General Mason

(QUALIFICATION PACK: Ref. Id. CON/Q0103)

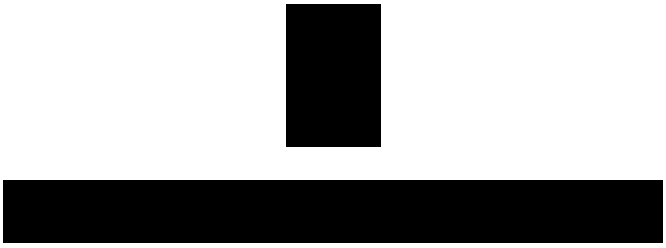
Student Text Book

(Job Role)

Qualification Pack: Ref. Id. CON/Q0103

Sector: Construction

Textbook for Class XII



First Edition
June 2019 Jyestha 1941

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Printed on 80 GSM paper with NCERT Watermark

Published at the Publication Division by the Secretary, National Council of Educational Research and Training, Sri AurobindoMarg, New Delhi 110 016 and printed at

ISBN 000-00-0000-000-0

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FOREWORD

The National Curriculum Framework 2005 (NCF 2005) recommends bringing work and education into the domain of the curricular, infusing it in all areas of learning while giving it an identity of its own at relevant stages. It explains that work transforms knowledge into experience and generates important personal and social values such as self-reliance, creativity and cooperation. Through work, one learns to find one's place in the society. It is an educational activity with an inherent potential for inclusion. Therefore, an experience of involvement in productive work in an educational setting will make one appreciate the worth of social life and what is valued and appreciated in society. Work involves interaction with material or other people (mostly both), thus creating a deeper comprehension and increased practical knowledge of natural substances and social relationships.

Through work and education, school knowledge can be easily linked to learners' life outside the school. This also makes a departure from the legacy of bookish learning and bridges the gap between the school, home, community and the workplace. The NCF–2005 also emphasises on Vocational Education and Training (VET) for all those children who wish to acquire additional skills and/or seek livelihood through vocational education after either discontinuing or completing their school education. VET is expected to provide a 'preferred and dignified' choice rather than a terminal or 'last-resort' option.

As a follow-up of this, the NCERT has attempted to infuse work across the subject areas and also contributed in the development of the National Skill Qualification Framework (NSQF) for the country, which was notified on 27 December 2013. It is a quality assurance framework that organises all qualifications according to levels of knowledge, skills and attitude. These levels, graded from one to ten, are defined in terms of learning outcomes, which the learner must possess regardless of whether they are obtained through formal, non-formal or informal learning. The NSQF sets common principles and guidelines for a nationally recognised qualification system covering Schools, Vocational Education and Training Institutions, Technical Education Institutions, Colleges and Universities.

It is under this backdrop that Pandit Sunderlal Sharma Central Institute of Vocational Education (PSSCIVE), Bhopal, a constituent of the NCERT has developed learning outcomes based modular curricula for the vocational subjects from Classes IX to XII. This has been developed under the Centrally Sponsored Scheme of Vocationalisation of Secondary and Higher Secondary Education of the Ministry of Human Resource Development.

This textbook has been developed as per the learning outcomes based curriculum, keeping in view the National Occupational Standards (NOS) for the job role and to promote experiential learning related to the vocation. This will enable the students to acquire necessary skills, knowledge and attitude.

I acknowledge the contribution of the development team, reviewers and all the institutions and organisations, which have supported in the development of this textbook.

The NCERT would welcome suggestions from students, teachers and parents, which would help us to further improve the quality of the material in subsequent editions.

HRUSHIKESH SENAPATY
Director
National Council of Educational
Research and Training

New Delhi
June 2020

ABOUT THE TEXTBOOK

Construction sector in India is considered to be the second largest employer and contributor to economic activity, after agriculture sector. This sector employs more than 44.08 million people in the country. Around 50 per cent of the demand for construction activities in India comes from the infrastructure sector, while the rest comes from industrial activities, residential and commercial development, etc. The construction industry accounts for about 11 per cent of India's GDP. The Planning Commission estimates that the construction sector will require another 47 million people in the workforce over the next decade.

There is a need for formal training for construction workers. This book contains chapters for imparting knowledge and skills on various aspects of the construction technology. It also includes information, exercises and assessment activities.

This textbook has been developed with the contribution of subject experts, vocational teachers, industry experts and academicians for making it a useful and inspiring teaching-learning resource material for the vocational students. Adequate care has been taken to align the content of the textbook with the National Occupational Standards (NOS) for the job role so that the student acquires the necessary knowledge and skills as per performance criteria mentioned in the respective NOS of the Qualification Pack (QP). The NOS for the job role of 'General Mason' covered through this textbook are as follows:

1. CON/N0110: Construct masonry structures using brick and block
2. CON/N0111: Execute plaster on internal and external surfaces of masonry and RCC structure
3. CON/N0112: Carry out waterproofing works for structures using cementitious materials
4. CON/N0113: Build structures using random rubble masonry
5. CON/N0114: Carry out IPS and Tremix flooring
6. CON/N8001: Work effectively in a team to deliver desired results at the workplace
7. CON/N8002: Plan and organise work to meet expected outcomes

Unit 1 of the textbook gives introduction to random rubble masonry. Unit 2 focusses on IPS/Tremix flooring. Unit 3 deals with Rate Analysis of different items of work. Unit 4 discuss about Plan and organize work to meet expected outcomes, Unit 5 deals with the Personal health, safety and environment protocol at construction site.

