



Bar Bending & Concreting Level II

Learning Guide # 29

Unit of Competence: Install and Fix Reinforcement Bar

**Module Title: Installing and Fixing
Reinforcement Bar**

LG Code: EIS BBC2 M09 LO1 LG-29

TTLM Code: EIS BBC2 TTLM 10 19 v1

LO1: Prepare for work



This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- 1.1 Obtaining, confirming and applying work instructions, including plans, specifications, quality requirements and operational details
- 1.2 Following safety requirements in accordance with safety plans and policies.
- 1.3 Selecting tools and equipment to carry out tasks
- 1.4 Checking stock of reinforcement for correct type and quantities
- 1.5 Identifying environmental protection requirements for the project

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- 1.1. Obtain, confirm and apply Work instructions, including plans, specifications, and quality requirements
- 1.2. Follow safety requirements in accordance with safety plans and policies.
- 1.3. Rectify or report tools and equipment selected to carry out tasks
- 1.4 Check stock of reinforcement for correct type and quantities against reinforcement schedule and specifications
- 1.5 Identify environmental protection requirements for the project in accordance with environmental plans and regulatory obligations

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written for each “Information Sheets given below
4. Accomplish the “Self-check after reading & understanding of each information sheet
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet
6. Lastly do the “LAP test
7. If you have any question ask your teacher



Information Sheet 1	Obtaining, confirming and applying work instructions, including plans, specifications, quality requirements and operational details
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1.1. Obtaining, confirming and applying work instructions, including plans, specifications, quality requirements and operational details

Work Instruction

Information about the work

- Describe what workers need to be able to do on the job
 - Work functions
 - Key activities of each work function
 - Performance indicators
- Describe what task to be done or work roles in a certain occupation

Work instruction is a description of the specific tasks and activities within an activity. A work instruction in a project will generally outline all of the different jobs needed for the operation of the firm in great detail and is a key element to running a project smoothly.

In other words it is a document containing detailed instructions that specify exactly what steps to follow to carry out an activity. It contains much more detail than a Procedure and is only created if very detailed instructions are needed. For example, describing precisely how a Request for Change record is created in the Change Management software support tool.

Job Specification

A statement of employee/workers characteristics and qualifications required for satisfactory performance of defined duties and tasks comprising a specific job or function.



Placing of reinforcement bars for structures requires a working drawing or reinforcement plan, containing all the necessary information. It is important to be able to read this plan in order to cut and bend the required bars to the correct size and shape.

The exact measurement of every rebar to be used is usually indicated in a bar bending schedule, which is prepared together with the drawings. The bar bending schedule is a chart giving a clear picture of bar lengths and diameters, and where the bars should be placed.

Reinforcement: - reinforcement is strong in tensile strength but weak in compression. Steel combines very well with concrete to act against forces. The steel resists tensile forces while the concrete resists compressive force. The reinforcement in the concrete may be simple bars, welded mesh fabric or a series of rod bent and tied to a given schedule with wire stirrup to enable the concrete to resist shear stresses and to keep the bar in their correct position until the concrete is laid

Work Instructions of Structural Drawing

A. Structural foundation Plan or Layout:-

Definition: - plan section of intended completed foundation construction, that shows foundations immediately before back filling and super structure foundation begins.

Purpose:-

- Shows such sub structure building components in plan view as footings, piles, and grade beams.
- Give information on the size, thickness and lay out of foundation.
- Used in reference to the structural foundation details.

Check list

- Dimensions to show size and arrangement of concrete members.
 - Column size (for internal, external)
 - Footing size (single, combined)
 - Grade beam sizes
 - C/c dimensions



- Over all dimensions
 - Internal dimensions
 - Grid (structural) lines and their identification (in letters and numbers)
 - Mark numbers and dimensions
-
- Footing column (eg Fc1,Fc2,.....)
 - Grade beam (eg Gb1,Gb2,.....)
 - Detail drawings
-
- At construction joints (grade beam, slabs and column connection points)
 - At splice points.
 - Centre lines showing the location of footings.
 - Location and size of holes left through foundation for service pipes.
 - Footing schedule

STRUCTURAL FOUNDATION PLAN

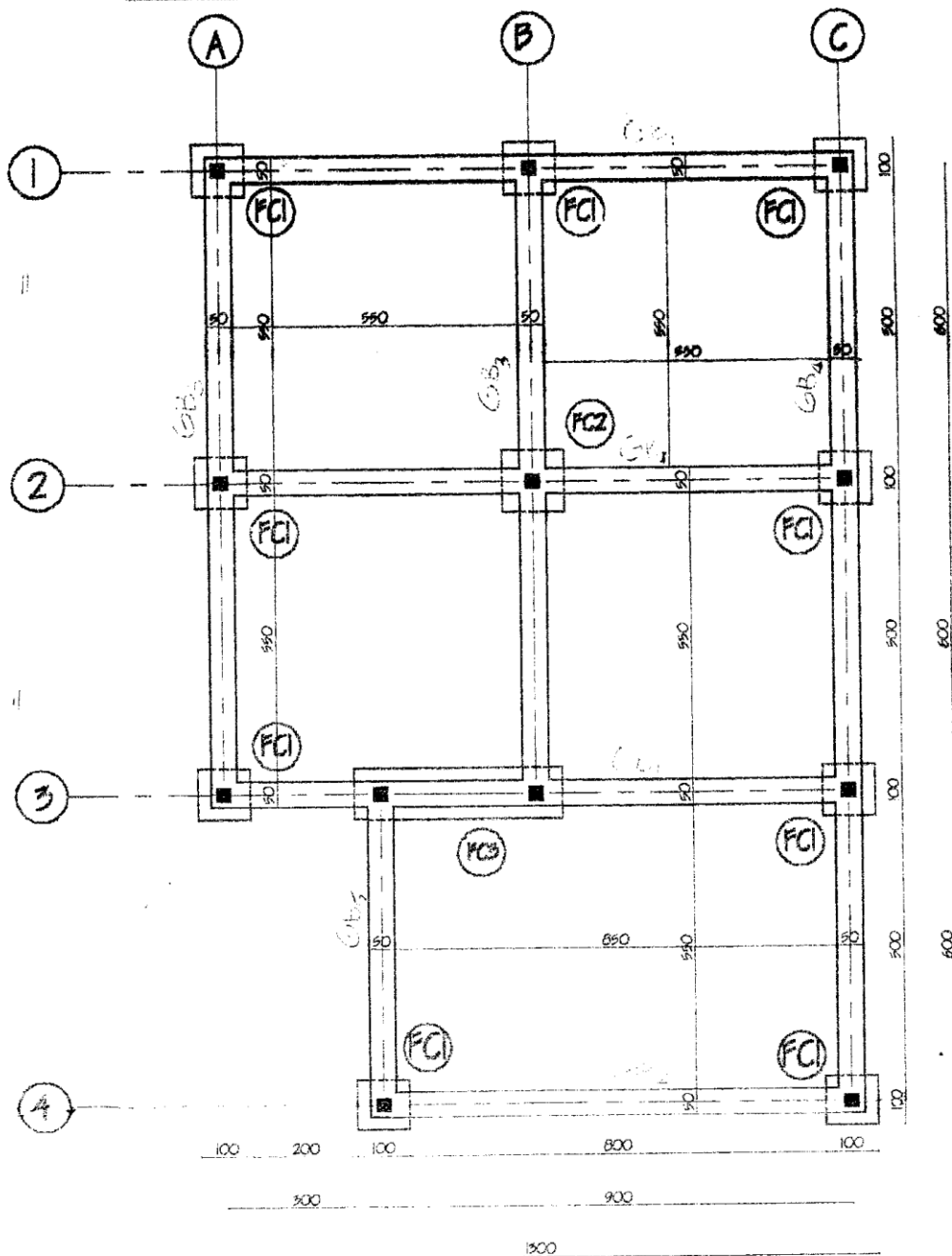


Fig. 1 Structural foundation Plan or Layout



Information's about structure in floor plans:

- Width and height of windows
- Width and height of doors
- Dimensions of inner places and outer surfaces
- Names of places, types of floor covers (ceramic, parquet etc.)
- Elevations (whole floor or any part)
- Width, length, riser height of stairs and rising direction of staircase
- Thickness of outer and party wall
- Slab elevations of floors according to soil elevation
- Length, width and slope of existing platforms
- Type and slope of roof, chimney & roof exiting spaces

