, क्वोइनहरू र स्तम्भहरू निर्माण गर्न उपयुक्त छन्। यसले स्थिरता र एक मनमोहक सौन्दर्य प्रदान गर्छ ।)
- ii. Rectangular Stones (आयताकार ढुङ्गाहरू): Ideal for constructing walls, especially when uniformity and a clean finish are desired. They can be easily arranged in rows to create a strong and visually appealing structure. (पर्खालहरू निर्माण गर्नका लागि उपयुक्त, विशेष गरी जब एकरूपता र सफा finish चाहिन्छ। यो बलियो र दृशात्मक रूपमा आकर्षक संरचना सिर्जना गर्न सजिलैसँग पङ्क्तिहरूमा व्यवस्थित गर्न सकिन्छ ।)
- iii. Irregular Stones (अनियमित ढुङ्गाहरू): For a more natural look, irregularly shaped stones can be used. They are often employed in landscaping or for creating retaining walls. (अधिक प्राकृतिक रूपको लागि, अनियमित आकारको पत्थरहरू प्रयोग गर्न सकिन्छ। तिनीहरू प्रायः भूनिर्माण वा रिटेनिङ पर्खालहरू सिर्जना गर्न प्रयोग गरिन्छ ।)
- iv. Angular Stones (कोणीय ढुङ्गाहरू): Stones with angular shapes are good for load-bearing purposes. They interlock well, providing stability and strength, making them suitable for foundations and base courses. (कोणीय आकारका ढुङ्गाहरू भार वहन गर्ने प्रयोजनका लागि राम्रो हुन्छन्। तिनीहरूले राम्रो तरिकाले इन्टरलक गर्छन्, स्थिरता र शक्ति प्रदान गर्छन्, तिनीहरूलाई foundations र base courses को लागि उपयुक्त बनाउँदछन् ।)
- v. Round Stones (गोलाकार ढुङ्गाहरू): These are commonly used in landscaping and decorative elements. They can also be used for erosion control. (यी सामान्यतया भूनिर्माण र सजावटी तत्वहरूमा प्रयोग गरिन्छ । यसलाई कटान नियन्त्रणमा पनि प्रयोग गर्न सकिन्छ ।)
- vi. Slab Stones (चेप्टा ढुङ्गाहरू) : Flat and broad stones, known as slabs, are suitable for pathways, patios, and flooring. They provide a stable and even surface for walking or placing structures. (समतल र चौडा पत्थरहरू, जसलाई स्ल्याब

भनिन्छ, हिड्ने मार्गहरू, आँगनहरू र flooring को लागि उपयुक्त छन्। तिनीहरूले हिड्ने वा संरचनाहरू राख्नको लागि स्थिर सतह पनि प्रदान गर्छन्।)

- vii. Crushed Stones (पिसेको ढुङ्गाहरू): Crushed stones are used as aggregates in concrete and road construction. They come in various sizes, with smaller stones providing stability to concrete mixtures, while larger ones are used for road bases. (कंक्रीट र सडक निर्माणमा पिसेका ढुङ्गाहरू aggregates को रूपमा प्रयोग गरिन्छ। तिनीहरू विभिन्न आकारहरूमा आउँछन्, साना ढुङ्गाहरूले कंक्रीट मिश्रणलाई स्थिरता प्रदान गर्दछ, जबकि ठूला हरू सडक आधारहरूको लागि प्रयोग गरिन्छ।)
- viii. Flagstones (झण्डा आकारको ढुङ्गाहरू) : Thin, flat stones known as flagstones are commonly used for paving. They are versatile and can be used for walkways, patios, and even as stepping stones. (पातलो, समतल पत्थरहरू जसलाई फ्ल्यागस्टोन भनिन्छ सामान्यतया हिड्ने बाटोमा बिछ्याउनको लागि प्रयोग गरिन्छ। तिनीहरू बहुमुखी छन् र पैदल मार्ग, आँगन, र पाइला पत्थरको रूपमा पनि प्रयोग गर्न सकिन्छ।)
- ix. Rubble Stones (भग्नावशेष ढुङ्गाहरू): Irregularly shaped and uncut stones, also known as rubble, are often used in the construction of foundations, retaining walls, and as fill material. They provide strength and stability. (अनियमित आकारका र नकाटिएका ढुङ्गाहरू, जसलाई rubble पनि भनिन्छ, प्रायः जग निर्माण गर्न, पर्खालहरू कायम राख्न र भर्ने सामग्रीको रूपमा प्रयोग गरिन्छ। यसले शक्ति र स्थिरता प्रदान गर्छ।)

#### 5. Dressing, seasoning and stacking (Extraction and preparation for use) (ड्रेसिङ, सिजनिङ र स्ट्याकिङ (निकासी र प्रयोगको लागि तयारी))

- Dressing stone: Shaping and finishing quarried stone to the desired size and shape (इच्छित आकारमा उत्खनन गरिएको पत्थरको आकार दिनु र राम्रो देखिने बनाउनु)
- Seasoning stone: Removing moisture from stone through a cycle of drying and airing (सुक्खा हावाको प्रयोग मार्फत पत्थरबाट आर्द्रता हटाउनु)
- Stacking stone: the art of balancing rocks to create beautiful and often temporary sculptures. It's a meditative and creative practice. (सुन्दर र अस्थायी मूर्तिहरू बनाउन चट्टानहरू सन्तुलन गर्ने कला। यो एक ध्यान केन्द्रित र रचनात्मक अभ्यास हो।)

The extraction of facing stone involves complex processes, preserving natural qualities during cutting and shaping with advanced techniques. From stone cutting machines to thermal jet methods, technology plays a vital role in transforming raw

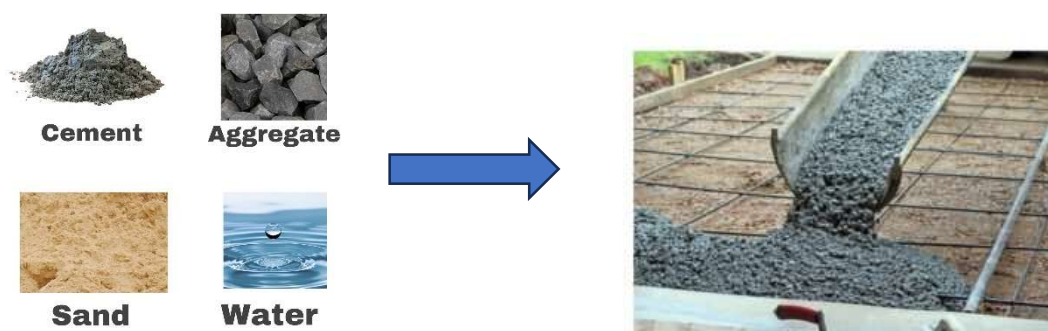
blocks into high-quality products. Checks on physical and mechanical properties ensure suitability for construction. Then the stones are stacked upon each other in the truck or other transporting vehicles and are sent to construction site for use.

Facing पत्थरको निकासीमा जटिल प्रक्रियाहरू समावेश छन् । काट्ने र आकार दिने क्रममा प्राकृतिक गुणहरूको संरक्षण गर्न उन्नत प्रविधिहरूको मदत लिईन्छ । पत्थर काट्ने मेशिनहरूदेखि थर्मल जेट विधिहरूमा, टेक्नोलोजीले कच्चा ब्लकहरूलाई उच्च गुणस्तरको उत्पादनहरूमा रूपान्तरण गर्न महत्त्वपूर्ण भूमिका खेल्छ । भौतिक र यान्त्रिक गुणहरूको जाँचले निर्माणको लागि उपयुक्तता सुनिश्चित गर्दछ। त्यसपछि ढुङ्गाहरू ट्रक वा अन्य ढुवानी गर्ने सवारी साधनहरूमा एक अर्कामा Stacking गरिन्छ र प्रयोगको लागि निर्माण स्थलमा पठाइन्छ ।

## Task 3 : Aggregates

### 1. Introduction (परिचय)

- Aggregate can be fine aggregate or coarse aggregate based on the size distribution of particles. These aggregates can be used for making concrete with the proper mixing of sand and cement. The properties of the aggregates will be different for different sizes of aggregates. (कणहरूको आकारको आधारमा एग्रीगेट fine aggregate वा coarse aggregate हुन सक्छ । यी एग्रीगेटहरू बालुवा र सिमेन्टको उचित मिश्रणको साथ कंक्रीट बनाउन प्रयोग गर्न सकिन्छ। एग्रीगेटको गुणहरू एग्रीगेटको विभिन्न आकारहरूको लागि फरक हुनेछ ।)



### 2. Uses (प्रयोग)

Aggregates have many uses in the construction of various structures. Its use depends on the aggregates' size, shape and strength parameters. Aggregates are used in different sizes in the concrete mix based on the required strength and compactness. (विभिन्न संरचनाहरूको निर्माणमा एग्रीगेटहरूको धेरै प्रयोगहरू छन्। यसको प्रयोग एग्रीगेटको आकार र शक्ति मापदण्डहरूमा निर्भर गर्दछ। विभिन्न आकारमा एग्रीगेटहरू आवश्यक शक्ति र संकुचितताको आधारमा कंक्रीट मिश्रणमा प्रयोग गरिन्छ।)

- Aggregates are used to construct buildings, railway, bridges, dams and other concrete structures. (भवनहरू, रेलवे, पुलहरू, बाँधहरू र अन्य कंक्रीट संरचनाहरू निर्माण गर्न एग्रीगेटहरू प्रयोग गरिन्छ।)
- Using aggregates in concrete structures helps to bind the other ingredients in the concrete structures. (एग्रीगेटले कंक्रीट संरचनाहरूमा प्रयोग हुने सामग्रीहरू एकआपसमा बाँध्न मद्दत गर्दछ।)
- Aggregate enhances the strength of the concrete structures. (एग्रीगेटले कंक्रीट संरचनाहरूको शक्ति बढाउँछ ।)
- The crushing strength of concrete is enhanced by using aggregate material. (कंक्रीट को क्रशिंग शक्ति एग्रीगेट प्रयोग गरेर वृद्धि गरिएको हुन्छ।)

- Its uses in concrete structures reduce the cement quantity in the concrete. (कंक्रीट संरचनाहरूमा यसको प्रयोगले कंक्रीटमा सिमेन्ट कम मात्रामा प्रयोग गर्दा हुन्छ ।)

### 3. Classification; according to nature of formation, grain size, shape and texture (वर्गीकरण; गठनको प्रकृति अनुसार, दानाको आकार अनुसार, आकार अनुसार र बनावट अनुसार)

According to nature of formation: (गठनको प्रकृति अनुसार:)

- Natural Aggregates (प्राकृतिक एग्रीगेट): Sand and Gravel (बालुवा र ग्राभेल), Crushed Aggregates (पिसेको एग्रीगेट)
- Artificial Aggregates (कृत्रिम एग्रीगेट): made out of various by-products such as fly ash, power plant solid waste, rice husk ash, blast furnace slag, granite powder, iron ore slag, over burnt brickbats etc. (विभिन्न उप-उत्पादनहरू जस्तै फ्लाई एश, पावर प्लान्ट solid waste, धानको भूसको खरानी, ब्लास्ट फर्नेस स्ल्याग, ग्रेनाइट पाउडर, फलाम ओर स्ल्याग, जलेको ईट्टाको टुक्राहरू आदि बाट बनाइएको ।)

According to Grain size : (दानाको आकार अनुसार:)

- Fine Aggregate (फाइन एग्रीगेट): Smaller than 4.75 mm (४.७५ मि.मि. भन्दा सानो)
- Coarse Aggregate (कोर्स एग्रीगेट): Greater than 4.75 mm (४.७५ मि.मि. भन्दा ठुलो)

According to shape: (आकार अनुसार:)

- Rounded aggregates (गोलाकार एग्रीगेट)
- Angular aggregates (कोणीय एग्रीगेट)
- Irregular aggregates (अनियमित एग्रीगेट)
- Elongated aggregates (लामो एग्रीगेट)
- Flaky aggregates (पत्रे एग्रीगेट)
- Flaky & elongated aggregates (पत्रे एवम् लामो एग्रीगेट)

According to texture: (बनावट अनुसार:)

- Smooth Surface Texture Aggregate (चिल्लो सतही बनावट भएको एग्रीगेट)
- Rough Surface Textures Aggregate (खस्रो सतही बनावट भएको एग्रीगेट)

#### 4. Gradation of aggregate (एग्रीगेट को ग्रेडिङ्ग)

Grading of aggregates means the process of using/mixing aggregates in such a way that it contains all the standard fractions of aggregates in the required proportion so that the sample contains minimum voids. (एग्रीगेटको ग्रेडिङ आवश्यक अनुपातमा एग्रीगेटको सबै मानक अंशहरू समावेश गर्दै एग्रीगेटको प्रयोग / मिश्रण गर्ने प्रक्रिया हो । यसले गर्दा एग्रीगेटको नमूनामा कम खाली ठाउँहरू हुन्छन् ।)

In simpler words, grading is a way of using different sizes of aggregate in a concrete mix to fill the space that the bigger particles can't fill. (सरल शब्दहरूमा, ग्रेडिङ ठूलो एग्रीगेटहरूले भर्न नसक्ने खाली ठाउँ भर्न कंक्रीट मिश्रणमा एग्रीगेट को विभिन्न आकारहरू प्रयोग गर्ने एक तरिका हो ।)

Gradation of aggregate speaks about the particle size distribution in a sample of aggregate. (एग्रीगेट को ग्रेडेशनले एग्रीगेट को एक नमूना मा कण आकार वितरणको बारेमा वर्णन गर्छ ।)