We extend our gratitude to all the contributors for selflessly sharing their precious knowledge, acclaimed expertise and valuable time and positively responding to our request for the development of this textbook.

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ACKNOWLEDGEMENTS

The National Council of Educational Research and Training (NCERT) expresses its gratitude to the members of the Project Approval Board (PAB) and the officials of the Ministry of Human Resource Development (MHRD), Government of India, for the financial support to the project for development of learning outcome based curricula.

The Council acknowledges the contribution of the members of the Review Committee for sharing their expertise and time. The Council would also like to thank Rajesh Khambayat, *Joint Director*, PSS Central Institute of Vocational Education (PSSCIVE), Bhopal for providing support and guidance in the development of this textbook.

The Council is also grateful to Saroj Yadav, *Professor* and *Dean* (*Academics*), and Ranjana Arora, *Professor* and *Head*, Department of Curriculum Studies, NCERT, for their sincere efforts in coordinating the review workshops for the finalisation of this book.

This text book would not have been possible without the support of the Indian Plumbing Skill Council (IPSC), New Delhi. We would like to acknowledge and thank IPSC for giving us the permission to use the pictures in this textbook.

We extend our gratitude to all the contributors for selflessly sharing their precious knowledge, acclaimed expertise and valuable time, and positively responding to our request for development of the textbook.

We are thankful to the course coordinator Saurabh Prakash, *Professor*, Department of Engineering and Technology, PSSCIVE, Bhopal, for his untiring efforts towards developing the content for this textbook and also providing photographs used in the textbook. The images used other than these are under Creative Commons License. The contribution of Dr. Satyendra Singh Thakur, Consultant, and Avinash Singh Ex- *Consultant*, Department of Engineering and Technology, PSSCIVE, Bhopal is also acknowledged.

The Council also acknowledges the copyediting and proof reading by ....., *Editorial Assistant* (Contractual), Publication Division, NCERT. The efforts of ....., *DTP Operator*, and ,,,,,,..., *DTP Operator* (Contractual), Publication Division, NCERT; Vinod Kumar Soni, *Computer Operator Grade-II*; Vikas Kumar Kogey, *Graphic Artist* (Contractual) and Pinki Tiwari, *Graphic Designer* (Contractual), PSSCIVE, NCERT, are also acknowledged.

CONTENTS

INTRODUCTION

As we know that Construction industry in India is facing a huge shortage of manpower, especially those with skill-sets to sustain the burgeoning growth in infrastructure and housing sectors. Although the construction industry employs about 31 million people, second only to the agriculture sector, the workforce requirement is about five million people per year over the next 7 years to sustain the current 8 percent growth rate. With only 10 milion workers available in the country every year, the construction industry will face a heavy manpower challenge, as it requires employing five million people per annum. There is also dearth of contractors due to face that while the existing contracting agencies are overloaded, attempts, are being made to form new ones.

This workbook is to assist students with completing the Assistant mason**.** Students should study the workbook in class or in their own time

There is need for institutional training for construction workers, infrastructure developers can pool resources and found for training institutions. This workbook contains sessions for imparting knowledge & skills on various aspects of the building construction technology. The workbook also includes information, exercises and assessment activities to complete. The material will help you to ensure that you have fulfilled all of the requirements to receive a 'competency' grading/Certification.

Learning outcomes

On completion of this unit the student will be able to:

- carryout rubble masonry work
- carryout trimix masonry work
- carryout rate analysis work
- carryout health hazard protection work

UNIT 1: Random Rubble masonry

As you know that stone is one of the important building material used in construction. The properties of stones should be as per reference of IS 1123 : 1975. Important properties of stone should be as;

Quality: All stones used for building purposes shall be strong, hard and durable.

Strength: The strength of building stones should be adequate to carry the loads imposed. For ashlar and coursed rubble masonry, the strength shall be as worked in accordance with IS 1905 : 1987, taking into account, the appropriate crushing strength of stone as given in Table 1, and also the type of mortar used. For random rubble masonry, the strength value shall be specified on the basis of local experience.

Durability: The stone shall be free from defects like cavities, cracks, flaws, sand holes veins, patches of soft or loose materials, etc. The percentage of water absorption (see IS 1124 : 1974 for the method of test shall be generally not exceed 5 percent.

Size of stone: Normally stones used in rubble masonry should be small enough to be lifted and placed by hand. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourth of the thickness of wall nor less than 150 mm. The height of stone for rubble masonry may be up to 300 mm.

Tools for dressing of rubble masonry

While carrying out masonry work, mason requires different types of tools. In stone masonry, tools are categorised as dressing tools and masonry construction tools. Stones are available in irregular size and shape. As per the construction requirements, to make them regular size and shape and to form correct shape, following tools are used by the stone dresser/mason.