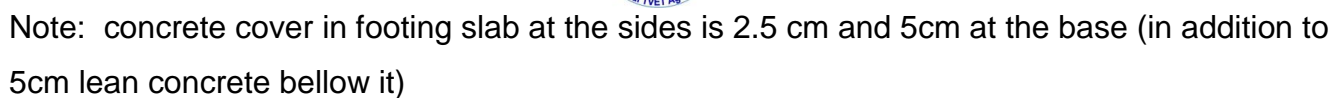
Work Instructions of Footing reinforcement details

Purpose:

- ❖ To show the details of reinforcement bars in the footing.
- ❖ To show the amount, size, spacing and location of bars needed in the footing.
- ❖ To show size, depth and shape of footing.
- ❖ To show the shape of bars. (show how the bars are to be placed in the form or footing profile)

Includes

- ❖ Plan view ,section and details
- ❖ Basic dimensions
- ❖ Lay out of reinforcing bars
- ❖ Size, number and spacing of bars
- ❖ Bar mark for bars (to identify the bars)
- ❖ Details.
 - Footing columns reinforcement
 - stirrups development
- ❖ Bar schedule



.Fig 2 Footing Reinforcement Detail



Note in structural drawings

- Notes are text information's that are further describe the graphic information on the drawing.
Notes are used to indicate material, size ,fastening methods ,finishes ,lay out requirements .work procedures and other information 's that can not be clearly described graphically.