#### Types of gradations in aggregate (एग्रीगेट को ग्रेडिङ्ग का प्रकारहरू)

1. Well-graded (or) Dense graded aggregate (राम्ररी ग्रेडिङ्ग गरिएको वा घना ग्रेडिङ्ग गरिएको एग्रीगेट)
2. Uniform-graded (or) Poorly graded aggregate (एकैनाशले ग्रेडिङ्ग गरिएको वा राम्ररी ग्रेडिङ्ग नगरिएको एग्रीगेट)
3. Gap-graded aggregate (केहि एग्रीगेट आकार छुटाई ग्रेडिङ्ग गरिएको एग्रीगेट)
4. Open-graded aggregate (थोरै खाली ठाउँ छोडी ग्रेडिङ्ग गरिएको एग्रीगेट)

## Task 4: Bricks

### 1. Introduction (परिचय)

- A brick is a man-made building material used to make walls and make places to walk. It is a single unit of a kneaded clay-bearing soil, sand and lime, or concrete material, fire-hardened or air-dried, used in masonry construction. ईँटा मानव निर्मित निर्माण सामग्री हो जुन पर्खाल बनाउन र हिँड्ने ठाउँ बनाउन प्रयोग गरिन्छ। यो निर्माण कार्यमा प्रयोग गरिन्छ। ईँटा माटो, बालुवा र चुना, वा कंक्रीट सामग्री मिसाई आगो वा तातो हावा प्रयोग गरेर बनाइएको हुन्छ।
- Bricks are made mostly of clay. They are put into molds or cut with wires, and then baked in an oven. The color of a brick depends on the clay from which it was made. ईँटाहरू प्रायजसो माटोबाट बनाइन्छ। यसलाई मोल्डमा राखिन्छ वा तारले काटिन्छ, र त्यसपछि ओभनमा पकाइन्छ। ईँटाको रङ त्यो माटोमा निर्भर हुन्छ, जसबाट यो बनाइएको हुन्छ।
- Masons build brick walls. They join bricks together using mortar. Bricks can be assembled into many different patterns. मिस्त्रीहरूले ईँटाको पर्खाल निर्माण गर्छन्। उनीहरू मोर्टरको प्रयोग गरेर ईँटाहरू एकसाथ जोड्छन्। ईँटाहरू फरक फरक ढाँचाहरूमा लगाउन गर्न सकिन्छ।

### 2. Composition (रचना)

Ingredients	Proportion
Silica	50% to 60%
Alumina	20% to 30%
Lime	5% to 10%
Iron oxide	Less than 7%
Alkalis	Less than 10%
Magnesia	Less than 1%

### 3. Manufacturing; Soil/mortar preparation, Moulding, Drying, Burning (निर्माण; माटो / मोर्टर तैयारी, आकारमा ढाल्नु, सुकाउनु, पकाउनु)

The manufacturing process of bricks typically involves: ईँटाको निर्माण प्रक्रियामा सामान्यतया यी प्रक्रियाहरू हुन्छन् :

- Extraction: Clay and shale are excavated from quarries. खानीहरूबाट माटो र शेल उत्खनन गरिन्छ।

- Preparation: The extracted materials are crushed and ground to achieve a uniform particle size. निकालिएको सामग्री एक समान कण आकार प्राप्त गर्न पिसिन्छन् ।
- Mixing: Water is added to the crushed clay and shale to create a plastic and moldable mixture. प्लास्टिक र मोल्डेबल मिश्रण सिर्जना गर्न पिसेको माटो र शेलमा पानी थपिन्छ ।
- Molding: The mixture is shaped into bricks using molds. This can be done through various methods like extrusion or pressing. मिश्रणलाई मोल्डहरू प्रयोग गरेर ईटाको आकार दिइन्छ । यो एक्सट्रुजन वा दबाउने जस्ता विभिन्न विधिहरू मार्फत गर्न सकिन्छ ।
- Drying: The molded bricks are allowed to air dry or are placed in drying chambers to remove excess moisture. मोल्ड गरिएका ईटाहरूलाई हावा सुकाइन्छ वा अतिरिक्त आर्द्रता हटाउन सुखा कक्षहरूमा राखिन्छ ।
- Burning: The dried bricks are fired in kilns at high temperatures (around 1,000 to 2,000 degrees Celsius) to vitrify the clay particles, resulting in a hard and durable brick. सुकेका ईटाहरू उच्च तापक्रम (लगभग १,००० देखि २,००० डिग्री सेल्सियस) मा भट्टाहरूमा पकाइन्छ र कडा र टिकाउ इट्टा बाहिर निकालिन्छ ।

#### 4. Brick types and their uses (ईट्टाका प्रकार र तिनका प्रयोगहरू)

Classification of Bricks Based on Quality गुणस्तरका आधारमा ईटाको वर्गीकरण

- First Class Brick
- Second Class Brick
- Third Class Brick
- Fourth Class Brick

Classification of Bricks Based on Raw Materials कच्चा पदार्थको आधारमा ईटाको वर्गीकरण

- Burnt Clay Brick
- Fly ash clay Brick
- Concrete Brick
- Sand-lime Brick
- Firebrick

## 5. Machine made and locally made bricks and their sizes (मेशिनले बनाएको र स्थानीय रूपमा बनाइएका ईँटाहरू र तिनीहरूका आकारहरू)

- Machine-made bricks are high-quality bricks that are produced in large quantities. They are made using the extrusion or wire-cut method. मेशिनमा निर्मित ईँटाहरू उच्च गुणस्तरका ईँटाहरू हुन् जुन ठूलो मात्रामा उत्पादन गरिन्छ। तिनीहरू एक्सट्रुजन वा तार-कट विधि प्रयोग गरेर बनाइएका छन्।
- Handmade bricks or locally made bricks are made by hand throwing clay into sanded molds. They are not compacted or cut by machines. हातले बनाइएका ईँटा वा स्थानीय रूपमा बनाइएका ईँटाहरू हातले माटोलाई बालुवा हालेर राखिएको साँचोमा हालेर बनाइन्छ। तिनीहरू मेशिनहरू द्वारा कम्प्याक्ट वा काटिएका हुँदैनन्।

According to Nepal standard,

- Standard size of bricks = 240mm x 115mm x 57mm (Tolerances of -10 mm on length, -5 mm on width and  $\pm 3$  mm on thickness)
- Size of hand made bricks = 230mm x 110mm x 55mm (560 required in 1m<sup>3</sup>)
- Size of machine made bricks = 240mm x 115mm x 57mm (530 required in 1m<sup>3</sup>)

Indian standard:

- Standard size of bricks = 190mm x 90mm x 90 mm

## Task 5: Tiles

### 1. Introduction परिचय

- Tiles are usually thin, square or rectangular coverings manufactured from hard-wearing material such as ceramic, stone, metal, baked clay, or even glass. टायलहरू सामान्यतया सिरेमिक, पत्थर, धातु, पकाइएको माटो, वा सिसा जस्ता कडा सामग्रीहरूबाट निर्माण भएको पातलो, वर्गाकार वा आयताकार आवरणहरू हुन्।
- They are generally fixed in place in an array to cover roofs, floors, walls, edges, or other objects such as tabletops. यो सामान्यतया छतहरू, भुइँहरू, भित्ताहरू, किनाराहरू, वा अन्य वस्तुहरू जस्तै टेबलटपहरू ढाक्न प्रयोग हुन्छन्।
- Tiles are often used to form wall and floor coverings, and can range from simple square tiles to complex or mosaics. टाइलहरू अक्सर भित्ता र भुइँ बनाउन प्रयोग गरिन्छ, र साधारण वर्ग टाइलहरूदेखि जटिल वा मोजाइकसम्म हुन सक्छ।
- Tiles are most often made of ceramic, typically glazed for internal uses and unglazed for roofing. टाइलहरू प्रायः सिरेमिकबाट बनाइन्छ, सामान्यतया आन्तरिक प्रयोगको लागि ग्लेज्ड र छतको लागि अनग्लेज्ड गरिन्छ।

### 2. Soil preparation, Molding, Drying, Burning of tiles माटो को तयारी, मोल्डिंग, सुकाउनु, टाइल पकाउनु

- Soil Preparation: Selecting and refining raw materials like clay, feldspar, silica, etc. and creating a slurry for tile production. माटो, फेल्डस्पार, सिलिका, आदि जस्ता कच्चा पदार्थहरू चयन र प्रशोधन गर्ने र टाइल उत्पादनको लागि स्लरी तयार गर्ने ।
- Molding: Shape the slurry into tiles using molds and compacting methods. मोल्ड र कम्प्याक्टिङ विधिहरू प्रयोग गरेर स्लरीलाई टाइलमा आकार दिने ।
- Drying: Allow the formed tiles to thoroughly dry, that can take several hours or days. टाइलहरू राम्ररी सुक्न दिने, यो प्रक्रिया पुरा हुन केहि घण्टा वा दिन लाग्न सक्छ।
- Burning: Subject the dried tiles to high-temperature kiln firing, transforming them into durable ceramic through bisque and glaze firings. सुकेका टाइलहरू उच्च-तापमान भट्टी फायरिंगमा राख्ने, बिस्क र ग्लेज फायरिंगको माध्यमबाट टाइलहरू टिकाऊ सिरेमिकमा रूपान्तरण हुन्छन् ।

### 3. Types of tiles टाइलका प्रकारहरू

- **Ceramic Tiles:** Made from clay and minerals, baked at high temperatures, versatile for various applications. माटो र खनिजबाट बनेको, उच्च तापमानमा पकाइएको, विभिन्न अनुप्रयोगहरूको लागि प्रयोग गर्न सकिने ।
- **Porcelain Tiles:** Dense and durable ceramic tiles fired at higher temperatures, suitable for high-traffic areas. उच्च तापमानमा पकाइएको घना र टिकाऊ सिरेमिक टाइलहरू, उच्च ट्राफिक क्षेत्रहरूको लागि उपयुक्त ।
- **Glass Tiles:** Produced from molten glass, available in a variety of colors and finishes for decorative purposes. पलेको ग्लासबाट उत्पादित, सजावटी उद्देश्यका लागि विभिन्न रङ र फिनिशहरूमा उपलब्ध ।
- **Natural Stone Tiles:** Cut from quarried stone like marble, granite, or slate, offering unique textures and patterns. संगमरमर, ग्रेनाइट, वा स्लेट जस्ता उत्खनन गरिएको पत्थरबाट काटेर बनावट र ढाँचाहरू प्रदान गरिएको टाइल ।
- **Mosaic Tiles:** Small pieces of glass, ceramic, or stone arranged to create intricate patterns or images. सिसा, सिरेमिक वा ढुङ्गाका स-साना टुक्राहरूबाट जटिल ढाँचा वा चित्रहरू सिर्जना गर्न मिलाएर राखिएको ।
- **Vinyl Tiles:** Synthetic flooring material with a printed design layer, durable and easy to install. Printed डिजाइन भएको टाइल , टिकाऊ र काम गर्न सजिलो ।
- **Terracotta Tiles:** Unglazed clay tiles, often in earthy tones, providing a warm aesthetic. Unglazed माटोको टाइलहरू, प्रायः माटोको टोनमा पाइन्छ, न्यानो सौन्दर्य भएको ।
- **Quarry Tiles:** Durable unglazed tiles made from natural clay, commonly used in outdoor and commercial spaces. प्राकृतिक माटोबाट बनाइएका टिकाऊ अनग्लेज्ड टाइलहरू, सामान्यतया बाहिरी र व्यावसायिक स्थानहरूमा प्रयोग गरिन्छ।
- **Cement Tiles:** Handmade tiles with a layer of colored cement, offering vibrant patterns and designs. रंगीन सिमेन्ट प्रयोग गरी हातले बनाइएका टाइलहरू, जीवन्त ढाँचाहरू र डिजाइनहरू भएको ।
- **Metal Tiles:** Tiles made from metals like stainless steel or aluminum, providing a modern and industrial look. स्टेनलेस स्टील वा एल्युमिनियम जस्ता धातुहरूबाट बनेका टाइलहरू, आधुनिक र औद्योगिक रूप भएको ।

## Task 6: Hollow blocks खोक्रो ब्लक

### 1. Introduction परिचय

- Hollow blocks, also known as concrete blocks or cinder blocks, are commonly used in construction for building walls and other structures.
- They are made from concrete and have hollow spaces in them, which makes them lighter and easier to handle than solid blocks.
- The hollow spaces also provide insulation and reduce the overall weight of the structure.
- These blocks come in various sizes and shapes, and they're often used in combination with other building materials.
- People appreciate their versatility and cost-effectiveness

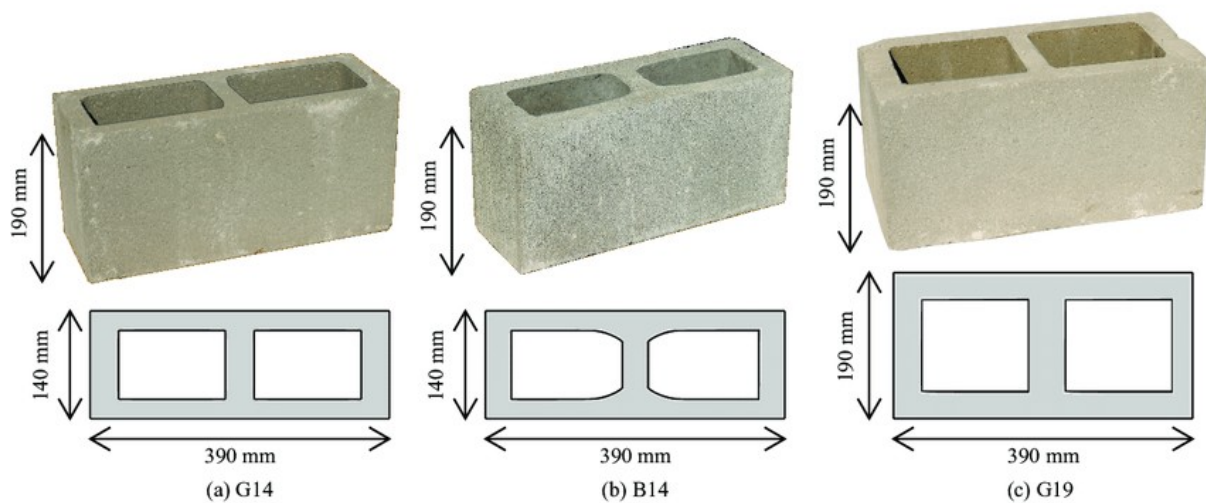
### 2. Composition रचना

- Cement
- Sand
- Aggregate (typically crushed stone or gravel)
- Additives (optional):
  - Plasticizers
  - Accelerators

### 3. Forms and sizes रूप र आकारहरु

- Standard Hollow Blocks: Rectangular or square-shaped blocks with regular hollow spaces.
- L-Shaped Blocks: Blocks shaped like the letter "L," providing versatility in building corners.
- U-Shaped Blocks: Blocks shaped like the letter "U," useful for creating channels or enclosures.