Types of masonry tools:

(i) Trowel

(ii) Plumb rule and Bob

(iii) Spirit level

(iv) Square

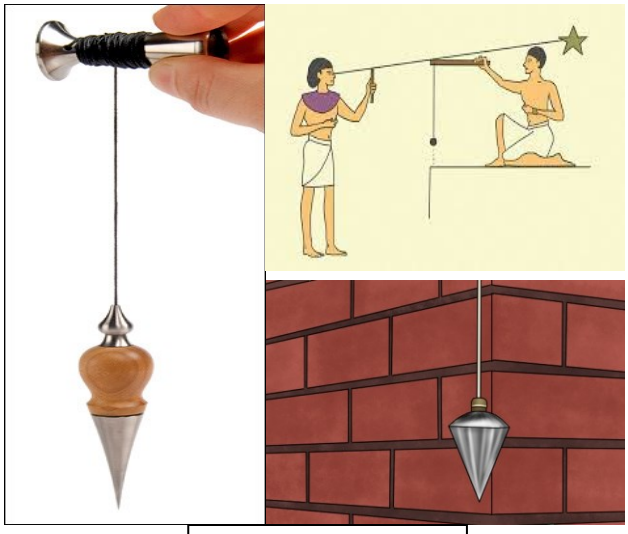

Fig.1.1: Plumb

(v) Line and pins

(vi) Bolster

(vii) Brick hammer

(viii) Scutch

(ix) Pick Axe

(x) Crowbar

(xi) Chisel

(xii) Mash Hammer

(xiii) Boaster

(xiv) Spall Hammer

(xv) Scrabbling Hammer

(xvi) Bevel

(xvii) Spade

(xviii) Picks and Beaters

(xix) Wooden Float

(xx) Metal Float

(xxi) Floating Rule

(xxii) Racking Needle

(xxiii) Hacking tool

(xxiv) Scratcher

(xxv) Pointing Tools (Nayals)

Fig.1.2: Spirit

(i) Trowel: A trowel is used to lift and spread mortar to form the joints and to cut the bricks. It is made of steel blade, shank and wooden handle (Fig.1.3).

(ii) Plumb Rule and Bob: The plumb rule and bob is

Fig.1.3: Trowel

used to check the verticality of the wall, column, wooden frame i.e. door, window etc. It consists of a wooden pieces of two meters long, whose top portion is attached to a plumb bob. (Fig.1.1).

(iii) Spirit Level: A spirit level is used to check the horizontally of the floor, roof, door, window frame etc.(Fig.1.2)

(iv) Square: A square is right angle steel piece, which is used to check the right angle (perpendicularity) of the walls, columns etc. (Fig.1.4)

***(v) Line and Pins*:** Line and pins are used to maintain the alignment of the work in progress i.e. brick or stone masonry. It consists of good quality thread and two pin (Fig.1.5).

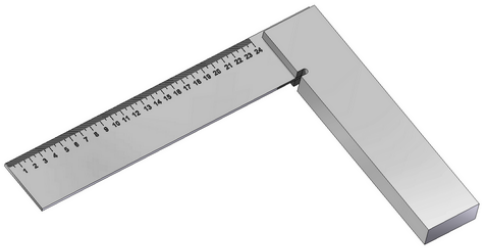

Fig.1.4: Square

Fig.1.5: Line and Pins

(vi) Chisel: Chisels are used to dress the stones. Chisels are of different shapes and sizes, and are used for different stone cutting and dressing works (Fig.1.6).

(vii) Bolster: A bolster is used to cut the bricks accurately. The main part of bolster is a steel wide blade (Fig.1.7).

(viii) Mash Hammer: A mash hammer is used to dress the stones (Fig.1.8).

Fig.1.6: Chisel

Fig.1.7: Bolster

Fig.1.8: Mash Hammer

(ix) Scabbling Hammer: A scabbling hammer is used for breaking the small projection of the stones (Fig.1.9).

(x) Bevel: A bevel is used to set the angle of the stone, brick machinery, flouring, projections etc. It consists of two steel blades having slots and fixed together by a thumb screw. These two blades can be set at any desired angle (Fig.1.10).

(xi) Spade: A spade is used to lift the sand, soil, mortar etc. It is also used in excavation of soft soil (Fig.1.11)

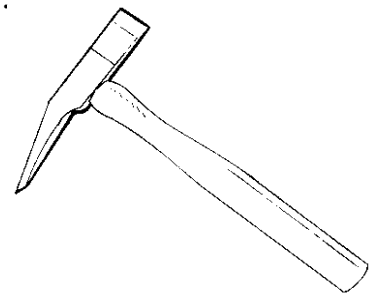

Fig.1.9: Scabbling hammer

Fig.1.10: Bevel

Fig.1.11: Spade

(xii) Hacking Tool: The plain surface of the concrete is roughened by hacking tool. It is in the form of hammer with chisel head or point head. The head is made of mild steel and pointed edge is made of tool steel (Fig.1.12)

(xiii) Pick Axe: A pick axes is used for rough dressing of the stones and to split stones in a quarry (Fig.1.13).

(xiv) Crowbar: A crowbar is used to make stones in a quarry (Fig.1.14).

(xv) Wooden Float: A wooden float is used to spread the mortar on the surface. It is also used to finish the coat of plaster. It is made of wood.

Rubble masonry

The stone masonry in which either undressed or roughly dressed stone are laid in a suitable mortar is called rubble masonry. In this masonry the joints are not of uniform thickness. In construction rubble masonry stones of irregular sizes are used. The stones as obtained from quarry are taken in use in the same or they are broken and shaped to suitable size by means of hammer as the work processed. The strength of rubble masonry depends upon the following three factors:

(i) The quality of mortar.
(ii) The use of long through h stones at frequent intervals.
(iii) The proper filling of mortar in the space between stones

Uncoursed random rubble masonry: The random rubble masonry in which stones are laid without forming courses is known as un coursed random rubble masonry. This is the roughest and cheapest type of masonry and is of varying appearance. The stones used in this masonry are of different sizes and shapes. before lying, all projecting corners of stones are slightly knocked off. Vertical joints are not plumbed, joints are filled and flushed. Large stones are used at corners and at jambs to increase their strength. Once "through stone" is used for every square meter of the face area for joining faces and backing.