Typical notes to describe:-

The concrete cover used in structural members

Eg Beam 2.5 cm

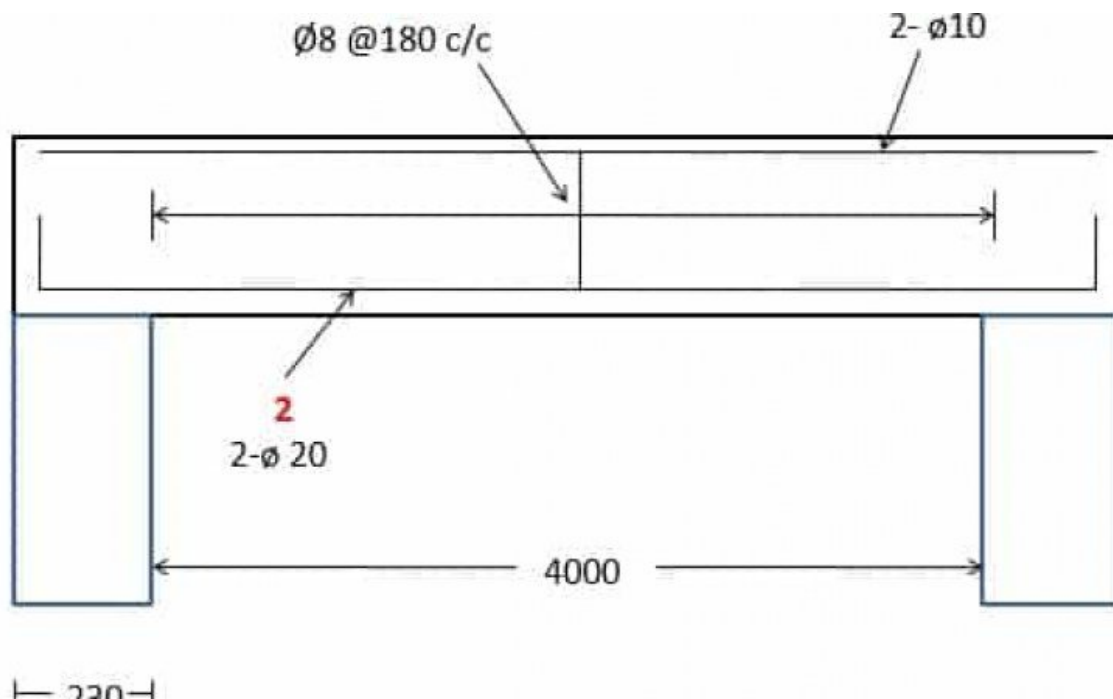


Fig. 3 Structural Drawing of Beam

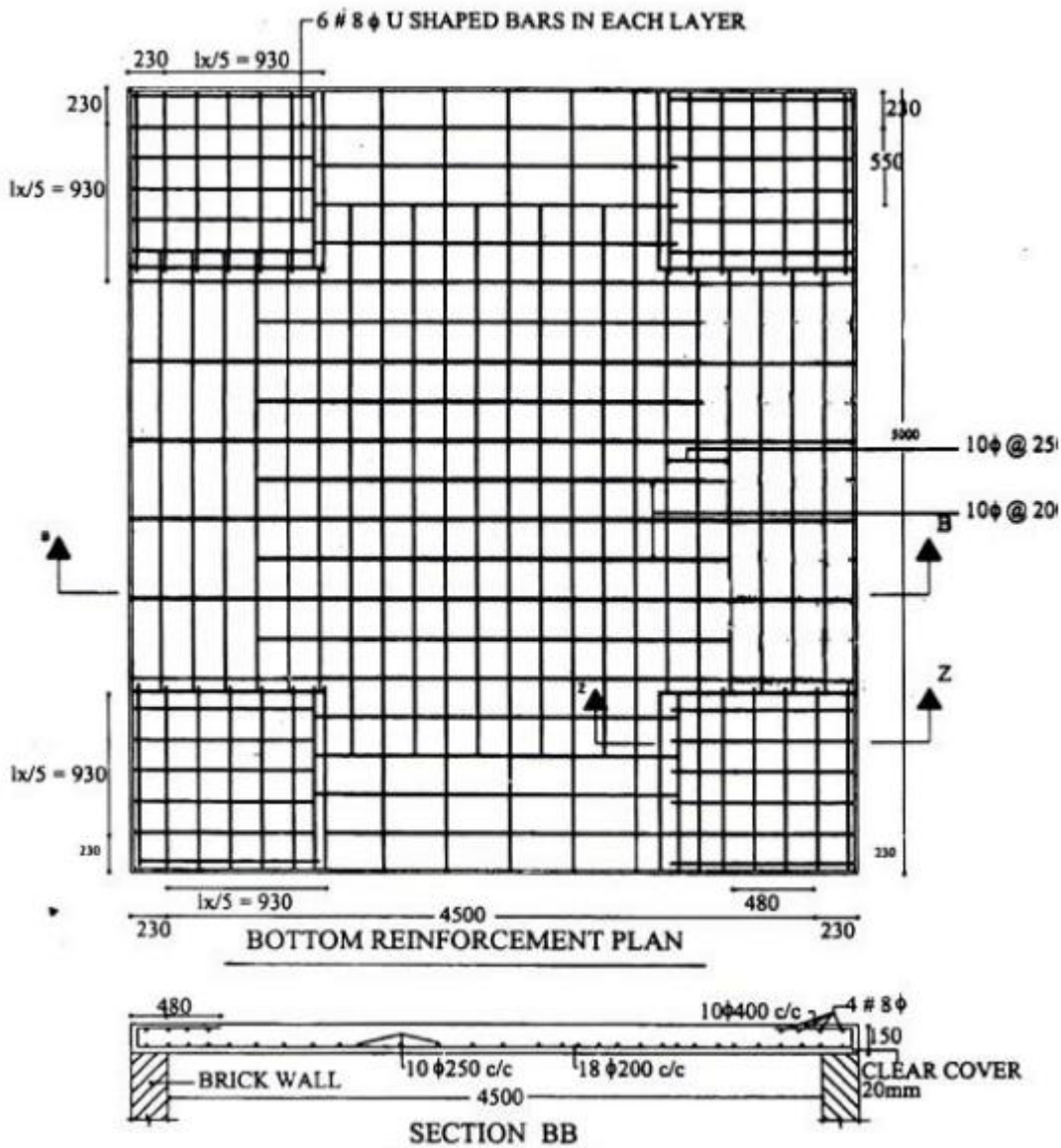


Fig.4 structural member of slab

Cantilever:-

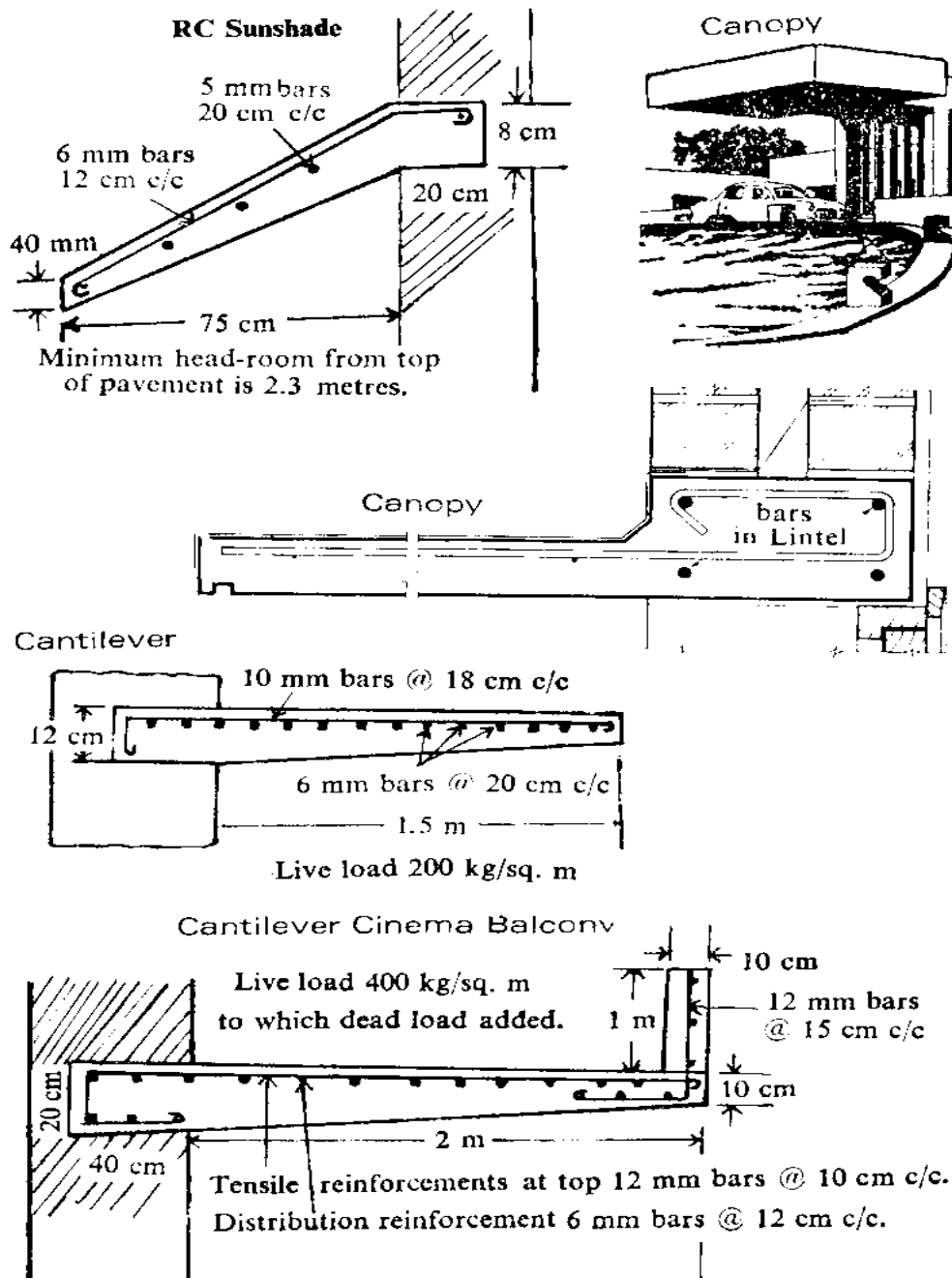


Fig.5 structural member of cantilever



STAIR SECTION

DEFN. - It is a sectional view showing the arrangement of reinforcing bars in stair waist.

PURPOSE - Used to show

1. Placement of bars along stair waist.
2. Stair size.
3. Number, size, spacing, length of bars.
4. Detail references.

INCLUDE - BASIC dimensions

- . Levels (Floor elevations)
- . Landing thickness (depth)
- . Slab depth.
- . Total rise and thread in the flight.
- . Sizes of thread, height of rise.
- Reinforcing bars.
 - . Layout.
 - . Length.
 - . Spacing.
 - . Size.
 - . Number.
 - . Mark.
 - . Lap length.

- Necessary notes.

- Details.

- Bar schedule.

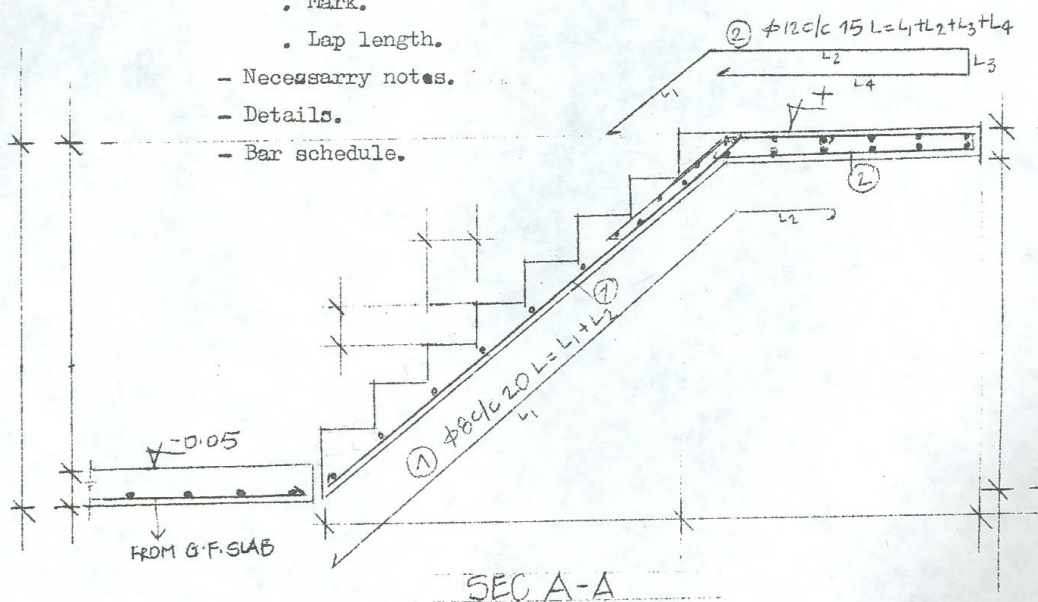


Fig. 6 structural member of stair



Self-Check 1

Multiple Choice

Instruction: Select the best answer and encircle the letter

1. After wearing PPE what will be the next steps for a bar bender before bending bar?
A/ Reading working drawings
B/Interpreting working drawings
C/Interpreting concrete related working drawings and sketches
D/ All of the above are correct
2. Which one of the following statement is true about reinforcement?
A/ Reinforcement is strong in tensile strength but weak in compression
B/ Reinforcement is strong in compression strength but weak in tensile
C/There is no any difference in compression & tensile strength
D/ None of the above
3. What is the main advantage of stirrup in concrete work?
A/To enable the concrete to resist shear stresses
B/ To keep the bar in their correct position until the concrete is laid
C/To support compression force
D/ A & B are correct
4. One of the following is true about the instruction of structural drawing
A/ Its dimensions shows size and arrangement of concrete members.
B/ Its grid (structural) lines and their identification is expresses in letters and numbers
C/ Its center lines showing the location of footings
D/All of the above



Note: Satisfactory rating - 2 points Unsatisfactory - below 2 points
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____



Information Sheet 2	Following safety requirements in accordance with safety plans and policies.
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1.2. Following safety requirements in accordance with safety plans and policies.

➤ Occupational Health and Safety (OHS)

OHS requirements are legislation/regulations/codes of practice and enterprise safety policies and procedures. This may include protective clothing and equipment, use of tooling and equipment, workplace environment and safety, handling of material, use of firefighting equipment, enterprise first aid, hazard control and hazardous materials and substances.

Personal protective equipment includes those prescribed under legislation /regulations/ codes of practice and workplace policies and practices. Safe operating procedures include the conduct of operational risk assessment and treatments associated with workplace organization. Emergency procedures include emergency shutdown and stopping of equipment, extinguishing fires, enterprise first aid requirements and site evacuation.