- **Interlocking Blocks:** Blocks with interlocking features that allow them to fit together without the need for mortar, providing ease of construction.
- **Lightweight Blocks:** Blocks designed to be lighter for easier handling, often used in construction where weight is a concern.
- **Aerated Concrete Blocks:** Blocks with aerated or foam-like structures, offering improved insulation properties.
- **Decorative Blocks:** Blocks with textured or decorative surfaces for aesthetic purposes.
- **Hollow Blocks with Voids:** Blocks with irregularly shaped hollow spaces, providing additional design flexibility.
- **Cellular Concrete Blocks:** Blocks with multiple small cells or voids, offering enhanced insulation and reduced weight.



#### 4. Types; Concrete, Clay किसिम; कंक्रीट, माटो

- Rectangular or square-shaped blocks made from concrete with regular hollow spaces. (Fig1)
- Rectangular or square-shaped blocks made from fired clay with regular hollow spaces. (Fig2)



Figure 1 Hollow Concrete Block



Figure 2 Hollow Clay Block

## 5. Test (Concept only) परीक्षण (अवधारणा मात्र)

Compressive Strength Test:

Density Test:

Water Absorption Test:

Dimensional Accuracy Test:

Soundness Test:

Flexural Strength Test:

Efflorescence Test:

Thermal Conductivity Test:

Abrasion Resistance Test:

Shear Strength Test:

## Task 7: Lime

### 1. Introduction परिचय

- In construction, "lime" typically refers to quick lime or hydrated lime, derived from limestone. निर्माणमा, "चुना" ले सामान्यतया चुनढुङ्गाबाट प्राप्त quick lime वा hydrated lime लाई बुझाउँछ।
- Quicklime is obtained by heating limestone at high temperatures, creating calcium oxide. Quicklime उच्च तापमानमा चुनढुङ्गा तताएर calcium oxide सिर्जना गरेर प्राप्त गरिन्छ।
- When water is added to quicklime, it undergoes a chemical reaction to produce hydrated lime, or calcium hydroxide. जब quicklime मा पानी थपिन्छ, यो रासायनिक प्रतिक्रिया बाट गुञ्जन्छ र यसले hydrated lime, वा calcium hydroxide उत्पादन गर्छ।
- This hydrated lime is utilized in mortar, improving its workability and durability in masonry. यो Hydrated lime mortar मा प्रयोग गरिन्छ, यसले mortar को workability र durability सुधार गर्दछ।
- Lime's versatility contributes significantly to the construction industry, improving the strength and longevity of various building elements. लाइमको प्रयोगले भवनका विभिन्न तत्वहरूको शक्ति र आयु सुधार गर्दछ।

### 2. Types प्रकारहरू

- Quicklime (Calcium Oxide): Produced by heating limestone to high temperatures, quicklime is a reactive substance. It is used in the production of hydrated lime and as an ingredient in mortar and plaster. चुनढुङ्गालाई उच्च तापक्रममा तताएर उत्पादन गरिएको quicklime एक प्रतिक्रियाशील पदार्थ हो। यो hydrated lime को उत्पादनमा र mortar र plaster मा एक ingredient को रूपमा प्रयोग गरिन्छ।
- Hydrated Lime (Calcium Hydroxide): Created by adding water to quicklime, hydrated lime is less reactive and more user-friendly. It is a key ingredient in mortar and plaster, contributing to improved workability and durability. Quick lime मा पानी थपेर सिर्जना गरिएको, hydrated lime कम प्रतिक्रियाशील र अधिक प्रयोगकर्ता अनुकूल छ। यो मोर्टार र प्लास्टरमा एक प्रमुख ingredient हो, जसले सुधारिएको कार्यक्षमता र स्थायित्वमा योगदान पुऱ्याउँछ।

- Natural Hydraulic Lime (NHL): Produced from limestone containing impurities like clay, hydraulic lime can set in the presence of water. It's suitable for masonry and plaster, offering some hydraulic properties. माटो जस्ता अशुद्धता युक्त चुनदुङ्गाबाट उत्पादित hydraulic lime पानीको उपस्थितिमा set गर्न सकिन्छ । यो masonry र प्लास्टरको लागि उपयुक्त हुन्छ ।

### 3. Uses प्रयोग

- Mortar: Lime, especially hydrated lime, is a crucial component in mortar. It enhances workability, plasticity, and bond strength, contributing to durable and resilient masonry. Lime, विशेष गरी hydrated lime, mortar मा एक महत्वपूर्ण ingredient हो । यसले workability, plasticity, र bond strength बढाउँछ, टिकाऊ र लचिलो masonry मा योगदान पुऱ्याउँछ।
- Plaster: Lime plaster is known for its flexibility and breathability. It reduces the risk of cracks and mold, providing a durable and aesthetically pleasing finish to walls and ceilings. Lime Plaster यसको flexibility र breathability लागि चिनिन्छ। यसले cracks र mold को जोखिम कम गर्दछ, पर्खालहरू र छतहरूमा टिकाऊ र सौन्दर्यपूर्ण रूपमा मनमोहक finish प्रदान गर्दछ।
- Soil Stabilization: Lime is used to stabilize soils, particularly clayey ones. It improves the load-bearing capacity of the soil and reduces its moisture content. चुनको प्रयोग माटोलाई stable गर्न प्रयोग गरिन्छ । यसले माटोको भार वहन क्षमतामा सुधार गर्दछ र moisture content कम गर्दछ।
- Road Construction: Lime is added to soils for road stabilization, creating a solid foundation that resists swelling and shrinking. It improves the overall strength and durability of road surfaces. Road stabilization को लागि माटोमा चुन थपिन्छ, यसले एक ठोस जग सिर्जना गर्दछ जसले swelling र shrinkage हुन दिदैन । यसले सडक सतहहरूको overall strength र durability सुधार गर्दछ।
- Building Preservation: Lime-based materials are often used in the restoration and preservation of historic buildings. Lime allows for compatibility with original materials and promotes breathability. ऐतिहासिक भवनहरूको restoration र preservation मा प्रायः चुनमा आधारित सामग्रीहरू प्रयोग गरिन्छ । चुना मूल सामग्रीको अनुकूल हुन्छ र यसले breathability बढाउँछ ।

- **Water Treatment:** Lime is used in water treatment processes for its ability to reduce acidity and soften water. Acidity कम गर्न र पानीलाई soft पार्नको लागि Water Treatment process हरूमा चुना प्रयोग गरिन्छ।
- **Brick Manufacturing:** Lime can be used in the production of bricks, contributing to their strength and durability. चुना ईटा को उत्पादन मा प्रयोग गर्न सकिन्छ, यसले इट्टा मा आफ्नो strength र durability प्रदान गर्छ ।

#### 4. Manufacturing process निर्माण प्रक्रिया

- **Quarrying:** Limestone, the primary raw material for lime production, is extracted from quarries. The quality and composition of the limestone are crucial factors. चुनढुङ्गा, चुन उत्पादनको लागि प्राथमिक कच्चा पदार्थ, खानीहरूबाट निकालिन्छ। चुनढुङ्गाको गुणस्तर र संरचना महत्त्वपूर्ण कारकहरू हुन्।
- **Preparation of Raw Material:** The extracted limestone is crushed into small pieces to increase the surface area for the subsequent calcination process. निकालिएको चुनढुङ्गालाई पछिको क्याल्सिनेसन प्रक्रियाको लागि सतह क्षेत्र बढाउन सानो टुकामा पिसिएको छ।
- **Calcination:** The crushed limestone is then heated in a kiln to high temperatures (around 900–1000°C) in a process called calcination. This thermal decomposition converts calcium carbonate ( $\text{CaCO}_3$ ) in the limestone into calcium oxide ( $\text{CaO}$ ), also known as quicklime. This reaction releases carbon dioxide ( $\text{CO}_2$ ) as a byproduct. त्यसपछि पिसिएको चुनढुङ्गालाई भट्टीमा उच्च तापक्रम (लगभग ९००-१००० डिग्री सेल्सियस) मा तताइन्छ। यो thermal decomposition ले चुनढुङ्गामा क्याल्सियम कार्बोनेट ( $\text{CaCO}_3$ ) लाई क्याल्सियम अक्साइड ( $\text{CaO}$ ) मा रूपान्तरण गर्दछ, जसलाई क्विकलाइम पनि भनिन्छ। यो प्रतिक्रियाले कार्बन डाइअक्साइड ( $\text{CO}_2$ ) लाई उप-उत्पादनको रूपमा बाहिर छोड्छ ।
- **Hydration (Optional):** Quicklime can be hydrated by adding water to produce hydrated lime (calcium hydroxide). This process is often carried out immediately or at a later stage, depending on the desired lime product. हाइड्रेटेड लाइम (क्याल्सियम हाइड्रोक्साइड) उत्पादन गर्न पानी थपेर क्विकलिमलाई हाइड्रेटेड गर्न सकिन्छ। यो प्रक्रिया अक्सर तुरुन्तै वा पछिको चरणमा गरिन्छ, इच्छित चूना उत्पादनमा निर्भर गर्दछ।
- **Finishing and Packaging:** The resulting lime product is then finely ground, sieved, and sometimes further processed based on the specific application. The final lime product is packaged for distribution and use in construction. चूना उत्पादन भएपछि सूक्ष्म

रूपमा पिसेको, चालेको, र कहिलेकाँही विशिष्ट अनुप्रयोगको आधारमा थप प्रशोधन गरिन्छ। अन्तिम चुना उत्पादन वितरण र निर्माणमा प्रयोगको लागि प्याक गरिन्छ।

## 5. Setting time of lime चुनको सेट हुने समय

- Hydrated Lime (Type S or Type N):
  - Initial Set: Typically occurs within 24 hours, but it can vary based on factors like temperature and humidity. सामान्यतया 24 घण्टा भित्र हुन्छ, तर यो तापमान र आर्द्रता जस्ता कारकहरूको आधारमा भिन्न हुन सक्छ।
  - Final Set: Final setting time may range from a few days to a couple of weeks, depending on conditions and the specific formulation. अन्तिम सेटिङ समय केही दिनदेखि केही हप्तासम्म हुन सक्छ, परिस्थिति र विशिष्ट सूत्रीकरणमा निर्भर गर्दछ।
- Natural Hydraulic Lime (NHL):
  - Initial Set: Begins within a few hours after mixing. मिश्रण पछि केही घण्टा भित्र सुरु हुन्छ।
  - Final Set: Final setting time can vary, but it generally occurs over a period of several days to a few weeks. अन्तिम सेटिङ समय फरक हुन सक्छ, तर यो सामान्यतया धेरै दिनदेखि केही हप्ताको अवधिमा हुन्छ।
- Quicklime (Calcium Oxide):
  - Setting Time: Quicklime undergoes a rapid reaction with water, resulting in a quick initial set. However, it continues to react over a longer period, achieving greater strength with time. क्विकलाइम पानीको साथ द्रुत प्रतिक्रियाबाट गुञ्जन्छ, जसको परिणामस्वरूप छिटो प्रारम्भिक सेट हुन्छ। तथापि, यसले लामो समयसम्म प्रतिक्रिया जारी राख्छ र समयको साथ अधिक शक्ति प्राप्त गर्दछ।

## 6. Storage भण्डारण

- Quicklime (Calcium Oxide):
  - Store quicklime in a dry and ventilated area to prevent exposure to moisture, which can cause it to react and deteriorate. आर्द्रताको जोखिम रोक्न सुख्खा र हावादार क्षेत्रमा क्विकलाइम भण्डारण गर्नुहोस्, जसले यसलाई प्रतिक्रिया दिन र बिगार्न सक्छ।