Coursed random rubble masonry: The random rubble masonry in which stones are laid in layers of equal height is called random rubble masonry. In this masonry, the stones are laid in somewhat level courses. Headers of one coursed height are placed at certain intervals. The stones are hammer dressed.

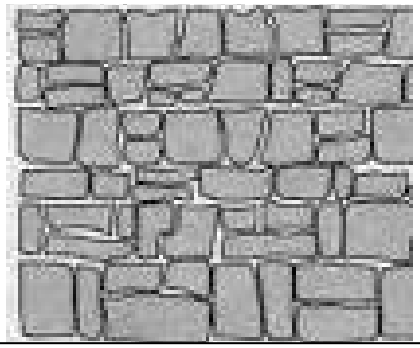

Fig.1.6: Coursed Rubble Masonry

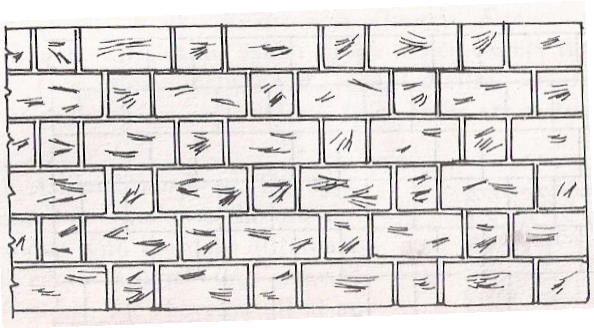

Fig.1.7: Coursed Rubble Masonry Class I

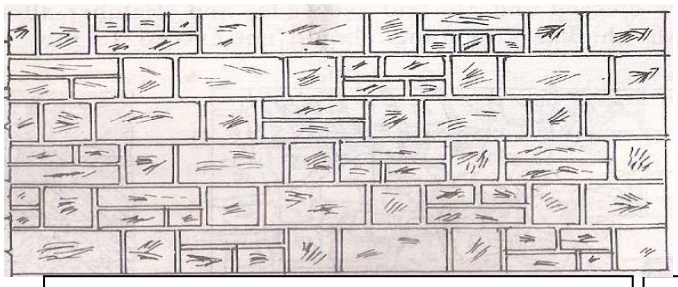

Fig.1.8: Coursed Rubble Masonry Class II

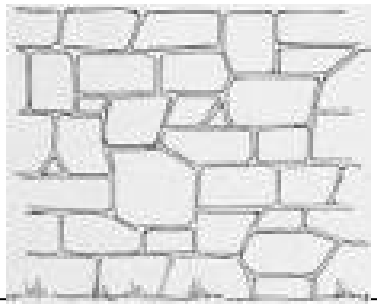

Fig.1.9: Uncoursed Rubble Masonry

Types of stones used in rubble masonry:

1. **Granite:** It consists of grains of quartz in combination with felspar and mica. These are the hardest types of stones and difficult to work with. They are available in various colors ranging from white to green. These are used for the construction of steps, walls, sills and as facing over other masonry.

2. **Sandstone:** They are made of quartz cemented by a matrix of silica. They also contain mica, felspar and oxides of iron. The colors of sandstones are due to the presence other minerals in them. They can be worked easily to take any ornamental shape. Their texture being coarse, they give a good appearance when used along with brick masonry. Colored sandstones are used in the face work of building to give architectural treatment. They are used for walls, columns, facing, steps, flooring, etc.

3. **Limestone:** These are calcareous rocks and consist of carbonate of lime. They are available in various colors and easy to work with. They are used for walls, floors, steps, etc.

4**. Marbles:** They are like limestone, are calcareous rocks and consist and consist of carbonate of lime. They are very useful material for flooring and monumental structures. Marble are available in various colors and can very good polish.

5. **Slates:** These are available in hilly areas and are metamorphic rocks. Generally they have a black color. Slates can be split in thin sheets along their bedding planes. They mostly used for roofing work.

6. **Basalt and trap**

The structure is medium to fine grained and compact. Their colour varies from dark gray to black. Fractures and joints are common. Their weight varies from 18 kN/m3 to 29 kN/m3. The compressive strength varies from 200 to 350 N/mm2. These are igneous rocks. They are used as road metals, aggregates for concrete. They are also used for rubble masonry works for bridge piers, river walls and dams. They are used as pavement.

7. Laterite

It is a metamorphic rock. It is having porous and sponges structure. It contains high percentage of iron oxide. Its colour may be brownish, red, yellow, brown and grey. Its specific gravity is 1.85 and compressive strength varies from 1.9 to 2.3 N/mm2. It can be easily quarried in blocks. With seasoning it gains strength. When used as building stone, its outer surface should be plastered.

Different types of plasters and mortar requirements for the rubble masonry works as per the specification and aesthetic requirements

- Masonry in cement / lime mortar : 1:8
- Masonry in cement / lime mortar : 1:6
- Masonry in cement / lime mortar : 1:4
- Masonry in cement / lime mortar : 1:2

Various types of cement paste / adhesives used on the base

Based on ISO 13007 -1:2004, adhesives fall into three major categories :

- Type C (Cementitious): Mixture of hydraulic binding agents, aggregates and additives; to be mixed with water or other liquid just before use.
- Type D (Dispersion): Ready -for-use mixture of binding agents in the form of polymer dispersion, additives and other mineral fillers.