Occupational safety and health (OSH) also commonly referred to as occupational health and safety (OHS) or workplace health and safety (WHS) is an area concerned with the safety, health and welfare of people engaged in work or employment. The goals of occupational safety and health programs include fostering a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment. In the United States the term occupational health and safety is referred to as occupational health and occupational and non-occupational safety and includes safety for activities outside work.

Occupational safety and health can be important for moral, legal, and financial reasons. In common-law jurisdictions, employers have a common law duty (reflecting an underlying moral obligation) to take reasonable care for the safety of their employees. Statute law may build upon this to impose additional general duties, introduce specific duties and create government bodies

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with powers to regulate workplace safety issues: details of this will vary from jurisdiction to jurisdiction. Good OSH practices can also reduce employee injury and illness related costs, including medical care, sick leave and disability benefit costs.

- **protective clothing and equipment**

Personal Safety is designed to protect workers from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

So there are many equipment those are used by worker that protect from them self

Rebar up to #4 can often be bent and cut by hand. Larger diameter rebar is not typically used outside commercial or industrial concrete work and usually requires specialized equipment such as hydraulic shears and benders. When cutting bar of 1/2 inch (number 4) rebar which is a common rebar found in residential landscaping and concrete work we have to follow the following safety rules

Have the right safety equipment. Rebar can be sharp and is heavy, and can create sparks when being cut. Always wear eye protection, sleeved shirts, long pants, gloves, and sturdy boots when handling rebar



Fig.7 Personal Safety, Working Clothes and shoes



Hard hat:-Protects head of the worker from any falling objects dropping from high level during construction.



Overall:-Protects the normal clothes from dust, grease and other spilling materials.



Safety shoe (boot):-Protects the worker from nail, sharp objects and heavy falling objects by hard rolled leather shoes with metal toe caps.



Glove:-Protects the workers from oils, chemicals, and dust and other dangerous material that affect the skin.



- **Workplace hazards**

Although work provides many economic and other benefits, a wide array of workplace hazards also present risks to the health and safety of people at work. These include "chemicals, biological agents, physical factors, adverse ergonomic conditions, allergens, a complex network of safety risks," and a broad range of psychosocial risk factors.



Physical and mechanical hazards



Fig 8 At-risk workers without appropriate safety equipment

Physical hazards are a common source of injuries in many industries. They are perhaps unavoidable in certain industries, such as construction and mining, but over time people have developed safety methods and procedures to manage the risks of physical danger in the workplace. Employment of children may pose special problems. Falls are a common cause of occupational injuries and fatalities, especially in construction, extraction, transportation, healthcare, and building cleaning and maintenance.

First aid A building site should have a first aid box which as minimum contents: -

- Plasters;
- Bandages;
- Ointments;
- Disinfectant.

Someone on site should be in charge of the box and know how to with broken bones, burns and electric shocks.

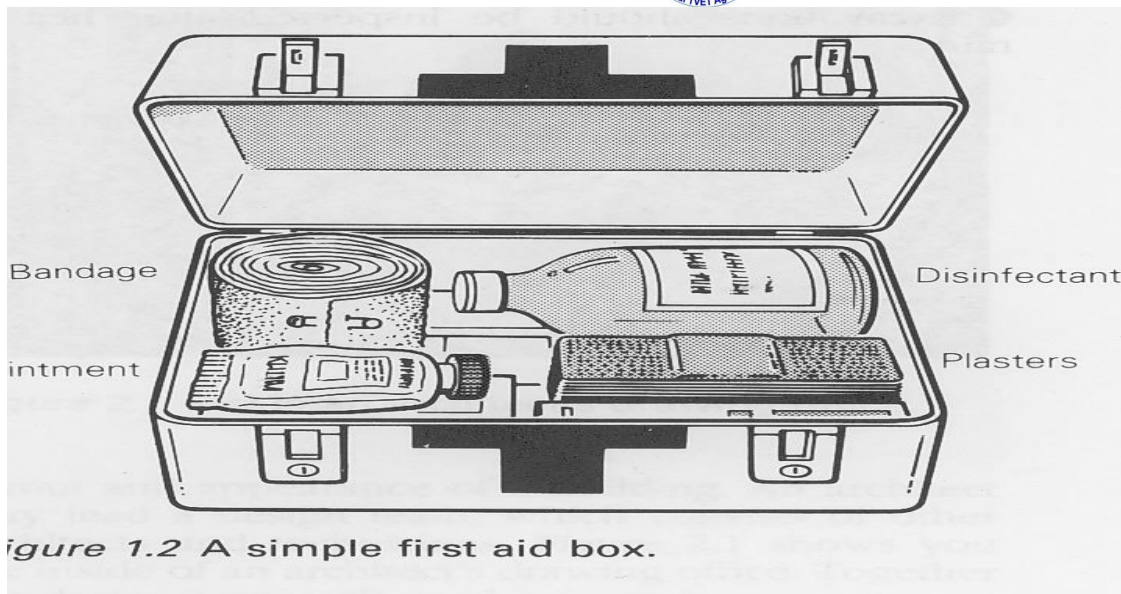


Fig 9 A simple first aid box

•Workplace environment and safety,

1. **Setup a workspace.** Rebar comes in very long rods (typically 8–20 foot and up to 40 foot in length). Due to its length, tendency to be covered with mill scale or rust, and overall weight rebar is usually best handled in a large open area with few obstructions. Cutting rebar often creates very hot sparks so make sure the area is clear of flammable materials. The rust and sparks from rebar can ruin clothing so wear something sturdy and old.

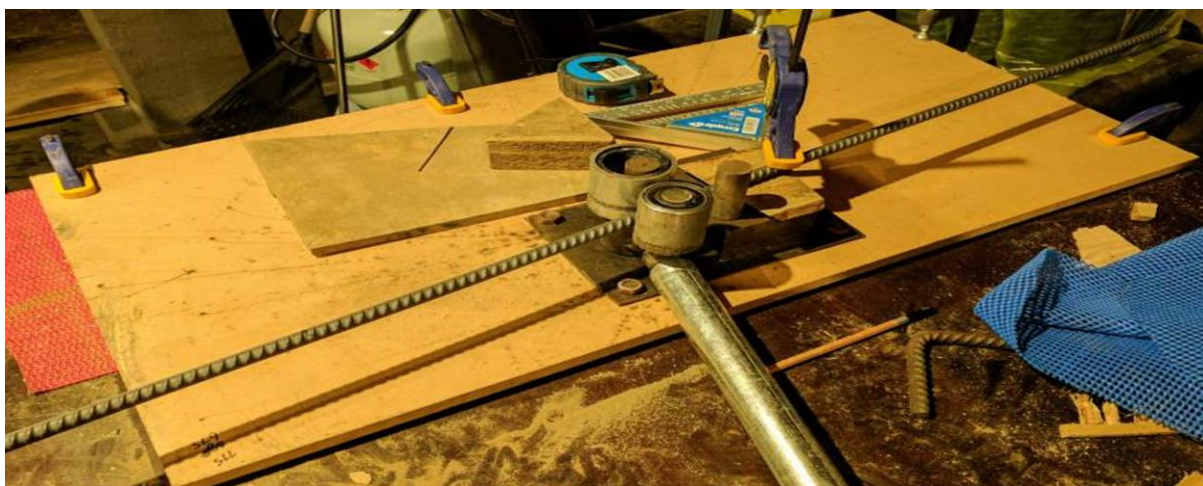


Fig.10 Bending of bar in the work place



2. Measure carefully. Taking into account the overall length, any overlap (where you might tie it to another piece), and especially the curves can be a bit tricky. You may find that the first few times you bend and cut a piece of rebar it is shorter or longer than you had intended. This is often due to a failure to account for the length of the rebar through the curve. It can be tricky but you'll get the hang of it. Rebar is very easy to mark with wax crayon (if you'd like waterproof marking) or chalk (often handy in art projects where you'd like the marks to wipe off).