- Keep quicklime away from water and humidity. क्विकलाइमलाई पानी र आर्द्रताबाट टाढा राख्नुहोस्।
- Use airtight containers or bags to minimize contact with air. हावाको सम्पर्क कम गर्न एयरटाइट कन्टेनर वा ब्यागहरू प्रयोग गर्नुहोस्।
- Hydrated Lime (Calcium Hydroxide):
  - Store hydrated lime in a cool, dry place to prevent it from absorbing moisture. हाइड्रेटेड चुनलाई चिसो, सुख्खा ठाउँमा राख्नुहोस् ताकि यसलाई आर्द्रता अवशोषित गर्नबाट रोक्न सकियोस्।
  - Keep hydrated lime containers tightly sealed to avoid exposure to air and humidity. हावा र आर्द्रताको सम्पर्कबाट बच्न हाइड्रेटेड चुना कन्टेनरहरू कसिलो गरी सील गर्नुहोस्।
  - Store away from direct sunlight and sources of heat. प्रत्यक्ष सूर्यको प्रकाश र गर्मीको स्रोतहरूबाट टाढा भण्डारण गर्नुहोस्।
- Hydrated Lime (Calcium Hydroxide):
  - Store hydrated lime in a cool, dry place to prevent it from absorbing moisture. हाइड्रेटेड चुनलाई चिसो, सुख्खा ठाउँमा राख्नुहोस् ताकि यसलाई आर्द्रता अवशोषित गर्नबाट रोक्न सकियोस्।
  - Keep hydrated lime containers tightly sealed to avoid exposure to air and humidity. हावा र आर्द्रताको सम्पर्कबाट बच्न हाइड्रेटेड चुना कन्टेनरहरू कसिलो गरी सील गर्नुहोस्।
  - Store away from direct sunlight and sources of heat. प्रत्यक्ष सूर्यको प्रकाश र गर्मीको स्रोतहरूबाट टाढा भण्डारण गर्नुहोस्।
- Natural Hydraulic Lime (NHL):
  - Store NHL in a dry location to prevent the absorption of moisture. आर्द्रताको अवशोषण रोक्न सुख्खा स्थानमा एनएचएल भण्डारण गर्नुहोस्। Use airtight containers or bags to minimize exposure to air. हावाको जोखिम कम गर्न एयरटाइट कन्टेनर वा ब्यागहरू प्रयोग गर्नुहोस्।
  - Keep away from extreme temperatures and direct sunlight. अत्यधिक तापक्रम र प्रत्यक्ष सूर्यको प्रकाशबाट टाढा राख्नुहोस्।

## Task 8: Cement

### 1. Introduction

- Cement is a key ingredient in concrete, made from limestone, clay, and silica. चुनढुङ्गा, माटो र सिलिकाबाट बनेको सिमेन्ट कंक्रीटको एक प्रमुख ingredient हो।
- It binds materials together in construction, forming a durable and versatile building material. यसले निर्माण सामग्रीलाई एकसाथ बाँध्छ, durable र versatile निर्माण सामग्री बनाउँदछ।

### 2. Composition

- Cement typically consists of limestone, clay, silica, and gypsum. सिमेन्टमा सामान्यतया चुनढुङ्गा, माटो, सिलिका र जिप्सम हुन्छन्।
- The combination undergoes a heating process called calcination, resulting in clinker, which is then ground into the fine powder we know as cement. यो combination क्याल्सिनेसन भनिने तातो प्रक्रियाबाट गुज्रन्छ, जसको परिणामस्वरूप क्लिंकर बन्छ, जसलाई पाउडर बनाउन पिसिन्छ। यहि पाउडरलाई हामी सिमेन्टको रूपमा चिन्दछौं।

### 3. Manufacturing process

- Cement is manufactured through a multi-step process. सिमेन्ट बहुचरणीय प्रक्रियाबाट निर्माण गरिन्छ।
- First, raw materials like limestone, clay, and silica are crushed and blended. पहिले, चुनढुङ्गा, माटो र सिलिका जस्ता कच्चा पदार्थहरू पिसेर एउटा मिश्रण बनाइन्छ।
- This mixture is heated in a kiln to form clinker. यो मिश्रणलाई भट्टीमा तताएर क्लिंकर बनाइन्छ।
- After cooling, the clinker is ground into a fine powder, which is cement. चिसो भएपछि क्लिंकरलाई पाउडरमा पिसिन्छ, जुन पाउडर नै सिमेन्ट हो।
- Gypsum is added during the grinding process to control the setting time. सेटिङ समय नियन्त्रण गर्न पिसिरहेको समयमा जिप्सम थपिन्छ।
- The final product is used in construction for various applications. अन्तिम उत्पादन विभिन्न कामहरूको लागि निर्माणमा प्रयोग गरिन्छ।

#### 4. Types

- Ordinary Portland Cement (OPC): Commonly used in general construction work. सामान्यतया सामान्य निर्माण कार्यमा प्रयोग गरिन्छ।
- Portland Pozzolana Cement (PPC): Blended with pozzolanic materials like fly ash, offering enhanced durability and workability. फ्लाई ऐश जस्ता पोञ्जोलानिक सामग्रीको साथ मिश्रित, उन्नत स्थायित्व र कार्यक्षमता प्रदान गर्दछ।
- Rapid Hardening Cement: Sets quickly and gains strength faster, suitable for projects with tight schedules. छिटो सेट गर्दछ र छिटो शक्ति प्राप्त गर्दछ, धेरै छिटो काम सक्नु पर्ने परियोजनाहरूको लागि उपयुक्त।
- Low Heat Cement: Generates less heat during hydration, preventing the risk of cracking in large concrete structures. हाइड्रेसनको समयमा कम गर्मी उत्पन्न गर्दछ, ठूलो कंक्रीट संरचनाहरूमा क्रैकिंगको जोखिम लाई रोक्छ।
- Sulfate-Resistant Cement: Resists the damaging effects of sulfate ions, often used in marine and chemical industry constructions. सल्फेट आयनहरूको हानिकारक प्रभावहरूको प्रतिरोध गर्दछ, प्रायः समुद्री र रासायनिक उद्योग निर्माणहरूमा प्रयोग गरिन्छ।
- White Cement: Used for aesthetic purposes, it is color-controlled and often used in architectural applications. सौन्दर्य प्रयोजनका लागि प्रयोग गरिने, यो रङ-नियन्त्रित छ र प्रायः आर्किटेक्चरल अनुप्रयोगहरूमा प्रयोग गरिन्छ।
- Expansive Cement: Expands slightly during hydration, useful for reducing shrinkage in large concrete structures. हाइड्रेसनको समयमा थोरै expand हुन्छ, ठूलो कंक्रीट संरचनाहरूमा shrinkage कम गर्न उपयोगी।
- Colored Cement: Similar to white cement but with added pigments for a range of colors. सेतो सिमेन्ट को समान तर पिगमेन्ट थपिएको हुन्छ।

#### 5. Properties

- Setting and Hardening: Cement undergoes a chemical reaction with water, gradually setting and hardening to form a strong, solid mass. सिमेन्टले पानीसँग chemical reaction गर्छ, बिस्तारै सेट र कडा हुँदै एक बलियो, solid mass बनाउँछ।

- **Strength:** It provides compressive strength to structures, crucial for supporting loads and ensuring stability. यसले संरचनाहरूलाई compressive strength प्रदान गर्दछ, load लाई support गर्न र stability सुनिश्चित गर्न महत्वपूर्ण भूमिका निर्वाह गर्छ ।
- **Durability:** Cement contributes to the durability of structures, resisting environmental factors and wear over time. सिमेन्टले structure हरूको durability मा योगदान पुऱ्याउँछ, environmental factor हरू resist गर्दछ र समयको साथ wear out हुँदै जान्छ ।
- **Workability:** The ease with which cement can be mixed, placed, and finished influences construction efficiency. सिमेन्ट मिसाउन, राख्न र राम्रो finish दिन सकिने सहजताले निर्माण कार्यमा राम्रो प्रभाव पार्छ ।
- **Hydration:** The process of reacting with water to form hydrates, contributing to the strength development of the concrete. हाइड्रेट्स बनाउन पानीको साथ reaction गर्ने प्रक्रिया, कंक्रीटको शक्ति विकासमा योगदान पुऱ्याउँदछ।
- **Heat of Hydration:** The heat generated during the curing process, which should be controlled to prevent cracking in large structures. Curing प्रक्रियाको क्रममा उत्पन्न heat, जुन ठूलो structure मा cracking रोक्न नियन्त्रण गर्नुपर्छ ।
- **Setting Time:** The time it takes for cement to solidify and reach a state where it can bear some load. सिमेन्टलाई बलियो बनाउन र केही load थेग्न सक्ने अवस्थामा पुग्न लाग्ने समय ।

## 7. Setting time of cement

The setting time of cement can vary, but as a general guideline:

- **Initial Setting Time:** Usually occurs within 30 minutes to a few hours after adding water. सामान्यतया पानी हालेको ३० मिनेटदेखि केही घण्टाभित्र हुन्छ ।
- **Final Setting Time:** Typically ranges from a few hours to several days after the initial setting, depending on the type of cement. सामान्यतया सिमेन्टको प्रकारमा निर्भर हुँदै, प्रारम्भिक सेटिङ पछि केही घण्टा देखि केहि दिन सम्म हुन्छ ।

These times can be affected by factors like temperature, cement type, and specific additives used in the mix. यी समयहरू तापमान, सिमेन्ट प्रकार, र मिश्रणमा प्रयोग हुने विशिष्ट योजकहरू जस्ता कारकहरूद्वारा प्रभावित हुन सक्छ।

Sr. No.	Type of Cement (Guidelines)	Setting Time	
		Initial Time Min. (minutes)	Final Time Max. (minutes)
1	33 Grade OPC (IS 269-1989)	30	600
2	43 Grade OPC (IS 81112-1989)	30	600
3	53 Grade OPC (12269-1987)	30	600
4	SRC (IS 12330-1988)	30	600
5	PPC (IS 1489-1991) Part I	30	600
6	Rapid Hardening (IS 1489-1991) Part I	30	600
7	Slag Cement (IS 445-1989)	30	600
8	High Alumina Cement (IS 6452-1989)	30	600
9	Super Sulphated Cement (IS 6909-1990)	30	600
10	Low Heat Cement (IS 12600-1989)	60	600
11	Masonry Cement (IS 3466-1988)	90	600
12	IRS-T-40	60	600

## 8. Compressive strength, tensile

- The compressive strength of cement is often measured in megapascals (Mpa), and 1 Mpa is approximately equal to 1,000 kilonewtons (kN) per square meter. सिमेन्टको compressive strength प्रायः मेगापास्कल (एमपीए) मा मापन गरिन्छ, र १ एमपीए लगभग १,००० किलोन्यूटोन (केएन) प्रति वर्ग मिटर बराबर हुन्छ।
- So, if we consider compressive strength in terms of kilonewtons per square meter: त्यसोभए, यदि हामी प्रति वर्ग मिटर किलोन्यूटोनमा compressive strength लाई हेर्छौं भने :
- Ordinary Portland Cement (OPC) can have compressive strengths ranging from around 17.5 Mpa to over 70 Mpa. Ordinary Portland Cement (ओपीसी) मा लगभग 17.5 एमपीए देखि 70 एमपीए भन्दा बढी compressive strength हुन सक्छ।

- For tensile strength, it's important to note that concrete's tensile strength is significantly lower than its compressive strength, often in the range of 1/8 to 1/12 of the compressive strength. Tensile strength को लागि, यो नोट गर्न महत्वपूर्ण छ कि कंक्रीटको tensile strength यसको compressive strength भन्दा उल्लेखनीय रूपमा कम छ, प्रायः compressive strength को 1/8 देखि 1/12 जति tensile strength हुन्छ

## 9. Strength and consistency

- The strength of cement refers to its ability to withstand loads, and it's commonly measured in terms of compressive strength. Ordinary Portland Cement (OPC) can have compressive strengths ranging from 17.5 Mpa to over 70 Mpa. सिमेन्टको शक्तिले यसको भार सहन सक्ने क्षमतालाई बुझाउँछ, र यो सामान्यतया compressive strength को सन्दर्भमा मापन गरिन्छ। Ordinary Portland Cement (ओपीसी) मा १७.५ एमपीएदेखि ७० एमपीए भन्दा बढीको compressive strength हुन सक्छ ।
- Consistency, on the other hand, relates to the workability and uniformity of the cement paste. It's crucial for ease of mixing, placing, and finishing during construction. The consistency of cement paste can be controlled by adjusting the water-to-cement ratio. अर्कोतर्फ, Consistency , सिमेन्ट पेस्टको workability र एकरूपतासँग सम्बन्धित छ । यो निर्माण को समयमा मिश्रण गर्न , राख्न, र काम राम्रो सँग सक्नको लागि महत्वपूर्ण छ । Water cement ratio मिलाएर सिमेन्ट पेस्टको consistency नियन्त्रण गर्न सकिन्छ।
- Balancing strength and consistency is essential in construction to ensure the durability and practicality of the resulting structures. संरचनाहरूको durability र व्यावहारिकता सुनिश्चित गर्न निर्माणमा strength र consistency लाई सन्तुलन गर्न आवश्यक छ।

## 10. Storage

Cement should be stored properly to maintain its quality:

- Dry Environment: Store cement in a dry place to prevent it from absorbing moisture, which can lead to lumps and affect its setting properties. सिमेन्टलाई ओसिलोपन सोस्नबाट रोक्नका लागि सुख्खा ठाउँमा भण्डारण गर्नुहोस्, ओसिलोपनले गाँठाहरू निम्त्याउन सक्छ र यसको सेटिङ गुणहरूलाई असर गर्न सक्छ।
- Elevated Surface: Keep bags of cement off the ground on pallets or a raised platform to prevent direct contact with moisture. सिमेन्टका झोलाहरू भुइँबाट प्यालेट वा उठेको प्ल्याटफर्ममा राख्नुहोस् ताकि moisture को प्रत्यक्ष सम्पर्कबाट बच्न सकियोस्।

- **Sealed Containers:** Once opened, reseal cement bags tightly to minimize exposure to air and moisture. एक पटक खोल्दा, हावा र moisture को जोखिम कम गर्न सिमेन्ट ब्यागहरू कसिलो गरी पुनः सिल गर्नुहोस्।
- **Cool Storage:** Avoid exposure to high temperatures, as excessive heat can lead to premature setting of the cement. उच्च तापमानको सम्पर्कमा आउनबाट जोगिनुहोस्, किनकि अत्यधिक गर्मीले सिमेन्टको तोकिएको समय भन्दा पहिले नै सेटिङ गर्न सक्छ।
- **Proper storage helps ensure that cement retains its properties, contributing to the strength and durability of the concrete it forms.** उचित भण्डारणले यो सुनिश्चित गर्न मद्दत गर्दछ कि सिमेन्टले यसको गुणहरू कायम राख्छ, यसले कंक्रीटको strength र durability मा योगदान पुऱ्याउँछ।

## Task 9: Asbestos

### 1. Introduction

- Asbestos is a material known for its fire-resistant properties, making it widely used in insulation and fireproofing applications. एस्बेस्टस यसको आगो प्रतिरोधी गुणहरूको लागि परिचित एक सामग्री हो, जसले यसलाई insulation र fireproofing कामहरूमा व्यापक रूपमा प्रयोग गर्दछ।
- However, prolonged exposure to airborne asbestos fibers poses significant health risks, including severe conditions such as lung cancer and asbestosis. तथापि, लामो समयसम्म हावामा एस्बेस्टस फाइबरको सम्पर्कमा रहनुले फोक्सोको क्यान्सर र एस्बेस्टोसिस जस्ता गम्भीर अवस्थाहरू सहित महत्वपूर्ण स्वास्थ्य जोखिमहरू उत्पन्न गर्दछ।
- In modern construction, there is a shift towards alternative materials that prioritize both structural integrity and the well-being of individuals. आधुनिक निर्माणमा, वैकल्पिक सामग्री सबैले खोजिरहेका छन् जुन सामग्रीले structural integrity र व्यक्तिको कल्याण दुवै लाई प्राथमिकता दिन्छ।

### 2. Types of asbestos

There are two main types of asbestos: serpentine and amphibole.