- Type R (Reaction Resin): Single or multi-component mixture of synthetic resin, mineral fillers and other additives in which the curing occurs by chemical reaction.

Basic methods of stone work and finishing in rubble masonry

Stone masonry originated with dry-stacked stonework where the walls are carefully layed up without mortar. Gravity serves as the glue that holds everything together. Free-standing dry-stack stone walls are usually made larger at the base and then taper in slowly as the height increases. For absolutely no expense but the labor, farmers built miles upon miles of stone fences this way in the northeastern states.

Many old houses were built in a similar way. Where "mortar" was used, it was often merely mud or limestone plasters with little strength. The mortar functioned as caulking to stop the flow of air, rather than as cement to bond the stones together. Short, dry-stacked stone walls are especially ideal for landscaping projects. Taller walls require more skill and time.

Fig.1.9 Random rubble masonry finished wall

Procedure for preparation of sub base for random rubble masonry works

For constructing such a footing, a bed of lean cement concrete (1:8:16) is first laid over the entire length of the wall.

- The thickness of this lean concrete bed is usually kept 15cm and its width is kept 20 to 30 cm more than that of the bottom course.

- In no case, the depth of the concrete bed should be less than its projection beyond the wall base.
- For foundations over firm soil or compacted ground, the concrete bed below the brick wall footing may be dispensed with.
- After laying the concrete for constructing the concrete bed, it should be properly compacted and cured before laying the base course of the wall.

Procedure for performing visual checks on the materials used in random rubble masonry works.

- Materials Stones used in masonry shall be of approved quality locally available black trap. They shall be hard, sound and free from decay, weathering and fissures. Stones with round surface shall not be used.
- Cement Mortar Cement mortar shall meet the requirements of IS: 2250 and shall be prepared by mixing cement and sand by volume. Proportion of cement and sand shall be 1:6 (one part of cement and six part of sand) or as specified. The sand being used shall be sieved before use. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement, after the water is added to the dry mixture. Mortar unused for more than initial setting time or cement shall be rejected and removed from the site of work.
- The unit of measurement for cement shall be bag of cement weighing 50 KGs and this shall be taken as 0.035 cubic meter. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, it quantity shall be increased suitably to allow for bulk age.
- The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Engineer-In-Charge may however, permit hand mixing, as a special case, taking in to account the magnitude nature and location of work. The Contractor shall take the prior permission of the Engineer-In-Charge in writing, for using hand-mix, before the commencement of work.

Procedure for cutting stones to prepare for sides, edges and bed of random rubble masonry works.

Dressing Stone shall be hammer dressed on the face, the sides and the beds to enable it to come in proximity with the neighboring stone. The “bushing”

(projection) on the face shall not be more than 40 mm on an exposed face and 19 mm on the face to be plastered. It shall not have depression more than 10mm from the average wall surface. It shall also conform to the general requirements for dressing of stones covered in IS: 1129.

Procedure for preparation of mortar for random rubble masonry works.

Hand Mixing :

- The measured quantity of sand shall be leveled on a clean masonry platform and cement bags emptied on top.
- The cement and sand shall be thoroughly mixed dry by being turn over and over, backward and forward, several times till the mixture is of uniform color.
- The quantity of dry mix which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

Various techniques / procedures to work with undressed and hammer dressed stones used for un-course and course random rubble masonry.

Dressing Stone shall be hammer dressed on the face, the sides and the beds to enable it to come in proximity with the neighboring stone.

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Procedure for building of wall in coursed and un-coursed random rubble masonry.

All stones shall be wetted before laying to prevent absorption of water from mortar. The stones shall be laid so that the pressure is always perpendicular to the natural bed. The courses (if any) shall be built perpendicular to the pressure which the masonry will bear. In case of battered walls, the base of stone and plan of courses (if any) shall be at right angles to the batter. The walls shall be carried up truly plumbed or to the specified batter. Every stone

shall be carefully fitted to the adjacent stones, so as to form neat and close joints. Vertical joints shall be staggered as far as possible. Stone may be brought to level course at plinth, Window sills and roof level. Leveling up at plinth level, window sills and roof level shall be done with concrete comprising of one part of the mortar as used for the masonry and two parts of graded stone aggregate of 20mm nominal size. The bond shall be obtained by fitting in closely the adjacent stones. Transverse bonds shall be provided by the use of bond stones extended from the front to the back of the wall. At angular junctions the stones at each alternate course shall be well bonded into the respective courses of the adjacent wall. Face stones shall extend and bond well in the back. These shall be arranged to breaked joints as much as possible, and to avoid long vertical lines of joints. The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face. Where there is a break in the masonry work, the masonry shall be raked in sufficiently long steps for facilitating joining of old and new work. The stepping of the raking shall not be more than 45 degrees with the horizontal. The masonry work shall not be raised more than 1.2 meter per day. Toothed joints in masonry shall not be permitted. 3.1.3 Hearing of Chips The hearting or interior filling of the wall shall consist of rubber stones which may be of any shape but shall not be less than 150mm on any face. These shall be carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing, except that at about one meter intervals, vertical bonds stones shall be firmly embedded to form a bond between successive courses. 3.1.4 Insertion of Chips The chips and spalls of stones shall be used wherever necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are lefty anywhere in the masonry. The chips shall not be used below their hearting stone to bring these up to the level of face stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and this shall in no case exceed 20% of the quantity of stone masonry. 3.1.5 Bond Stone Bond or through stone running

across the thickness of wall shall be provided in the walls having thickness up to 600mm, two or more bonds stones overlapping each other by at least 150mm shall be provided in a line from face to back. At least one bond stone or a set of bond stones shall be provided for every 0.5 sq m courses and shall be staggered in subsequent course. An identification mark for the bond stones shall be given on both faces.