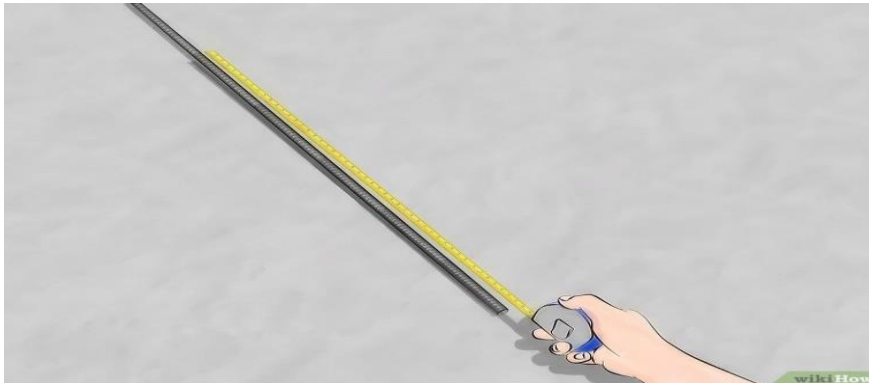


Fig. 11 measuring with tape rule

3. Cut your rebar. Cutting rebar can be done easily with a metal cutting hacksaw blade. You can also use a reciprocating saw, portable band saw, or grinder equipped with a blade suitable for cutting "mild steel".[3] Rebar tends to want to roll around when being cut, therefore it is often necessary to step on the bar or have an otherwise steady hold while cutting it. Cut rebar is always hot and/or sharp. Use gloves and caution.

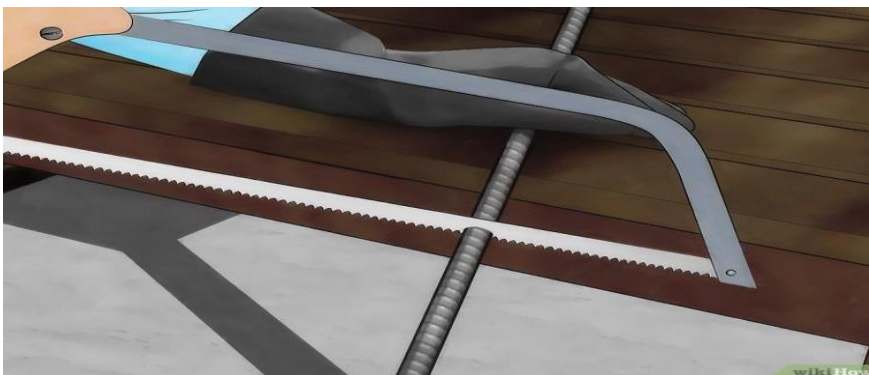


Fig. 12 cutting of rebar

- **Materials Handling and Storage**



Storing Materials

Storage facilities are required in working places. Depending on the type of material, the storing can be done either in the shop or at the work site. For example cement should be stored in store house where as reinforcement can be stored outside the store house.

A reinforcing bar, commonly known as rebar, provides strength and stability to concrete structures. While concrete is extremely strong, it can lose its integrity under tension stresses and lead to cracking and spalling, which occurs when the material starts flaking and breaking away. Rebar helps prevent concrete structures from premature cracking and flaking by absorbing and distributing the stress. However, common rebar is manufactured from unfinished tempered steel and is susceptible to rusting.

Using rusted rebar isn't allowed when constructing a concrete structure and would result in your company's work being turned down by the building inspector, unless the rust is removed. This is an obvious problem for anyone working with rebar, so it is paramount that your materials remain clean and rust free.

No matter the type of rebar you choose to invest in for your projects, storing it properly is still essential, and we have compiled the following tips to help you do just that.

- Put the rebar on top of a raised non-metallic platform, such as wooden pallets. Both the ground and concrete areas absorb moisture and can lead to rusting.
- Cover the rebar with a thick protective tarp and secure it with cinder blocks (or something similarly heavy) at the corners and edges. You want to minimize the rebar's exposure to the elements.
- If using galvanized rebar, avoid contact with uncoated rebar and excessive exposure to wooden materials, which can stain its surface. We recommend using another type of non-metallic platform.
- If using stainless steel rebar, avoid contact with carbon steel rebar or other ferrous (iron) materials. If this is unavoidable, make sure the stainless steel rebar is placed on the top of the other materials.

When it's time to call it a day and head home, the best way to prevent corrosion is to take the rebar indoors. While we know that this is often easier said than done, it will ensure that your materials are ready for use and that extra time will not be needed to clean it and remove any accumulated rust. Remember that structural building materials not kept in good shape, such as rusted rebar, may not be approved by the building inspector



Fig.13 handling of tools

1. Clean your tools. Cleaning the tools regularly is essential to their proper functioning. After a day of work, your tools will be covered with some amount of dirt. It's important to clean them after you're finished using them. Although a thorough cleaning is not required on a daily basis, make sure you clean your tools regularly. When cleaning your tools, don't use chemicals that are extremely harsh. Follow the manufacturer's guidelines for proper cleaning and maintenance.

2. Protect electrical cords. Airlines and electrical cords are prone to heavy damage since they are generally in the way of construction vehicles, and foot traffic. Other machinery like forklifts, drills, etc. can easily cut through wires. To keep the wires and airlines from getting damaged, it is important to protect them. You can cover the electrical cords with industrial strength casings or purpose-built ramps.

3. Lubricate tools. Whether you work with pneumatic or regular tools, it is important to lubricate them regularly. Lubricating tools helps them to perform better and reduces wear and tear of components.

4. Lubrication is even more important when working with air or pneumatic tools. Pneumatic tools need to be lubricated once a day before use. When moisture or condensation enters the interiors of pneumatic tools, it can cause corrosion. Corrosion can decrease the life of an instrument. Corroded parts are difficult to repair and replace. Hence, the internal components of pneumatic tools should be coated with special air-tool oil. This oil prevents corrosion by displacing any moisture that enters the interior of the equipment.



5. Store tools with care. Storing tools properly is of prime importance. Although tools are designed for rough use, it is important to store them properly. Cover up your tools to keep dirt and rain away from the machine. If the tools aren't used for a long time, inspect them regularly for signs of damage, wear and tear, corrosion, etc.

•Use of firefighting equipment

Installing fire fighting system:- Fire protection system should be installed in the building sites. The most common type of fire protection equipment is the fire extinguisher. Fire extinguisher should be suitably placed, distinctly marked and easily accessible.



Fig.14 Fire extinguisher



Self-Check 1

Multiple Choice

Instruction: Select the best answer and encircle the letter

1. Why a bar bender & concrete worker wear the right safety equipment?

A/ Rebar can be sharp and is heavy
B/ Rebar can create sparks when being cut.
C/Concrete has a harmful chemical
D/ All of the above are correct

2. All are PPE for a bar bender & concrete worker **EXCEPT**

A/ Eye protection

B/ Sleeved shirts

C/ Gloves, and sturdy boots
D/ None of the above

3. Which one of the following is not Responsibility of bar bender?

A/ wearing of personal protective equipment

B/ Clean of his hand tools after finishing his work

C/ Measure carefully before cutting bar

D/ Providing Main Electric supply line for cutting bar with power saw

4. All are the reason rebar is usually best handled in a large open area but not one?

A/ Due to its length

B/ Because rebar is not attack by rust



C/ Overall weight rebar is usually best handled in a large open area with few obstructions.

D/ None of the above

5. What is the advantage of Lubricating tools?

A/ Helps Tools to perform better and reduces wear and tear of components

B/ It prevent corrosion

C/ To repair and replace Tool parts Easley

D/ All of the above are correct

6. What makes wrong if you store your rebar in the moisture area?

A/ The material starts flaking

B/ The material breaking away

C/ The bar can lose its integrity under tension stresses

D/ All of the above

7. Why we store our rebar properly?

A/ To prevent from thief

B/ To manage it properly

C/ To avoid wastage of material

D/All of the above

8. If you store you bar outside of the shade what must be the measure you will take to avoid rust that appear due to moisture?

A/ Put the rebar on top of a raised non-metallic platform, such as wooden pallets.

B/ Put the rebar on ground

C/ Put the rebar on concrete areas

D/ All of the above

Note: Satisfactory rating above - 4 points Unsatisfactory - below 4 points

You can ask you teacher for the copy of the correct answers.

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Answer Sheet

Score = _____

Rating: _____

Operation Sheet- 1	Performing Protection from hazard
<p>PROCEDURE for Performing Protection from hazard</p> <p>Step 1. Identify the kind of protective equipment PPE needed</p> <p>Step 2. Understand the limitations of personal protective equipment in protecting workers from injury or accident,</p> <p>Step 3 Identify and provide appropriate PPE</p> <p>Step 4. Use protective equipment properly,</p> <p>Step 5. Wear personal protective equipment</p>	



Information Sheet 3

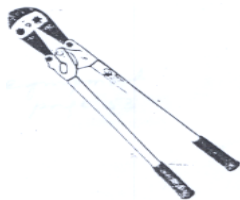
Selecting tools and equipment to carry out tasks.