- Chrysotile (Serpentine): This is the most common type of asbestos. It has long, curly fibers and is often used in construction materials like roofs and ceilings. यो एस्बेस्टोसको सबैभन्दा सामान्य प्रकार हो। यसमा लामो, curly fiber हरू हुन्छन् र प्राय छत मा प्रयोग हुने निर्माण सामग्रीहरूमा प्रयोग गरिन्छ।
- Amphibole Asbestos (includes crocidolite, amosite, anthophyllite, tremolite, and actinolite): These asbestos fibers are needle-like and can be more harmful when inhaled. They were commonly used in insulation materials and other industrial applications. यी एस्बेस्टस फाइबरहरू सुई जस्तो हुन्छन् र सास फेर्दा बढी हानिकारक हुन सक्छन्। तिनीहरू सामान्यतया insulation सामग्री र अन्य औद्योगिक कामहरूमा प्रयोग गरिन्थ्यो।

### 3. Properties

Asbestos possesses several properties that made it attractive for various applications, especially in construction and industrial settings. Here are some key properties: एस्बेस्टससँग धेरै गुणहरू छन् जसले यसलाई विभिन्न अनुप्रयोगहरूको लागि आकर्षक बनाउँदछ, विशेष गरी निर्माण र औद्योगिक सेटिङ्समा। यहाँ केही प्रमुख गुणहरू छन्:

- **Fire Resistance:** Asbestos is highly resistant to heat and flames, making it effective for fireproofing and insulation. एस्बेस्टस गर्मी र ज्वालाको लागि अत्यधिक प्रतिरोधी छ, यसलाई fireproofing र insulationको लागि प्रभावकारी बनाउँदछ।
- **Chemical Resistance:** It is resistant to chemical corrosion, adding durability in different environments. यो रासायनिक खिया प्रतिरोधी छ, यस कारणले गर्दा यो विभिन्न वातावरणमा durable हुन्छ।
- **Insulating Properties:** Asbestos has excellent insulating properties, both thermally and electrically, making it useful in insulating materials. एस्बेस्टसमा उत्कृष्ट insulating गुणहरू छन्, जसले गर्दा यसलाई थर्मल र इलेक्ट्रिकल इन्सुलेट सामग्रीमा उपयोगी बनाउँदछ।
- **Strength and Durability:** Asbestos fibers are strong and durable, contributing to the structural integrity of materials in which it is used. एस्बेस्टस फाइबर बलियो र टिकाऊ हुन्छन्, यसले सामग्रीको संरचनात्मक अखण्डतामा योगदान पुऱ्याउँछ।
- **Flexibility and Versatility:** Asbestos fibers can be woven into fabrics, providing flexibility and versatility in various applications. एस्बेस्टस फाइबरहरूबाट कपडामा बुन सकिन्छ, जसले गर्दा यसले विभिन्न कामहरूमा flexibility र versatility प्रदान गर्दछ।

#### 4. Health Hazards

Exposure to asbestos poses serious health hazards due to the inhalation of microscopic asbestos fibers. Here are some of the associated health risks:

- **Lung Cancer:** Prolonged inhalation of asbestos fibers can lead to lung cancer. This risk is particularly high among individuals who have been exposed to high levels of asbestos over an extended period. एस्बेस्टस फाइबर भएको ठाउँमा लामो समयसम्म सास फेर्दा फोक्सोको क्यान्सर हुन सक्छ। यो जोखिम विशेष गरी लामो अवधिमा एस्बेस्टसको उच्च स्तरको सम्पर्कमा आएका व्यक्तिहरूमा उच्च छ।
- **Asbestosis:** This is a chronic lung disease caused by the scarring of lung tissue from asbestos fibers. It can result in difficulty breathing and decreased lung function. यो एस्बेस्टस फाइबरबाट फोक्सोको तन्तुको दागको कारण हुने फोक्सोको दीर्घकालीन रोग हो। यसले सास फेर्न गाह्रो हुन सक्छ र फोक्सोको कार्यक्षमतामा कमी आउन सक्छ।
- **Mesothelioma:** Asbestos exposure is a major cause of mesothelioma, a rare and aggressive form of cancer that affects the lining of the lungs, abdomen, or heart.

एस्बेस्टोस एक्सपोजर मेसोथेलियोमा (क्यान्सरको एक दुर्लभ र आक्रामक रूप जसले फोक्सो, पेट वा हृदयको अस्तरलाई असर गर्दछ) को एक प्रमुख कारण हो ।

- Pleural Disorders: Asbestos fibers can cause thickening of the pleura, the membrane surrounding the lungs, leading to breathing difficulties. एस्बेस्टोस फाइबरले फोक्सोको वरिपरिको झिल्ली pleura लाई बाक्लो बनाउन सक्छ, जसले गर्दा सास फेर्न गाह्रो हुन सक्छ।

## Task 10: Glass

### 1. Introduction

- Glass is a versatile and transparent material made primarily from silica, soda ash, and limestone. ग्लास एक बहुमुखी र पारदर्शी सामग्री हो जुन मुख्य तया सिलिका, सोडा खरानी र चुनढुङ्गाबाट बनाइन्छ ।
- Glass comes in various forms, from everyday items like windows and bottles to specialized uses in optics, electronics, and art. सिसा विभिन्न रूपहरूमा आउँदछ, दैनिक वस्तुहरू जस्तै झ्याल र बोतलहरूदेखि optics, इलेक्ट्रोनिक्स र कलामा विशेष प्रयोग गरिन्छ ।
- Its transparency allows light to pass through, making it an essential material for windows and lenses. यसको पारदर्शिताले प्रकाशलाई पार गर्न दिन्छ, यसलाई windows र lenses को लागि एक आवश्यक सामग्री बनाउँदछ ।
- Glass is also recyclable, making it environmentally friendly. ग्लास recyclable हुन्छ, त्यसैले यो environmentally friendly छ ।

### 2. Composition

Glass is primarily composed of silica, which is derived from sand. सिसा मुख्यतया सिलिकाबाट बनेको हुन्छ, जुन बालुवाबाट प्राप्त हुन्छ । The basic composition of glass includes:

- Silica (SiO<sub>2</sub>): The main component of glass, derived from sand, quartz, or other silica-containing materials. It provides the basic structure and strength to the glass. यो सिसाको मुख्य component हो । सिलिका बालुवा, क्वार्ट्ज, वा अन्य सिलिका युक्त सामग्रीबाट बनाइएको हुन्छ । यसले ग्लासलाई आधारभूत संरचना र शक्ति प्रदान गर्दछ।
- Soda Ash (Sodium Carbonate - Na<sub>2</sub>CO<sub>3</sub>): It is used as a flux to lower the melting point of silica, making it easier to work with during the manufacturing process. यो सिलिकाको melting point कम गर्न प्रयोग गरिन्छ, जसले निर्माण प्रक्रियाको समयमा काम गर्न सजिलो बनाउँदछ।
- Lime (Calcium Oxide - CaO): Acts as a stabilizer and enhances the durability and hardness of the glass. Stabilizer को रूपमा कार्य गर्दछ र glass को durability र hardness बढाउँछ।
- Alumina (Aluminum Oxide - Al<sub>2</sub>O<sub>3</sub>): Improves the chemical and thermal resistance of the glass. ग्लास को रासायनिक र थर्मल प्रतिरोध सुधार गर्दछ।

- Magnesia (Magnesium Oxide - MgO): Helps in increasing the resistance of the glass to chemical corrosion. रासायनिक खियापन प्रति ग्लासको प्रतिरोध बढाउन मद्दत गर्दछ।

Oxydes	Wt (%)
SiO <sub>2</sub>	72.2
Na <sub>2</sub> O	15.0
CaO	6.7
MgO	4.0
Al <sub>2</sub> O <sub>3</sub>	1.9
Balance	0.2

### 3. Classification

Glass can be classified in various ways based on different criteria. Here are a few common classifications:

- Chemical Composition:
  1. Soda-Lime Glass: The most common type, composed of silica, soda, and lime. सिलिका, सोडा, र चूना मिलेर बनेको सबैभन्दा सामान्य प्रकार।
  2. Borosilicate Glass: Contains silica and boron trioxide, known for its high resistance to heat. यसमा सिलिका र बोरोन ट्राइअक्साइड हुन्छ, जुन गर्मीको उच्च प्रतिरोधको लागि चिनिन्छ।
- Physical Properties:
  1. Transparent, Translucent, Opaque: Based on how much light can pass through. कति प्रकाश पार गर्न सकिन्छ भन्ने आधारमा।
  2. Colored Glass: Adding metal oxides during manufacturing can give glass different colors. उत्पादनको क्रममा धातु अक्साइड थप्दा ग्लासलाई विभिन्न रङहरू दिन सकिन्छ।
- Manufacturing Process:
  1. Float Glass: Produced by floating molten glass on a bed of molten metal. पग्लेको धातुको ओछ्यानमा पग्लेको सिसालाई बगाएर उत्पादन गरिन्छ।
  2. Blown Glass: Shaping glass by blowing air into a gather of molten glass on the end of a pipe. पाइपको अन्त्यमा पग्लेको सिसाको एउटा भाग मा हावा भरेर आकार दिईएको सिसा।
- Specialized Types:

1. Safety Glass: Designed to break into small, dull pieces for safety. सुरक्षाको लागि सानो टुक्राहरूमा तोड्न डिजाइन गरिएको।
  2. Tempered Glass: Heat-treated for increased strength and safety. ज्यादा शक्ति र सुरक्षाको लागि गर्मीले उपचार गरिएको।
  3. Laminated Glass: Layers of glass with a plastic interlayer for safety and security. सुरक्षाको लागि प्लास्टिक इन्टरलेयरको साथ ग्लासको तहहरू मिलाइएको।
- Use-Based Classification:
    1. Architectural Glass: Used in buildings and structures. भवन र संरचनामा प्रयोग गरिन्छ।
    2. Automotive Glass: Found in vehicles for windshields, windows, etc. विन्डशील्ड, झ्याल, आदिको लागि सवारी साधनहरूमा प्रयोग गरिन्छ।
    3. Container Glass: Used for bottles, jars, and containers. बोतल, जार, र कन्टेनरको लागि प्रयोग गरिन्छ।
  - Optical Properties:
    1. Fused Silica: High-purity glass with excellent optical qualities. उत्कृष्ट अप्टिकल गुणहरूको साथ उच्च-शुद्धता ग्लास।
    2. Low-Expansion Glass: Designed to minimize expansion with changes in temperature. तापमान मा परिवर्तन संग विस्तार कम गर्न डिजाइन।

#### 4. Commercial forms

- Sheet Glass:
  - Float Glass: Produced by floating molten glass on a molten tin bath, resulting in a smooth surface. Widely used in windows and architectural applications.
- Container Glass:
  - Bottles and Jars: Used for packaging beverages, food, pharmaceuticals, and cosmetic products.
- Flat Glass:

- Laminated Glass: Two or more layers of glass bonded together with a plastic interlayer, providing safety and security. Used in car windshields and architectural applications.
- Safety Glass:
  - Tempered Glass: Heat-treated to increase strength and shatter resistance. Commonly used in car windows, shower doors, and architectural applications.
- Optical Glass:
  - Fused Silica: High-purity glass with exceptional optical properties. Used in lenses, prisms, and other optical components.
- Glass Fibers:
  - Fiberglass: Thin strands of glass used for insulation, reinforcement in composites, and in the production of fabrics.
- Glass Containers:
  - Drinking Glasses, Tumblers, and Stemware: Used for serving beverages in various settings.
- Specialty Glass:
  - Borosilicate Glass: Known for its resistance to thermal shock, used in laboratory glassware and certain cookware.
  - Lead Glass: Contains lead oxide, providing high refractive index. Used in fine glassware and optical lenses.
- Electronic Glass:
  - Display Glass: Thin, high-resolution glass used in electronic displays such as LCD and OLED screens.
  - Glass Substrates: Used in the production of electronic components like semiconductors.