Quoins The quoins shall be of selected stones neatly dressed to the required angle and shall be of the same height as the course in which they occur and laid header and stretcher alternately. The quoin shall not be less than 0.03 cubic meters in volume. Jointing Stones shall be so laid that all joints are fully packed with mortar. Face joint shall be minimum 20mm thick. The joints shall be struck flush and finished at the time of laying; when plastering and pointing is not required. If walls are to be plastered or pointed, joint shall be raked to a minimum depth of 20mm during the progress of work when the mortar is still green. For the faces of the wall which are not to be plastered, stone surface shall be cleared of mortar splashing to give uniform stone appearance.

Importance of bond stones (through stones) and jambs at corners of random rubble masonry wall.

1. Individual stones shall have thickness and width of not less than 150 mm and length not less than 1.5 times its height. Stones shall be dressed with a mason's hammer by knocking off weak corners and edges. Face stone shall be so dressed that busing on the exposed face shall not project by more than 40 mm from the general wall surface. In case plastering is to be done, projection shall be limited to 19 mm and depression to 10 mm.
2. Bond or through stones shall be 2 piees (nos.) per sq.m. face area shall be 0.03 sq m and for full width of masonry for walls upto 600 mm stones shall be marked distinctly.

3. For massive work with a width of a meter and above, vertical header 450 mm long or with a depth of two courses whichever is more shall be provided at the rate of one for every sq m of area in the plan.
4. Quoins (corners) shall be dressed square to the face and rough tooled to 100 mm from face, and vertical joints dressed to 40 mm from face. No quoins shall be smaller than 0.025 cu m in volume and they shall also not be less than 300 mm in length , 25% of them being not less than 500 mm in length.
5. Hearting stone shall not be less than 150 mm in any direction. In walls upto 500 mm a minimum of 30% stone shall be 0.010 cu m (10 litres) For thicker walls minimum 30% stone shal be 0.015 cum (15 litres).
6. The jambs shall be made with stones specified for quoins except that stones provided on the jambs shall have their length equal to the thickness of the wall. For walls upto 600 mm, line of headers shall be provided as specified for bond.
7. A plum stone at about 900 mm intervals shall be provided.
8. Stones shall be laid with or without courses as specified. Quoins be laid header and stretcher alternatively. Laying shall be carefully done to form neat and close joints. Face stones shall extend and bond well in the back. These shall be arranged to break joints.

Procedure for laying course of dry rubble masonry works

- All stones shall be wetted before laying to prevent absorption of water from mortar.
- The stones shall be laid so that the pressure is always perpendicular to the natural bed.
- The courses (if any) shall be built perpendicular to the pressure which the masonry will bear. In case of battered walls, the base of stone and plan of courses (if any) shall be at right angles to the batter.
- The walls shall be carried up truly plumbed or to the specified batter.
- Every stone shall be carefully fitted to the adjacent stones, so as to form neat and close joints.

- Vertical joints shall be staggered as far as possible. Stone may be brought to level course at plinth, Window sills and roof level.
- Leveling up at plinth level, window sills and roof level shall be done with concrete comprising of one part of the mortar as used for the masonry and two parts of graded stone aggregate of 20mm nominal size.
- The bond shall be obtained by fitting in closely the adjacent stones. Transverse bonds shall be provided by the use of bond stones extended from the front to the back of the wall.
- At angular junctions the stones at each alternate course shall be well bonded into the respective courses of the adjacent wall.
- Face stones shall extend and bond well in the back. These shall be arranged to breaked joints as much as possible, and to avoid long vertical lines of joints.
- The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face.
- Where there is a break in the masonry work, the masonry shall be raked in sufficiently long steps for facilitating joining of old and new work.
- The stepping of the raking shall not be more than 45 degrees with the horizontal. The masonry work shall not be raised more than 1.2 meter per day.
- Toothed joints in masonry shall not be permitted.

Pointing tools : Pointing tools are used in masonry work for filling in small cavities and repairing crumbling mortar joints filling or grooving of joints in stone or brick.

Fig1.10 : Pointing Tools

Method of pointing

Fig1.11: Pointing wall

Pointing may be carried out either in lime mortar or in cement mortar. The materials for mortar are thoroughly mixed in dry condition on a impervious platform; water is then added and again it is thoroughly mixed. The quantity of mortar prepared should be such that it should be consumed within 30 minutes after adding water. Pointing is then carried out as follows :

Fig1.12: Pointing work

(i) Rake out the masonry joints at least up to a depth of 20 mm.
(ii) Remove the dust from masonry joints with a brush
(iii) Clean the surface with a water and keep it wet for few hours.
(iv) Apply the mortar in desired shape in prepared joints.
(v) The finished surface is kept wet for at least 3 days in case of using lime mortar and 7 days in case of using cement mortar.

Procedure for performing raking of joints for pointing in random rubble masonry works.

- The joints of masonry shall be raked at least 12mm deep whilst the mortar is green and not later than 48 hours of time of laying.
- The dust shall them be brushed out of the joints and the wall washed with water.
- The mortar shall be of specified mix.
- Mortar shall be filled into joints and well pressed with special steel trowels.
- The joints shall not be touched again after it has once begun to set.
- The joints of the pointed work shall be neat.
- The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or "V" as may be directed.
- No false joints shall be allowed. The work shall be kept wet for a week after the pointing is complete.