1.3 Selecting tools and equipment to carry out tasks

- **Type of Reinforcement Steel Tools and Equipment**

The following tools and equipment are the most type used in bar bending and cutting activities

Bar Cutter: - Used for cutting soft and medium hard metal and for center cutting of wires, bolts, rivets, screws, and nails. Always it should be in usable condition and sharp.



Bar Cutter

Bar Bender:- Used for bending reinforcing bar with the help of hook type bender mounted on bench on wood board. Select current size that fits the diameter of the reinforcement.



Bar Bender

Hook Type Bar Bender: - Used for right and left hand bending of reinforcing bar manually. It should be mounted on wood board or bench when being used.



Hook type bar bender

Hack Saw: - Used for cutting reinforcement bar. The bar should be held firmly in the vice while cutting. The blade should be tightened to the frame of the hacksaw properly and never use blunt blade when cutting.

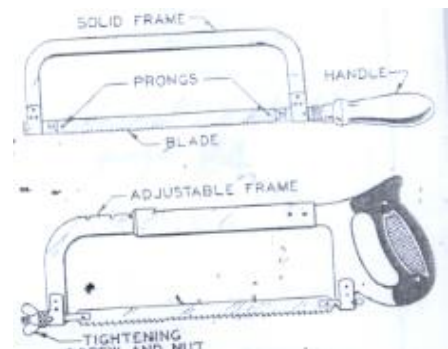
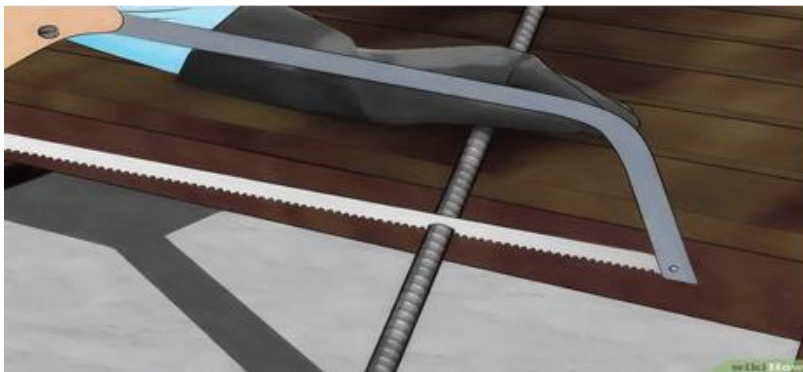
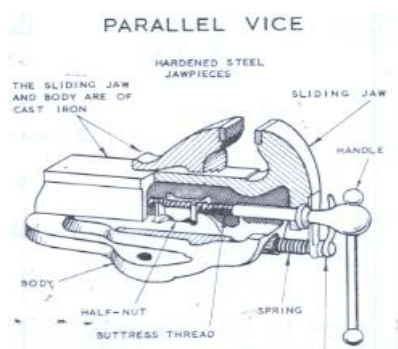


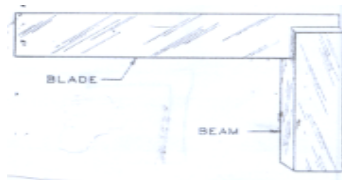
Fig.15 Cutting Bar with Hand hacksaws

Vice: - The parallel vice grips the work equally to the full depth of the jaws. The Smith's legs vice is made of wrought iron with cast steel jaws inserts. It is used for heavy work hammering, bending and sawing. The vices are mounted on bench or wooden board.



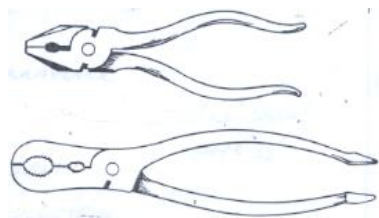


Try Square: - Used to check 90° of corners when fixing the reinforcement bars in the form work with the help of string



Try square

Pliers:- Used to tie transverse reinforcement bars with help of tying wire when reinforcements are placed in their position in the formwork



Pliers



Vernier Caliper:- The *Vernier* caliper is a precision measuring which is used when measurement to within 0.1 mm are required. *Vernier* caliper can be used to measure diameter of reinforcement. You have to take correct measurement when you are using vernier caliper.





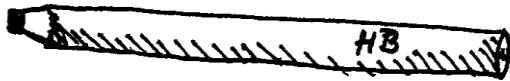
Fig 16 Measuring with Vernier caliper

Measuring Tape:- Used to take measurement of length of reinforcement. Correct sizes should be read from the tape while taking measurements.



. Measuring Tape

Marking Tools (Chalk and pencils):- chalk or pencils are used for marking on reinforcement bars. A pencil is also used for the same purpose. A saw can also be used for marking on reinforcement bar



Bolt cutter it is used to cut extensive iron pods





Self-Check 1	Multiple Choice
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Instruction: Select the best answer and encircle the letter

1. One of the following tool is used to measure length of rebar

A/ Measuring Tape

B/ Try square

C/ Venire Caliper

D/ All of the above

2. One of the following tool is used to make mark to cut rebar

A/Chalk

B/Pencils

C/ Hack saw

D/ All of the above

3. One of the following tool is used to measure diameter of reinforcement

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A/ Measuring Tape

B/ Try square

C/ Venire Caliper

D/ All of the above

4. One of the following tool is used to check 90^0 of corners when fixing the reinforcement bars in the form work

A/ Measuring Tape

B/ Try square

C/ Venire Caliper

D/ All of the above

5. Which of the following hand tools used for bending reinforcing bar with the help of hook type bender mounted on bench on wood board

A/ Hack saw

B/ Hook type Bar Bender

C/ Bar Bender

D/ All of the above

Note: Satisfactory rating - 2 points Unsatisfactory - below 2 points

You can ask you teacher for the copy of the correct answers.

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Answer Sheet

Score = _____

Rating: _____

Operation Sheet- 1	Selecting tools and equipment to carry out specific tasks
<p>PROCEDURE for Selecting tools and equipment to carry out specific tasks</p> <p>Step 1- Read specification to get appropriate information about the kind of task to be perform</p> <p>Step 2. Identify the kind of necessary PPE for the given specific tasks</p> <p>Step 3. Use protective equipment properly</p> <p>Step 4 List out the type & number of tools and equipment</p> <p>Step 5. Select tools and equipment from theirs storing area ,</p> <p>Step 6. Take the selected tools and equipment to the work site with care</p>	



Information Sheet 4	Checking stock of reinforcement for correct type and quantities
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1.4 Checking stock of reinforcement for correct type and quantities

- **Type reinforcement**

Reinforcement steel is normally provided as individual steel bars or as steel bars welded together into a mesh. The bars are used for beam and columns, while the mesh is prepared for large surfaces such as slabs and walls.

Reinforcement is also commonly used when building rural houses.

The common diameters of steel bars used in building work are 6, 8, 10, 12, 16, 18, 20, 22, 25 and 32 mm.