- **Mirror Glass:**
  - **Flat Mirrors:** Commonly used in households and commercial spaces.
  - **Two-Way Mirrors:** Designed to allow light to pass through from one side while reflecting from the other. Used in surveillance and observation applications.

## Task 11: Asphalt / Bitumen / Tar

### 1. Introduction

Asphalt:

- Asphalt is a sticky, black, and highly viscous liquid or semi-solid form of petroleum. Asphalt एक चिपचिपा, कालो, र अत्यधिक बाक्लो तरल वा पेट्रोलियमको अर्ध-ठोस रूप हो।
- It is a natural substance or can be produced as a byproduct of refining crude oil. यो एक प्राकृतिक पदार्थको रूपमा पाइन्छ वा कच्चा तेललाई refine गर्दा by-product को रूपमा पनि उत्पादन गर्न सकिन्छ।

Bitumen:

- Bitumen is a generic term for a class of black or dark-colored, thick, sticky, and viscous substances that are a byproduct of crude oil distillation. बिटुमिन कालो वा गाढा रङको, बाक्लो, चिपचिपा र बाक्लो तरल पदार्थहरूको एक वर्गको लागि एक सामान्य शब्द हो जुन कच्चा तेल distillation को by-product हो।
- It is commonly used in road construction and waterproofing. यो सामान्यतया सडक निर्माण र वाटरप्रूफिंगमा प्रयोग गरिन्छ।

Tar:

- Tar is a dark, thick, and viscous liquid that results from the destructive distillation of organic materials, such as wood, coal, or peat. टार एक गाढा, बाक्लो र चिपचिपा तरल हो जुन काठ, कोइला, वा पीट जस्ता जैविक पदार्थहरूको विनाशकारी distillation को परिणाम हो।
- It has been historically used for various purposes, including waterproofing and preserving wood. यो ऐतिहासिक रूपमा विभिन्न उद्देश्यहरूको लागि प्रयोग गरिएको छ, जसमा वाटरप्रूफिंग र काठ संरक्षण समावेश छ।

### 2. Types

Asphalt:

1. Hot Mix Asphalt (HMA): This is the most common type of asphalt used in road construction. It is produced at high temperatures and is flexible and durable. यो सडक निर्माणमा प्रयोग हुने asphalt को सबैभन्दा सामान्य प्रकार हो। यो उच्च तापमानमा उत्पादन गरिन्छ र लचिलो र टिकाऊ छ।

2. Warm Mix Asphalt (WMA): Similar to HMA but produced at lower temperatures, which can offer environmental and energy-saving benefits. HMA जस्तै तर कम तापमानमा उत्पादन गरिएको हुन्छ, जसले वातावरणीय र ऊर्जा-बचत जस्ता लाभहरू प्रदान गर्न सक्छ।
3. Cold Mix Asphalt: Produced and applied at lower temperatures, often used for temporary repairs. उत्पादन र प्रयोग कम तापमानमा गरिन्छ । प्राय अस्थायी मर्मत को लागि प्रयोग गरिन्छ।
4. Porous Asphalt: Engineered to allow water to pass through the surface, reducing stormwater runoff and helping with water management. पानी surfaceबाट pass हुन्छ । आँधीको पानीको बहाव कम गर्न र पानी व्यवस्थापनमा मद्दत गर्न प्रयोग गरिन्छ ।
5. Stone Mastic Asphalt (SMA): Contains a higher proportion of stone aggregates, providing a durable and wear-resistant surface. एक टिकाऊ र wear-resistant surface प्रदान गर्न stone aggregates को एक उच्च अनुपात समावेश हुन्छ ।
6. Quiet Asphalt: Designed to minimize road noise, particularly in residential areas. It incorporates special additives to reduce sound levels. विशेष गरी आवासीय क्षेत्रहरूमा सडकको आवाज कम गर्न डिजाइन गरिएको । यसले ध्वनिको स्तर कम गर्न विशेष योजकहरू समावेश गर्दछ ।

#### Bitumen:

1. Penetration Grade Bitumen: Classified based on the depth (in tenths of a millimeter) to which a standard needle penetrates the bitumen specimen under specific conditions. गहिराईको आधारमा वर्गीकृत (मिलिमिटरको दसौं मा) जसमा एक मानक सुई विशिष्ट परिस्थितिमा बिटुमिन नमूनामा प्रवेश गर्दछ।
2. Viscosity Grade Bitumen: Classified based on the viscosity of the bitumen at a specific temperature. एक विशिष्ट तापमानमा बिटुमिनको चिपचिपाहटको आधारमा वर्गीकृत ।
3. Oxidized Bitumen: Subjected to air at elevated temperatures, resulting in increased viscosity. It is commonly used for roofing and waterproofing applications. उच्च तापमानमा हावा pass गरिएको, जसको परिणामस्वरूप चिपचिपाहट बढ्छ । यो सामान्यतया छत र वाटरप्रूफिंगको लागि प्रयोग गरिन्छ।

4. Cutback Bitumen: Bitumen mixed with a solvent to reduce viscosity, making it more fluid for easier application. The solvent evaporates after application. Viscosity कम गर्न solvent को साथ बिटुमिन मिसाइन्छ । सजिलोसंग काम गर्नको लागि अधिक तरल बनाइएको हुन्छ । Bitumen प्रयोग गरिसकेपछि solvent evaporate हुन्छ ।
5. Polymer Modified Bitumen (PMB): Enhanced with polymers (usually thermoplastics or elastomers) to improve performance characteristics such as strength, elasticity, and resistance to aging. Strength, elasticity, र resistance to aging सुधार गर्न पोलिमर (सामान्यतया थर्मोप्लास्टिक्स वा इलास्टोमर्स) प्रयोग गरिएको ।
6. Emulsion Bitumen: Bitumen dispersed in water with the aid of an emulsifying agent. It is used for various applications, including road construction and maintenance. बिटुमिन एक emulsifying agent को सहायताले पानीमा छरिन्छ । यो सडक निर्माण र maintenance सहित विभिन्न कामहरूको लागि प्रयोग गरिन्छ।
7. Hard Bitumen: Bitumen with a higher softening point, making it more resistant to deformation under high temperatures. उच्च नरम बिन्दु भएको बिटुमिन, यसले उच्च तापमानमा deformation लाई धेरै resist गर्न सक्छ ।
8. Soft Bitumen: Bitumen with a lower softening point, making it more flexible and suitable for colder climates. कम नरम बिन्दु भएको बिटुमिन, अधिक लचिलो र चिसो मौसमको लागि उपयुक्त ।

#### Tar:

1. Coal Tar: Derived from the distillation of coal. Historically used for road construction and preservation of wood. कोइला को distillation बाट व्युत्पन्न । ऐतिहासिक रूपमा सडक निर्माण र काठको संरक्षणको लागि प्रयोग गरिन्छ ।
2. Wood Tar: Obtained from the destructive distillation of wood. Less common in modern applications. काठको विनाशकारी distillation बाट प्राप्त । आधुनिक कामहरूमा कम प्रयोग।
3. Pitch: A thick, dark, sticky substance obtained from the distillation of coal tar. It has various applications, including roofing, waterproofing, and as a binder in some products. कोइला टारको distillation बाट प्राप्त बाक्लो, गाढा, चिपचिपा पदार्थ। यसमा विभिन्न कामहरू छन्, जसमा छत, वाटरप्रूफिंग, र केहि उत्पादनहरूमा बाइन्डरको रूपमा प्रयोग हुने काम समावेश छ।

4. **Petroleum Tar:** Produced as a byproduct of petroleum refining. It can be used for similar purposes as coal tar, including road construction and waterproofing. पेट्रोलियम refining को by-product को रूपमा उत्पादन गरिन्छ । यो सडक निर्माण र वाटरप्रूफिंग सहित कोइला टार को समान उद्देश्यको लागि प्रयोग गर्न सकिन्छ।
5. **Shale Tar:** Derived from the distillation of oil shale. It has been used historically in various applications, including as a binder in road construction. Shale Tar को distillation बाट व्युत्पन्ना यो सडक निर्माणमा बाइन्डरको रूपमा जस्ता विभिन्न कामहरूमा ऐतिहासिक रूपमा प्रयोग गरिएको छ।

### 3. Uses (Asphalt)

1. Road Construction
2. Parking Lots
3. Driveways
4. Airport Runways
5. Racetracks
6. Sidewalks and Pathways
7. Bicycle Paths
8. Bridge Decks
9. Playgrounds
10. Tennis and Basketball Courts
11. Waterproofing
12. Maintenance and Repairs

### Uses (Bitumen)

1. Road Construction
2. Roofing
3. Waterproofing
4. Sealants and Adhesives
5. Pavement Preservation

6. Paints and Coatings
7. Marine Applications
8. Pipe Coating
9. Cable Coating
10. Automotive and Industrial Lubricants
11. Emulsion Production

#### Uses (Tar)

1. Road Construction
2. Waterproofing
3. Preserving Wood
4. Sealing and Binding
5. Traditional Medicine
6. Fuel

## Task 12: Paints/Varnishes

### 1. Definition

Paint:

- Paint is a liquid substance that, when applied to surfaces, forms a thin, colored or protective layer. Paint एक तरल पदार्थ हो जुन surfaceहरूमा लगायो भने पातलो, रंगीन वा सुरक्षात्मक तह बनाउँछ।
- It is commonly used for decorative purposes, protection against corrosion, and to provide a specific finish to various surfaces. यो सामान्यतया सजावटी उद्देश्यहरूको लागि प्रयोग गरिन्छ, corrosion विरुद्ध सुरक्षा, र विभिन्न surfaceहरूमा एक राम्रो finish प्रदान गर्न प्रयोग गरिन्छ।
- Paint typically consists of pigments, binders, solvents, and additives. पेन्टमा सामान्यतया पिगमेन्ट, बाइन्डर, सल्वेन्ट्स र एडिटिभ्स हुन्छन्।
- Pigments give color, binders hold the pigments together, solvents thin the mixture for easy application, and additives provide additional properties like durability or texture. पिगमेन्टले रङ दिन्छ, बाइन्डरले पिगमेन्टहरूलाई एकसाथ राख्छ, सल्वेन्ट्सले सजिलो गरी लगाउनको लागि मिश्रणलाई पातलो बनाउँछ, र एडिटिभ्सहरूले durability वा बनावट जस्ता अतिरिक्त गुणहरू प्रदान गर्दछ।

Varnish:

- Varnish is also a liquid substance, but it differs from paint in its purpose and composition. Varnish पनि एक तरल पदार्थ हो, तर यसको उद्देश्य र संरचना paint भन्दा फरक छ।
- Varnish is a transparent or translucent finish applied to wood or other materials to enhance their appearance and provide protection. Varnish एक transparent वा translucent finish हो जुन काठ वा अन्य सामग्रीहरूमा तिनीहरूको appearance बढाउन र सुरक्षा प्रदान गर्न प्रयोग गरिन्छ।
- It contains resins, drying oils, and solvents. यसमा रेजिन, सुख्खा गराउने तेल र सल्वेन्ट्सहरू हुन्छन्।
- When applied, varnish forms a hard, clear coating that protects the underlying material from moisture, sunlight, and general wear and tear. Varnish ले कडा, clear coating बनाउँदछ जसले underlying सामग्रीलाई moisture, सूर्यको प्रकाश, र सामान्य wear र tear बाट बचाउँदछ।

- Varnish is often used on wooden furniture, floors, and other surfaces to bring out the natural beauty of the material while providing a durable finish. सामग्रीको प्राकृतिक सुन्दरता बाहिर ल्याउन Varnish प्राय काठको फर्नीचर, floor, र अन्य surfaceहरूमा प्रयोग गरिन्छ । यसले एक टिकाऊ फिनिश प्रदान गर्छ ।

## 2. Functions

### Functions (Paints)

- 1) It prevents decay of wood and corrosion of metals. यसले काठको decay र धातुहरूको corrosion लाई रोक्छ।
- 2) It is used to give good appearance to the surface. यो surface मा राम्रो appearance दिन प्रयोग गरिन्छ।
- 3) It protects the surfaces from weathering effects of the atmosphere. यसले surface हरूलाई वायुमण्डलको मौसमी प्रभावबाट बचाउँछ।
- 4) It provides a smooth surface for easy cleaning. यसले सजिलो सफाई को लागि एक smooth surface प्रदान गर्दछ।

### Functions (Varnishes)

- 1) To brighten the appearance of the grain in wood. काठमा grain को appearance चम्काउन।
- 2) To render brilliancy to the painted surface. Paint गरिएको surfaceमा चमक प्रदान गर्ने।
- 3) To protect painted surface from atmospheric action. Atmospheric action बाट Paint गरिएको surfaceको रक्षा गर्न ।
- 4) To protect the unpainted wooden surfaces of doors, windows, roof trusses, etc. from atmospheric action. ढोका, झ्याल, छतको ट्रस आदिको रङ नलगाइएका काठका surfaceहरूलाई atmospheric action बाट जोगाउन ।

## 3. Classification and uses (Paints)

- 1) Aluminium paint: It contains finely ground aluminium in spirit or oil varnish. It is widely used for painting gas tanks, water pipes and oil tanks. यसमा स्पिरिट वा तेल varnish मा पातलो पिसेको एल्युमिनियम हुन्छ। यो व्यापक रूपमा ग्याँस ट्यांकी, पानी पाइप र तेल ट्यांकी paint गर्नका लागि प्रयोग गरिन्छ।
- 2) Oil paint: This is the ordinary paint and it is generally applied in three coats of varying composition. The oil paints are used in general for all types of surfaces, such as wood work,

walls, ceilings, metal work etc. यो साधारण पेन्ट हो र यो सामान्यतया विभिन्न संरचनाको तीन कोटहरूमा प्रयोग गरिन्छ। तेल पेन्टहरू सामान्यतया सबै प्रकारका सतहहरूको लागि प्रयोग गरिन्छ, जस्तै काठको काम, पर्खालहरू, छतहरू, धातुको काम आदि।