Different mortar mixes used for pointing in random rubble masonry

Replacement pointing mortars must be weaker than the masonry, perform against the weathering stresses on the wall in question and match the original un-weathered mortars in overall appearance and in particular characteristics. The style of the joint is critical as it must blend in with the bonding pattern (or arrangement of the stone and/or bricks). Permeability is of particular importance, as well as the mechanical properties of strength, flexibility, adhesion and durability. Don't specify the mixing of extremely complicated mortar, but make sure the aggregates are well-graded, with at least 50% of sharp, angular sand.

Procedure for preparation of lime/cement, mortar for pointing works.

Masonry walls need to be maintained and repaired, just as roofs and rainwater goods do. Where walls are solid, without a cavity, keeping them in good repair is necessary for the interior to remain functional and dry.

Pointing is the most common repair, and often one of the most poorly executed.

The two main reasons for lime-pointing repairs are:

- The original lime pointing has decayed over time and needs to be replaced. This may be the result of gradual decay through weathering, or failure as a result of poor maintenance. Blocked gutters or overflow pipes, for example, lead to damp masonry and can result in frost damage.
- The masonry has been re-pointed with a cement-based (or other inappropriate) mortar at an earlier date, which is causing problems to the building and/or the adjacent masonry and must be replaced with a more appropriate mortar.

Procedure for performing various pointing works on random rubble masonry, namely:

Flush pointing:

In This type of pointing mortar is pressed hard in the raked joints and by finishing off flush with the edge of masonry units. The edges are neatly trimmed with trowel and straight edge. It does not give good appearance. But, flush pointing is more durable because of resisting the provision of space for dust, water etc., due to this reason, flush pointing is extensively used.

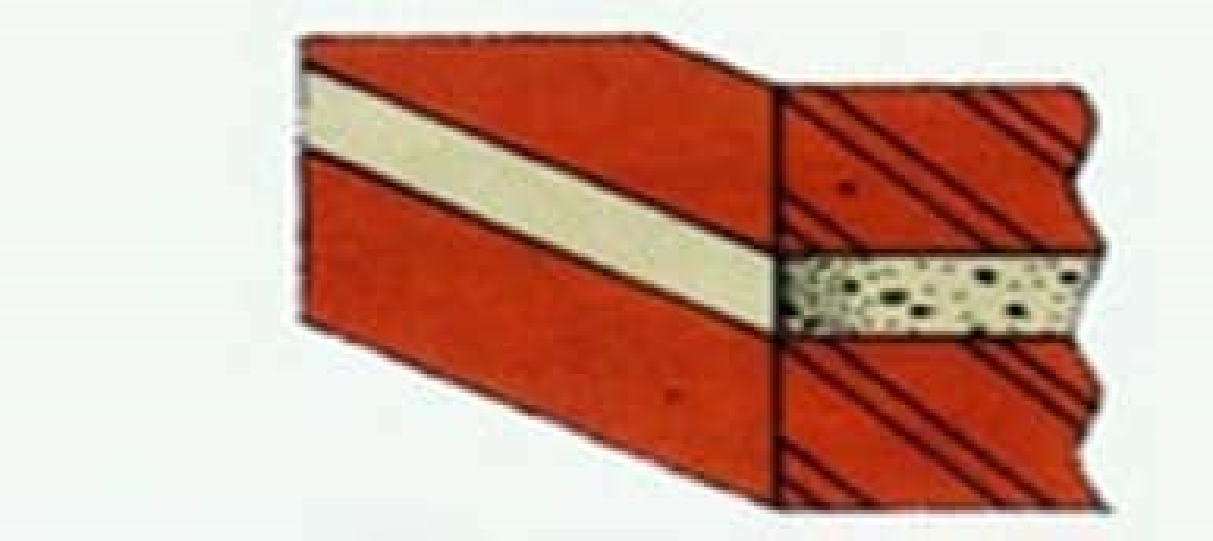


Fig 1.13 : Pointing

Weathered pointing- This pointing is made by making a projection in the form of V-shape.