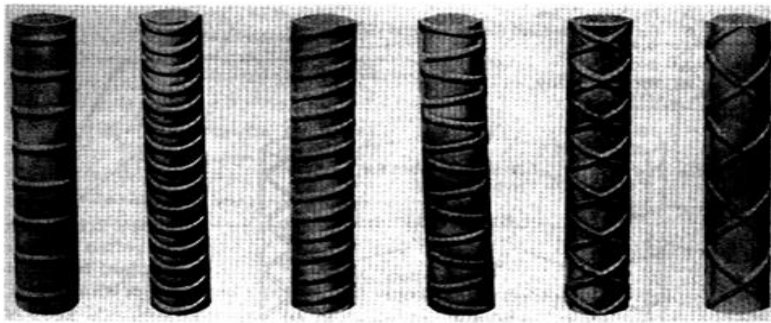


Fig17. types of Reinforcement bar

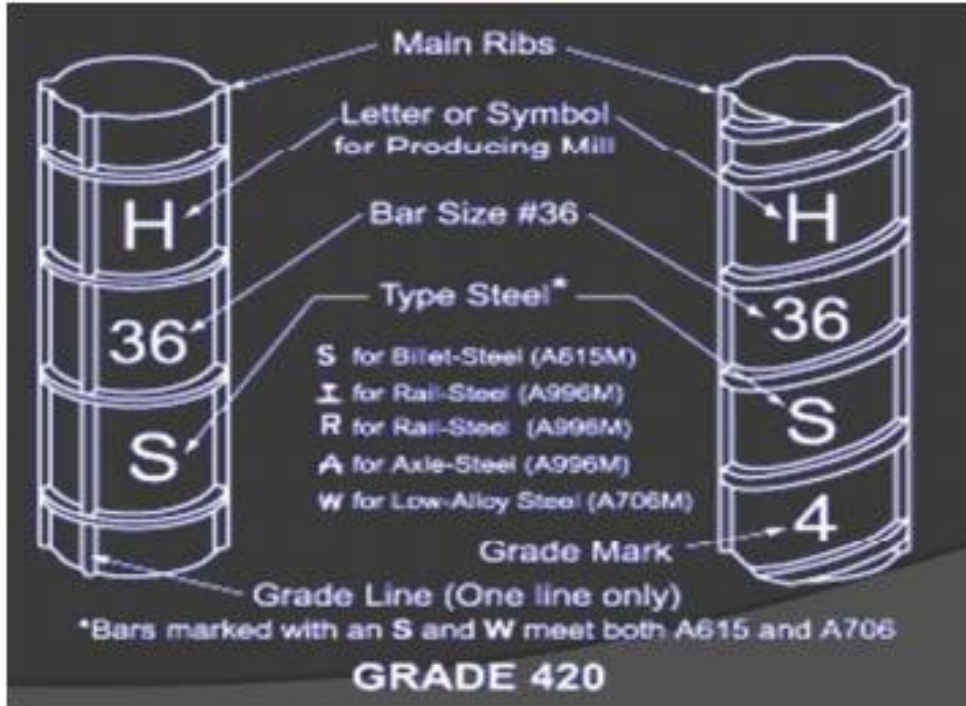


Fig 18. Specification of reinforcement



Plain (round) Bars (mild steel bars) $\phi 6-32\text{mm}$

Ordinary steel bars are used for reinforcing concrete. It develops bond with concrete. The grip depends upon the grades of concrete, ribs (lugs) provided around the reinforcement and degree of compaction.

The yield stress of round (MS) steel is 55% to 60% of the ultimate tensile strength. When structure of a building is designed using mild Steel large quantity of reinforcement are required because of less yield stress. This also affects the cost of a building.

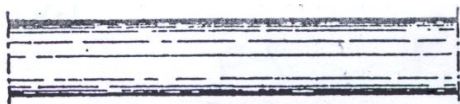


Fig19 Plain round bar or mild steel

Deformed Bars ($\phi 8- 32\text{mm}$)

Deformed bars are types of reinforcing bars provided with lugs, ribs or deformations on the surface of the Bar to minimize the slippage of the bar in concrete. Bond between concrete and bar can be improved by the use of deformed bars.

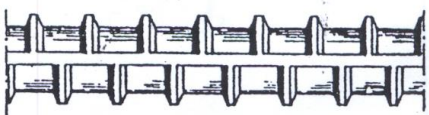


Fig20 Ribbed bar

Twisted Bars ($\phi 8-32\text{mm}$)

Twisted bars have considerable yield stress, about 50% more than ordinary plain bar. Their use can permit high working stress and hence considerable saving in quantity of steel can be achieved.



Fig 21 Twisted ribbed bar



There are two main categories and purposes of reinforcement steel. The main bars are meant to take most of the tension stresses, while the distribution reinforcement serves the purpose of spreading the load and keeping the main reinforcement in position when pouring concrete.

The main reinforcement bars are placed in the area where tension occurs. It should be adequately covered with concrete with minimum 20 to 25 mm for slabs, 25 to 30 mm for beams on all sides and 40 mm for columns to avoid any corrosion of the reinforcement.

If steel bars need to be extended, some of the critical points to be remembered are:

- ❖ The lap length should be greater than 50 times the diameter of the bars used.
- ❖ Lapping should not be done close to joints or any other critical areas of the structure.

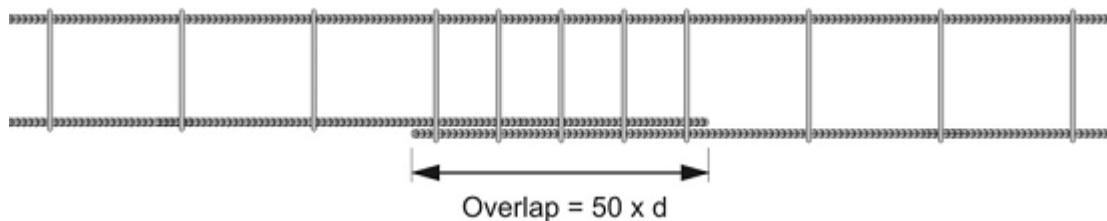


Fig 22 overlap of bar

- ❖ All the laps should not be concentrated in a single area or straight line as the lap may create a point of vulnerability within the structure.

The surface of the rods should be clean, free from dirt and certainly not covered with shuttering oil or any other release agent to ensure proper bonding with the concrete.



All bars should be completely surrounded by concrete. This ensures that the concrete and steel complement each other and behave as a single composite material, as well as not exposing the steel to moisture in the air that may lead to corrosion

- **Calculating materials quantity requirements**

After details of the structural design of any structure is completed, the reinforcement drawing and bar bending schedule is prepared. The quantity of reinforcement is estimated based on the reinforcement drawing and bar bending schedule.

Usually reinforcement quantity is worked and given in terms of weight or kilograms. In order to work out the quantity of reinforcement in terms of kilograms one has to know the specific weight of the bar.

In relation with the quantity, the quality of the steel is specified in the bending dimension and scheduling of bars for reinforcement of concrete in the type and size. The bar bending schedule will show the type, size and total length of each reinforcement bar in the design.

Weight of Reinforcement: - The formula given below helps us to find out weight of reinforcement in kilogram per meter

$$W/m = \frac{D^2 \times 0.222}{36}$$

OR

$$W/m = \frac{D^2}{162}$$

Where **D** is Diameter of the required of the reinforcement

Example: weight of diameter 12 mm is



$$W = (12 \times 12 \times 2.22) / 36 = 0.888 \text{ k.g/m}$$

To get number of bars for slab is

$$\text{Number of Bar} = \frac{\text{Length} - 2 \text{ end cover}}{\text{Spacing}} + 1$$

Spacing

Where Length = is span length

End cover = Concrete cover

Spacing = space b/n bars

$$\text{Number of stirrup} = \frac{\text{span Length}}{\text{Space}} + 1$$

Space

Bar Bending Schedule

Location	Mark	Shape	Diameter	Length (m)	Number of			Types of Bars with their size in m.m							Remark
					Bars	Members	Total No Bars	6	8	10	12	14	16	20	
					Total Length In meter										
					Unit weight per m			0.222	0.395	0.617	0.888	1.21	1.58	2.47	



Total Weight per Kg								
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Table 1 Bar Bending Schedule

Self-Check 1	Multiple Choice
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Instruction: Select the best answer and encircle the letter

1. If you prepare bar in the form of mesh it is used for

A/ For large surfaces such as slabs and walls.

B/ The bars are used for beam

C/ The bars are used for columns

D/ All of the above are correct

From equations 2 - 4 are based on the drawing given below



Figure Specification of rebar

2. The letter “H” in the figure stand for

A/ Symbol for producing mill



B/Bar size

C/ Type of steel

D/ None of the above

3. Which one of the following indicate bar size

A/ H

B/ 36

C/ S

D/ None of the above

4. The letter “S” in the figure stand for

A / Symbol for producing mill

B/Bar size

C/ Type of steel

D/ None of the above

5. What is the formula helps us to find out weight of reinforcement in kilogram per meter

A/ $W/m = \frac{D^2 \times 0.222}{36}$

B/ $W/m = \frac{D^2}{162}$

C/ Number of Bar = $\frac{\text{Length} - 2 \text{ end cover}}{\text{Spacing}} + 1$

D/ A & B are correct answer



6. The weight of bar having 10m meter length & a diameter of six is

A/ 2.22kg

B/ 0.888kg

C/ 0.395kg

D/ 0.222kg

7. When calculating take off sheet usually reinforcement quantity is given in terms of

A/ Weight or kilograms

B/ Meter

C/ Number

D/ Pcs

8. The format which contain shape of bar, total number of bar for registering the result of quantity of bar is known as

A/ Take off sheet

B/ Bar schedule

C/ BOQ

D/ All of the above

Note: Satisfactory rating - 7 points Unsatisfactory - below 7 points

You can ask you teacher for the copy of the correct answers.