3) Enamel paint: It contains white lead, oil petroleum spirit and resinous material. It can be used for both external and internal walls. यसमा white lead, oil petroleum spirit र resin भएको सामग्री हुन्छ। यो दुवै बाह्य र भित्री wall को लागि प्रयोग गर्न सकिन्छ।

4) Bituminous paint: This type of paint is manufactured by dissolving asphalt or vegetable bitumen in oil or petroleum. It is used for painting iron works under water. यस प्रकारको पेन्ट तेल वा पेट्रोलियममा asphalt वा vegetable bitumen घोलेर निर्माण गरिन्छ। यसको प्रयोग फलामको कामलाई पानीमुनि रङरोगन गर्न प्रयोग गरिन्छ।

5) Emulsion paint: It contains binding materials such as polyvinyl acetate, synthetic resins etc. This paint is recommended for use on stucco, bricks and masonry surfaces which contain free alkali. यसमा binding सामग्रीहरू जस्तै पोलिभिनाइल एसीटेट, सिंथेटिक रेजिन आदि समावेश छन्। यो पेन्ट stucco, ईटा र masonry surface हरूमा प्रयोगको लागि उत्तम हुन्छ।

6) Cement paint: This paint consists of white cement, pigment, accelerator and other additives. Cement paints are being extensively used for painting plastered brickwork, stone masonry and concrete. यो पेन्टमा सेतो सिमेन्ट, पिगमेन्ट, एक्सेलेरेटर र अन्य एडिटिभ्स हुन्छन्। Plastered brickwork, stone masonry र कंक्रीटमा रङ रोगन गर्न सिमेन्ट पेन्टको व्यापक प्रयोग भइरहेको छ।

#### 4. Composition

1) Base: A base is a solid substance of a metallic oxide in fine state of division. It is a principal constituent of paint. आधार धातु अक्साइडको ठोस पदार्थ हो। यो पेन्टको एक प्रमुख constituent हो।

2) Vehicle: A vehicle is a liquid substance which keeps the ingredients of paint in liquid suspension. Vehicle एक तरल पदार्थ हो जसले liquid suspension मा पेन्टको ingredients हरू राख्छ।

3) Drier: A drier is a substance which accelerates the process of drying of a paint film. Drier एक पदार्थ हो जसले पेन्ट फिल्म सुक्ने प्रक्रियालाई गति दिन्छ।

4) Colouring pigment: Colouring pigment gives required colour for paints. रङ पिगमेन्टले पेन्टका लागि आवश्यक रङ दिन्छ।

5) Solvent: It is a liquid which is mixed in a paint to make the paint thin so that it can be easily applied on the surface. यो एक तरल पदार्थ हो जुन पेन्टलाई पातलो बनाउनको लागि पेन्टमा मिसाइन्छ ताकि यो सजिलै सतहमा प्रयोग गर्न सकिन्छ।

### 5. Characteristics of good paints/varnishes

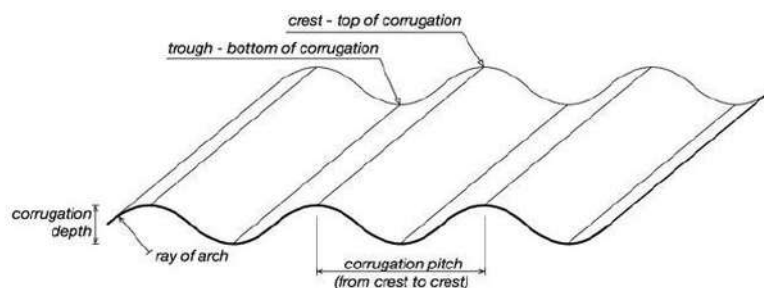
- 1) It should be possible to apply easily and freely. यो सजिलै र स्वतन्त्र रूपमा प्रयोग गर्न सम्भव हुनुपर्छ ।
- 2) It should dry in a reasonable time. यो उचित समयमा सुक्नुपर्छ ।
- 3) It should form hard and durable surface. यसले कडा र टिकाऊ सतह बनाउनुपर्छ ।
- 4) It should not be easily affected by atmosphere. वायुमण्डलले यसलाई सजिलै असर गर्नु हुँदैन ।
- 5) It should possess attractive and pleasing appearance. यसको आकर्षक र मनमोहक appearance हुनुपर्छ ।
- 6) It should not be harmful to be health of workers. कामदारको स्वास्थ्यमा हानी हुनु हुँदैन ।

## Task 13: CGI sheet

### 1. Introduction of CGI sheets

- CGI sheet stands for Corrugated Galvanized Iron sheet.
- It's a building material made from sheets of hot-dip galvanized steel, which is then cold-rolled to produce a linear corrugated pattern. यो एक निर्माण सामग्री हो जुन hot-dip galvanized steel को पानाहरूबाट बनाइएको हुन्छ, जुन त्यसपछि एक linear corrugated pattern बनाउन cold-roll गरिएको हुन्छ।
- These sheets are widely used in roofing and walling applications, providing durability and weather resistance. यी पानाहरू व्यापक रूपमा छत र पर्खालको कामहरूमा प्रयोग गरिन्छ र यसले स्थायित्व र मौसम प्रतिरोध प्रदान गर्दछ।
- The galvanized coating helps prevent corrosion, making CGI sheets a popular choice for construction in various climates. Galvanized coating ले corrosion रोक्न मद्दत गर्दछ, CGI sheet हरू विभिन्न climate मा निर्माणको लागि एक लोकप्रिय विकल्प बनाउँदछ।
- They're versatile and can handle different jobs, whether it's roofs or walls. तिनीहरू versatile छन् र विभिन्न कामहरू ह्यान्डल गर्न सक्दछन्, चाहे त्यो छत वा पर्खालको कामहरू हुन्।

### 2. Gauge of CGI sheet



Specifications for CGI	Recommended for Roofing ( According to Nepal Standard <sup>1</sup> )
Minimum Thickness	0.35 mm
Zinc Coating	Hot dip galvanization with minimum 120 g/m <sup>2</sup> zinc on each side of sheet.
Approximately Weight per bundle	55 kg
Nominal Depth of Corrugation	18 mm (Tolerance +/- 1.5 mm)
Nominal Pitch of Corrugation	76.2 mm (Tolerance +/- 2 mm)
No of Corrugation	½ + 10 + ½
Width of Sheet	875 mm (Tolerance +/- 10 mm)
Length per bundle approximately 72 feet.	
Each Bundle of CGI sheet have <b>different combination</b> : 12 sheets of 6 feet long; 10 sheets of 7 feet long ; 9 sheets of 8 feet long; <b>8 sheets of 9 feet long</b> ( most commonly used for house roof ); 7 sheets 10 feet long ; 6 sheets 12 feet long	
Approximate Price range per bundle in Nepal	6,000 - 6,700 Nepall Rupee (60 - 67 USD)

## Task 14: Reinforcing steels

### 1. Introduction

- Reinforcing steel, often known as rebar, is like the muscle of a concrete structure. Reinforcing steel , जसलाई अक्सर rebar भनिन्छ, कंक्रीट संरचनाको muscle जस्तै हो।
- It's a type of steel bar or mesh that gets embedded within concrete to add strength and support. यो एक प्रकारको स्टील बार वा जाली हो जुन strength र support थप्न कंक्रीट भित्र राखिएको हुन्छ।
- Just as bones provide structure to our bodies, reinforcing steel provides strength to concrete structures, like buildings and bridges. जसरी हड्डीले हाम्रो शरीरलाई संरचना प्रदान गर्छ, त्यसरी नै reinforcing steel प्रयोग गर्दा भवन र पुलजस्ता कंक्रीटका संरचनाहरूलाई strength मिल्छ।
- It helps them withstand the forces of nature, like heavy loads or earthquakes. यसले तिनीहरूलाई heavy loads वा भूकम्प जस्ता प्रकृतिका शक्तिहरूको सामना गर्न मद्दत गर्दछ।

### 2. Types

1. Mild Steel Rebar (MSR): This is the most common type, made from carbon steel. It's versatile and used in various construction projects. यो carbon steel बाट बनेको सबैभन्दा सामान्य प्रकार हो। यो versatile छ र विभिन्न निर्माण परियोजनाहरूमा प्रयोग गरिन्छ।
2. High Strength Deformed Bars (HYSD): These bars have enhanced strength due to the deformation patterns on their surface. They are commonly used where higher strength is required. यी बारहरूको सतहमा भएको ढाँचाहरूको कारण यसमा धेरै शक्ति हुन्छ । तिनीहरू सामान्यतया जहाँ उच्च शक्ति आवश्यक छ, त्यहाँ प्रयोग गरिन्छ ।
3. European Rebar (Euro Rebar): This type follows European standards and comes with specific markings for easy identification. It's widely used in European construction. यस प्रकारले युरोपेली standardहरू प्रयोग गर्दछ र सजिलो पहिचानको लागि specific marking हरूको साथ आउँदछ। यो व्यापक रूपमा युरोपेली निर्माणमा प्रयोग गरिन्छ।
4. Carbon Steel Rebar: Similar to mild steel rebar, this type is used in low-stress applications. Mild Steel Rebar जस्तै, यो प्रकार low-stress हुने कामहरूमा प्रयोग गरिन्छ।
5. Epoxy-Coated Rebar: To resist corrosion, these rebars have an epoxy coating. They are ideal for structures exposed to harsh environmental conditions. Corrosion

को प्रतिरोध गर्न, यी रिबारहरूमा इपोक्सी कोटिंग हुन्छ। तिनीहरू कठोर वातावरणीय अवस्थाको सम्पर्कमा रहेका संरचनाहरूको लागि राम्रो हुन्छ।

6. **Stainless Steel Rebar:** Known for its corrosion resistance, it's used in structures where corrosion is a significant concern, like in marine environments. यो corrosion resistance को लागि चिनिन्छ, जहाँ corrosion एक महत्वपूर्ण चिन्ताको विषय हो, संरचनाहरूमा यो Rebar प्रयोग गरिन्छ, जस्तै समुद्री वातावरणमा यो Rebar प्रयोग गरिन्छ।

### 3. Properties

1. **Strength:** Reinforcing steel is designed to provide added strength to concrete structures, improving their load-bearing capacity and resilience. Reinforcing steel कंक्रीट संरचनाहरूमा थप शक्ति प्रदान गर्न डिजाइन गरिएको हुन्छ, कंक्रीट संरचनाहरूमा उनीहरूको भार वहन क्षमता र लचीलापन सुधार गर्न Reinforcing steel प्रयोग गरिन्छ।
2. **Ductility:** It can deform without breaking, which is crucial in situations where structures might experience stress or movement. यो नभाँचिइकन deform हुन सक्छ। जुन संरचनाहरूमा stress or movement हुन सक्छ, त्यस्तो परिस्थितिहरूमा यो महत्वपूर्ण हुन्छ।
3. **Bonding Capability:** Reinforcement steel forms a strong bond with concrete, ensuring effective collaboration between the two materials in resisting forces. Reinforcement steel ले कंक्रीट संग एक मजबूत bond बनाउँछ र resisting force हरू मा दुई सामाग्री बीच प्रभावकारी सहयोग सुनिश्चित गर्दछ।
4. **Corrosion Resistance:** Some types of reinforcement steel, such as stainless steel or epoxy-coated rebar, are resistant to corrosion, enhancing the longevity of the structure. केही प्रकारका reinforcement steel, जस्तै stainless steel वा epoxy-coated rebar, corrosion को प्रतिरोधी हुन्छन् र यसले संरचनाको दीर्घायु बढाउँछन्।
5. **Thermal Expansion Compatibility:** Reinforcing steel expands and contracts at rates similar to concrete, minimizing the risk of cracks due to temperature variations. Reinforcing steel ले कंक्रीट को समान दरमा expand र contract गर्दछ, यसकारण तापमान भिन्नताको कारण दरारको जोखिम लाई कम गर्दछ।
6. **Weldability:** In cases where on-site adjustments are necessary, reinforcement steel can be welded without compromising its strength. साइटमा adjustments आवश्यक भएको अवस्थामा, reinforcement steel यसको शक्ति सम्झौता बिना वेल्ड गर्न सकिन्छ।

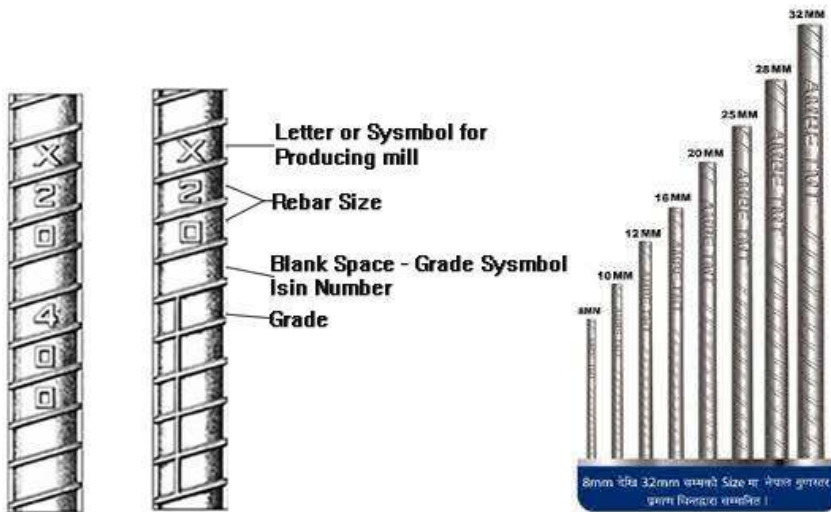
### 4. Uses

1. **Building Construction**

2. Bridges and Highways
3. Dams and Reservoirs
4. Foundations
5. Tunnels
6. Seismic Retrofitting
7. Retaining Walls
8. Water Treatment Plants
9. Airport Runways

**5. Commonly available reinforcement bar**

- Commonly used rebar sizes are 8mm, 10mm, 12mm , 16mm , 20mm , 25mm , 28mm and 32mm.



## Task 15: Bamboo/Cane

### 1. Introduction

Bamboo:

- Bamboo is a type of grass. बाँस एक प्रकारको घाँस हो ।
- It's known for its rapid growth and versatility. यो यसको तीव्र विकास र versatility को लागि चिनिन्छ।
- The stem of bamboo, called a culm, is often used as a construction material. बाँसको डाँठ, जसलाई कल्म भनिन्छ, प्राय निर्माण सामग्रीको रूपमा प्रयोग गरिन्छ।
- It's lightweight, strong, and has a high strength-to-weight ratio. यो हल्का, बलियो छ, र यसमा उच्च strength-to-weight अनुपात छ।
- Bamboo is sustainable as it grows quickly, sometimes inches per day, and it's an eco-friendly alternative to traditional building materials. बाँस दिगो छ किनकि यो छिटो बढ्छ, कहिलेकाहीँ प्रति दिन इन्च, र यो परम्परागत निर्माण सामग्रीको eco-friendly विकल्प हो।

Cane:

- Cane usually refers to the outer bark or skin of the rattan plant. बेतले सामान्यतया rattan को बोटको बाहिरी छाल वा छालालाई बुझाउँछ।
- Rattan is a type of climbing palm that grows in tropical regions. Rattan एक प्रकारको climbing palm हो जुन tropical क्षेत्रहरूमा पाइन्छ ।
- The cane is often used for making furniture, baskets, and various handicrafts. बेत प्राय फर्निचर, टोकरी र विभिन्न हस्तकला बनाउन प्रयोग गरिन्छ।
- It's flexible, durable, and has a natural beauty. यो लचिलो, टिकाऊ छ, र यसमा प्राकृतिक सुन्दरता हुन्छ।
- In the context of construction, cane can be used for things like weaving, creating screens, or forming lightweight structures. निर्माण को सन्दर्भमा, बेत बुनाई, स्क्रिन सिर्जना, वा हल्का संरचना हरू बनाउने जस्ता चीजहरूको लागि प्रयोग गर्न सकिन्छ।

## 2. Types

Types of Bamboo:

Clumping Bamboo:

- Non-invasive and tends to stay in a tight clump.
- Ideal for smaller spaces or as ornamental plants.

Running Bamboo:

- More invasive, spreading quickly through rhizomes.
- Often used for larger projects like construction due to its abundance.

Giant Bamboo:

- Known for its impressive height, often reaching 100 feet or more.
- Used for construction, furniture, and even as a food source in some cultures.

Timber Bamboo:

- Has a thick culm and is used for structural purposes, such as building houses and bridges.

Lucky Bamboo:

- Often grown indoors in water.
- Commonly used in decorative arrangements and believed to bring good luck in some cultures.

Types of Cane:

Malacca Cane:

- One of the most well-known types of rattan.
- Used for furniture making and basketry.

Manila Cane:

- Known for its smooth texture and flexibility.
- Used for weaving intricate patterns in furniture and handicrafts.

Calamus Cane:

- Has a thin diameter and is often used for finer weaving work.
- Commonly employed in basket making and the creation of lightweight structures.

Pole Cane:

- Typically used for chair caning.
- Has a uniform diameter and is harvested from the outer skin of rattan.

Tohiti Cane:

- Has a slender and flexible structure.
- Used for finer weaving in furniture and craftwork.

### 3. Uses

- Uses of Bamboo:
  1. Construction
  2. Furniture
  3. Crafts and Art
  4. Tools and Utensils
  5. Textiles
  6. Landscaping and Ornamental Plants

Uses of Cane (Rattan):

1. Furniture
2. Basketry
3. Home Decor

4. Handicrafts
5. Gardening and Outdoor Furniture

#### **4. Common types used in constructional purposes**

Common Types of Bamboo Used in Construction:

- Giant Timber Bamboo (*Dendrocalamus giganteus*)
- Guadua Bamboo
- Bambusa Balcoa
- Phyllostachys Edulis (Moso Bamboo)
- Dendrocalamus Asper (Giant Bamboo)

Common Types of Cane (Rattan) Used in Construction:

- Calamus Manan
- Calamus Rotang
- Calamus Scipionum
- Calamus Caesius
- Calamus Viminalis

## Task 16: Aluminium

### 1. Introduction

- Aluminum, a lightweight and versatile material, is a chemical element with the symbol Al and atomic number 13.
- It is a silvery-white metal with remarkable properties that make it widely used in various industries.

### 2. Types

#### 1. Pure Aluminum (1000 Series):

1. This includes aluminum that is at least 99% pure.
2. It is highly malleable and corrosion-resistant.
3. Used in applications where high corrosion resistance and formability are crucial, such as in cooking utensils and chemical equipment.

#### 2. Aluminum-Manganese Alloys (3000 Series):

1. Alloyed with manganese.
2. Exhibits improved strength and formability.
3. Widely used in the production of beverage cans, cooking utensils, and automotive parts.

#### 3. Aluminum-Silicon Alloys (4000 Series):

1. Alloyed with silicon.
2. Known for its good casting characteristics.
3. Used in welding wires and as a base for brazing alloys.

#### 4. Aluminum-Magnesium Alloys (5000 Series):

1. Alloyed with magnesium.
2. Offers a good combination of strength, corrosion resistance, and formability.
3. Commonly used in marine and aerospace applications.

5. Aluminum-Zinc Alloys (7000 Series):
  1. Alloyed with zinc.
  2. Known for high strength and toughness.
  3. Used in aircraft structures, bicycle frames, and rock climbing equipment.
6. Aluminum-Zinc-Magnesium Alloys (7000 Series):
  1. Alloyed with zinc and magnesium.
  2. Offers enhanced strength and stress corrosion resistance.
  3. Used in aerospace applications and high-stress structural components.
7. Aluminum-Lithium Alloys (8000 Series):
  1. Alloyed with lithium.
  2. Known for its low density and high stiffness.
  3. Used in aerospace applications to reduce weight.
8. Cast Aluminum Alloys (2000 Series, 3000 Series, 5000 Series, 7000 Series):
  1. Designed for casting processes.
  2. Commonly used in automotive components, engine parts, and various cast products.
9. Wrought Aluminum Alloys (1000 Series, 2000 Series, 3000 Series, 5000 Series, 6000 Series, 7000 Series, 8000 Series):
  1. Designed for forming and shaping processes.
  2. Used in a wide range of applications, including construction, transportation, and consumer goods.

### 3. Uses

#### Windows and Doors:

- Aluminum is commonly used for window frames, doors, and curtain wall systems due to its light weight, durability, and resistance to corrosion.

#### Structural Components:

- Used in the construction of structural elements such as beams, columns, and roofing systems, where its strength-to-weight ratio is advantageous.

#### Roofing:

- Aluminum roofing materials are lightweight, corrosion-resistant, and often used in both residential and commercial construction.

#### Exterior Finishes:

- Applied in various exterior finishes, including railings, balustrades, and decorative elements, to achieve a modern and attractive appearance.

#### Infrastructure Projects:

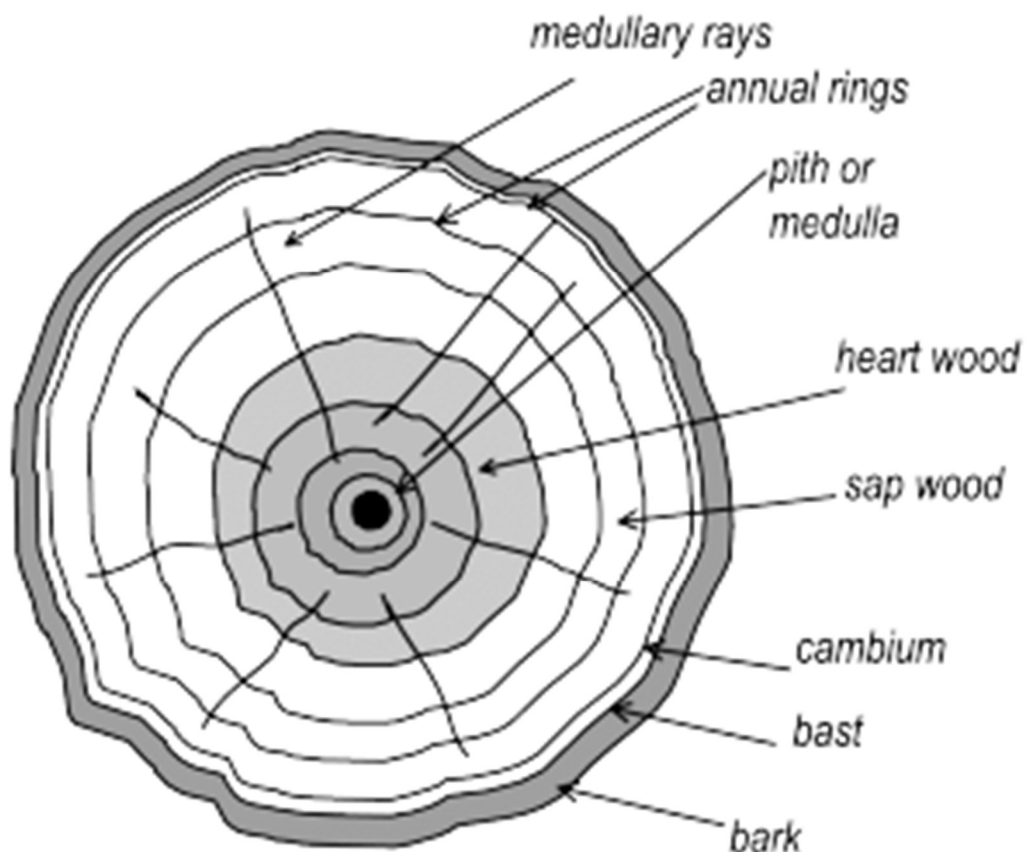
- Aluminum is used in the construction of bridges, stadiums, and other large-scale infrastructure projects due to its strength, durability, and corrosion resistance.

## Task 17: Timber

### 1. Introduction

- Timber refers to wood that has been prepared for use in construction or other purposes.
- It typically involves cutting, shaping, and treating wood from trees to create lumber or other wood products.
- Timber is widely used in building structures, furniture, and various applications due to its strength, versatility, and natural beauty.
- The term can also mean a forest of trees considered as a source of wood.

### 2. Structure [cross section] of a tree



- 1) Pith – It the innermost central part is called pith
- 2) Heart wood – This position is surrounded by the pith. It is strong & dark in colour
- 3) Sap wood – this layer is present next to the heart wood. It represents growth with saps.
- 4) Cambium layer – This layer is present between sap wood & inner bark.

5) Medullary rays—these are thin radial fibers extending from pith to cambium layer.

6) Inner bark – It is the inner skin of tree which protects cambium layer.

7) Outer bark – The outer skin or cover of the tree is known as outer bark.

### **3. Felling of trees**

It's the process of cutting down trees, usually for timber or to clear land for various purposes.

### **4. Objective and methods of seasoning**

Seasoning of timber is classified by two ways;

1) Natural seasoning – It may air seasoning / water seasoning.

a) Air seasoning is carried out in a shed with a platform.

b) Water seasoning is carried out on the bank of the river.

2) Artificial seasoning – Artificial seasoning is followed by following steps;

a) Boiling – In this method, the timber is dipped in water & then boiled the water for 3 to 4 hours & dried slowly.

b) Kiln seasoning – In this method The drying of timber is carried out inside an air tight oven

c) Chemical seasoning – In this method Timber is dipped in the suitable salts solutions & taken out for ordinary drying.

d) Electrical seasoning – In this method of seasoning a high frequency alternating currents are used.

### **5. Objects / purposes of seasoning –**

1) To reduce shrinkage & warping

2) To increase the strength of the timber

3) To increase the durability & workable properties of the timber

4) To reduce its tendency to split & decay of the timber

5) To make suitable for painting

6) To reduce weight of the timber

## **6. Timber defects and decaying**

Defects in timber

- 1) Natural defects – These defects may be in the form of knots, twisted fibers, ring shakes, rupture etc
- 2) Defects due to conversion– These defects are formed due to improper seasoning are radial shakes, case hardening, twisted, bowing, honey combing etc
- 3) Defects formed due to insects – In this defect wood is attacked by termites, insects, beetles, stem borers etc
- 4) Defects formed due to fungal action – In this defect wood is infected by fungal attack which reduces the strength of wood.
- 5) Defects due to seasoning – These are in the form of warp, cup, bow, twist etc.

## **7. Plywood and block board**

Plywood:

- It's made by gluing together layers (or plies) of wood veneer, with each layer's grain perpendicular to the adjacent one.
- This cross-graining gives plywood exceptional strength and stability.
- It's used in everything from furniture and cabinets to flooring and construction.

Blockboard:

- It's made by sandwiching a core of softwood strips between layers of veneer.
- A board that's sturdy, resistant to warping, and great for applications like doors, shelves, and tabletops.