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Answer Sheet

Score = _____

Rating: _____

Operation Sheet- 1	Calculating bar quantity requirements
<p>PROCEDURE for Calculating materials quantity requirements</p> <p>Step 1-. Read & interpret working drawing</p> <p>Step 2. Prepare Bar bending schedule</p> <p>Step 3. Identify the types of bar bending shape & size</p> <p>Step 4 calculate the amount of bars required for the given specification</p> <p>Step 5. Fill the calculated data in the given bar schedule format</p> <p>Step 6. Sum up & multiply the figure to get the total weight of bars</p>	



Information Sheet 5

Identifying environmental protection requirements for the project in accordance with environmental plans and regulatory obligations

1.5 Identifying environmental protection requirements for the project in accordance with environmental plans and regulatory obligations

What is Environmental Management?

Environmental management (EM) is a subject that combines science, policy, and socioeconomic applications. It primarily stresses on finding solution to practical problems that people face in cohabitation with nature, resource exploitation, and waste production.

In a purely anthropocentric sense, environmental management is all about dealing with the fundamental issue of how to innovate technology to evolve continuously while limiting the degree to which this process alters natural environment. Thus, Environmental management is closely linked with issues regarding sustainable economic growth, ensuring fair and equitable distribution of resources, and conserving natural resources for future generations.

There are a number of advantages to undertaking environmental management and these include:

- i. Cost savings
- ii. Ensuring legislative compliance
- iii. Anticipating future legislation
- iv. Reduced environmental risk
- v. Meeting supply chain requirements
- vi. Improved relations with regulators
- vii. Improved public image
- viii. Increased market opportunities
- ix. Employee enthusiasm



WHAT IS AN ENVIRONMENTAL POLICY?

An environmental policy is a document prepared by a company or an organization which clearly sets out its overall aims and intentions with respect to the environment. An environmental policy provides a sense of direction for a company and shows that it is committed to managing its environmental affairs in a responsible way. The policy should be endorsed by the company's senior management and should be publicly available. It should be an integral part of the business strategy and be compatible with company's other policies

(e.g. on quality and on health and safety).

Each of these benefits is now examined below:

COST SAVINGS

Most, if not all people, wish to protect the environment. However, many businesses fear that protecting the environment by improving their environmental performance will cost money.

They fear there will be a conflict between their desire to protect the environment and their desire to keep down costs and run a successful business.

The good news is that many businesses have discovered that far from increasing costs, improving environmental performance actually reduces costs. Many companies have found that it is possible to save money, sometimes large sums of money, by improving their environmental performance.

Cost savings within a company or a firm can be achieved through changes in areas such as:

- i. process efficiency
- ii. Product design
- iii. Waste disposal
- iv. Sourcing of raw materials
- v. infrastructure
- vi. Packaging and transport

Various ways of achieving cost savings are described briefly below:

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PROCESS EFFICIENCY

Improving the efficiency of existing processes

Optimizing the performance of existing processes minimizes the use of raw materials and energy and the production of waste. Reduced use of raw materials and energy and reduced waste production are all good for the environment and the reduced resource costs and waste disposal costs are good for business. Proper maintenance of equipment is important as it minimizes costly downtime and the resource waste often associated with shutdown and start-up periods.

Introducing more efficient processes

Introducing new and more efficient processes also reduces resource use and waste production. Many companies have been able to make large cost savings by reducing the amount of raw materials, energy and water that they use.

PRODUCT DESIGN

It may be possible to redesign a product so as to reduce the amount of resources it contains whilst still maintaining the level of service it provides.

WASTE DISPOSAL - MAKING MONEY FROM WASTE

As mentioned above, improving process efficiency will reduce the amount of waste that a process produces. Once waste has been generated, it is often possible to reuse it or pass it on to other companies that can use it and so avoid the costs of waste disposal.

SOURCING OF RAW MATERIALS

Changing the source of raw materials used in a particular process can result in cost savings. Companies could make large savings by using recycled wool rather than virgin wool to manufacture its products, or use recycle paper rather than manufactured paper that could save substantial number of trees being felled.

INFRASTRUCTURE

It is also possible to make savings by making efficiency changes to infrastructure e.g. installing energy efficient lighting, insulating buildings, improving the efficiency of heating systems.

PACKAGING AND TRANSPORT

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Once goods have been produced, they need to be packaged and transported. It is possible to make cost savings in these areas at the same time as improving environmental performance.

ENSURING LEGISLATIVE COMPLIANCE

By ensuring that it complies with relevant environmental legislation, a company or a firm can avoid the possibility of being fined by the regulatory authorities for noncompliance and the adverse media publicity and public criticism & outrage that can accompany such fines.

ANTICIPATING FUTURE LEGISLATION

Developing an awareness of likely changes in environmental legislation allows companies to plan for these changes and make appropriate investment decisions. If a company or an organization is not aware of proposed legislation it may make investments that are futile when the new legislation is enacted.

Alternatively, a company may find out about a legislative change at the last minute and be forced to undertake rapid investment to comply with its requirements. Prior knowledge of likely changes allows a longer time period over which to make the necessary investment and prevent possible cash flow problems.

REDUCED ENVIRONMENTAL RISK

Environmental risk is the single largest hidden risk for many companies. By undertaking environmental risk assessment as part of the environmental management process it is possible to reduce the risk of the occurrence of events that could have adverse environmental consequences. Banks, insurance companies and investors all base their decisions on an assessment of risk. The higher the risk, the less likely a bank is to lend, the less likely investors are to invest and the higher insurance premiums are likely to be.

Therefore a reduction in environmental risk is likely to be viewed favorably by all these parties, putting a company in a better position to obtain loans and insurance cover and to attract investment.

MEETING SUPPLY CHAIN REQUIREMENTS

An increasing number of large organizations are requiring their suppliers to demonstrate sound environmental management and are prepared to delist those that fail to do so. In some cases having an environmental policy is not considered sufficient proof of sound environmental management and evidence is required that a company is taking action to meet the commitments set out in their policies. Hence, undertaking effective environmental management will increasingly be necessary to gain or maintain supplier status with large organizations.

IMPROVED RELATIONS WITH REGULATORS

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The ability to demonstrate sound environmental management may lead to environmental regulators taking a more “hands-off” approach to regulation e.g. a reduction in the number of inspection visits required per year.

IMPROVED PUBLIC IMAGE AND COMMUNITY RELATIONS

By publicizing its efforts to improve environmental performance, a company can improve its public image, thereby enhancing its position in the market place. And by demonstrating sound environmental management, a company can reassure the local community about its activities and thus build up good community relations.

INCREASED MARKET OPPORTUNITIES

Lower production costs resulting from environmental management and good public image resulting from publicizing good environmental performance can result in a company increasing sales and gaining a larger market share.

EMPLOYEE ENTHUSIASM

The environment is an issue about which many people are concerned. Undertaking environmental management can generate a lot of enthusiasm within a company as it allows employees to express their environmental concern in a practical way by contributing towards improving environmental performance



Self-Check 1

Multiple Choice

Instruction: Select the best answer and encircle the letter

1. ----- is a subject that combines science, policy, and socioeconomic applications.

A/ Environmental management
B/ Hand tools
C/ Safety rule
D/ All of the above
2. Environmental management primarily stresses on finding solution to

A/ practical problems that people face
B/ practical problems that nature faces
C/ practical problems that resource exploitation, and waste production
D/ All of the above
3. One of the is the advantages to undertaking environmental management
A/ Cost savings
B/ Reduced environmental risk
C/ Improved relations with regulators
D/ All of the above
4. ----- is a document prepared by a company or an organization which clearly sets out its overall aims and intentions with respect to the environment
A/ Cost savings
B/ Environmental policy
C/ Safety rules
D/ None of the above



Note: Satisfactory rating - 2 points Unsatisfactory - below 2 points
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____



LAP Test	Practical Demonstration
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Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hour.

Task 1: Perform Protection from hazard

Task 2: Selecting tools and equipment to carry out specific tasks

Task 3: Calculating bar quantity requirements



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