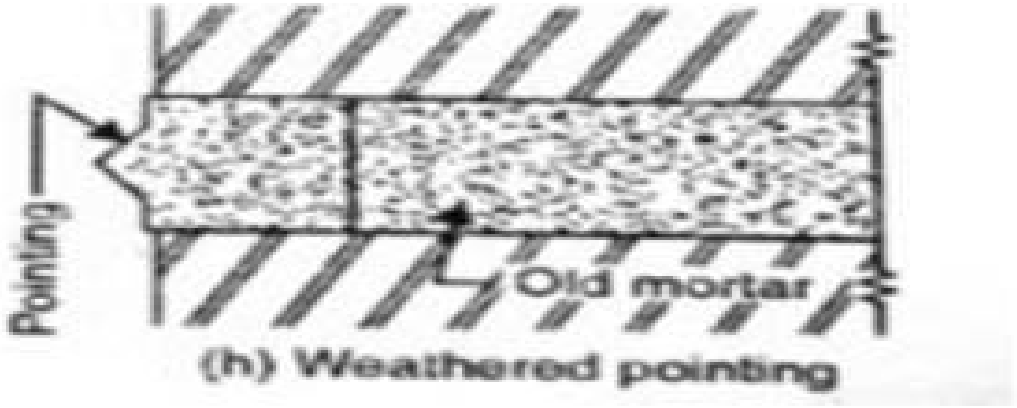


Fig1.14: Pointing surface in wall

CHECK YOUR KNOWLEDGE

1. What are the different types of coursed and uncoursed rubble masonry?
2. Enlist the tools used in stone masonry work.
3. Mention the cement paste / adhesives used in stone masonry work.
4. What is the importance of providing through stones in stone masonry?
5. Explain the procedure of construction stone masonry wall in coursed rubble masonry.
6. Enlist the tools used in pointing work with sketch.
7. Explain with sketch types of pointing work.
8. The thickness of mortar joint thickness in pointing work for coursed rubble masonry is ____ mm. (6, **15**, 20)
9. Write down the procedure of mixing cement mortar (1:3) for pointing work?

UNIT- 2: IPS / Tremix flooring

IPS flooring

IPS flooring stands for Indian patent stone flooring, it is a basic type of flooring which provides good wearing properties. It is generally used for all types of floors and mix of concrete used for IPS flooring specification is 1:1.5:3 (cement, sand and stone aggregates). As per the nature of use the flooring thickness of concrete is decided from 25 mm to 50 mm. It is laid over the concrete base (1:4:8), which is almost 3 to 4 inches thick plain cement concrete (PCC) base.
Thickness of the IPS flooring can be decide the as per the requirement of work; in residential floor 75 mm floor thickness is sufficient whereas industrial floor thickness should be kept 150 mm.

Preparation work before IPS flooring

- Prepare the sub-base by watering and ramming and ensuring no loose material are left. Level the surface and stone soling layer of 150mm to 230 mm to be provided as per the requirement.
- It is recommended to provide adequate slope in Plain cement concrete (PCC) in a base course as it will not be possible to maintain slope in IPS layer due to limited thickness.
- Door frames should be fixed prior to flooring work.

Procedure of IPS flooring

- First of all make reference level on the wall transfer this marking to all location where flooring to be done with help of water level tube.
- Ensure there is no air bubble present in water and then it is exactly matching the water level while keeping both end together. Reference mark is to be transferred on all across the flooring area and it should be marked permanently with the help of line marker.
- Flooring thickness level to be marked and dummy level dots provided in every 1 or 2 meter ensuring required slope of flooring.
- After proper setting of these dummy concrete dots. Concrete in specified mix should be poured in panels to minimize shrinkage cracks. The size of panel should not exceed more than 3 square meters for indoor and 2 square meter for outdoor flooring.
- Glass, aluminum or brass strip are fixed in cement mortar with their tops at proper level according to slope and allowed to harden for minimum 36 hours.

- After pouring of concrete, surface to be levelled with a Straight Edge and finished with a wooden float or trowel.
- The final troweling should be done before the concrete has become hard and sufficient pressure is required to make firm impression on the concrete surface.
- There should not be any mark left on the finished surface and care should be taken that no cement slurry spread on the surface.
- If glossy or smooth IPS flooring surface required then neat cement punning, 2 to 3 mm thick is spread over the IPS concrete surface and allowed to soak into the concrete. The surface is finished with metal trowel 3 to 4 times to give surface a glossy look.
- For curing of IPS concrete flooring surface pond or wet Hessian clothes are spread over surface for 15 days.
- If required, Vacuum dewatered machine to be used for big work to give surface smooth and better finish. This not only prevents concrete surface cracks but also increase the abrasion resistance of IPS concrete surface.
- Further to avoid surface cracks, polyurethane fibres are added to concrete, in small portion. This type of concrete is also called **Ferro cement concrete**.
- The casting of concrete flooring in panels to avoid shrinkage cracks and work as expansion joint. Therefore it is advisable to use Tremix flooring especially when large areas like platform surface, pavements and industrial flooring are to be done.

Tremix flooring

Tremix flooring method is defined as Vacuum Dewatered Flooring. It is a special type of flooring technique to achieve high strength, longer life, better finish and faster work. Tremix system also known as Dewatering System. It is used in making Industrial floors, Concrete roads, Runways, Railways Platforms, Warehouse container Yards, Canal Lining, Pathways, Bridges, RCC Roads etc. In this process dewatering of concrete is done by Vacuum Process wherein surplus water from the concrete is removed immediately after placing and vibration. There by reducing the water cement ratio to the optimum level. Tremix flooring increases the compressive strength, tensile strength and abrasion resistance and minimizes the shrinkage and floor wraps. This type of floor is suitable for high abrasion & heavy traffic movement areas floor in factories and industries have concrete being the most versatile of flooring material has been in use for a long time. To overcome the deficiencies of concrete a system was devised to improve the properties of such concrete floors.

Tremix flooring is a special type of flooring mostly being done in the industrial sector. It is generally used for industrial purposes where rigid surface necessary for machine foundation, light load carrier vehicle and light weight cranes. By this method economic high quality concrete floors can be laid.

This method improves the properties of concrete floors. Tremix flooring is also known as vacuum dewatering flooring, since in this method vacuum treatment is done to remove the surplus water from the concrete.

With the industrial revolution all over the world, the floor construction has been on the serious concerns of Architect, Engineers and users. A high quality concrete floors not only be levelled perfectly but also it should have high compressive strength with minimum cost. In this flooring the water/cement ratio is drastically reduced after placing. A lowered water/cement ratio automatically leads to noticeable improvement of almost all properties of concrete.

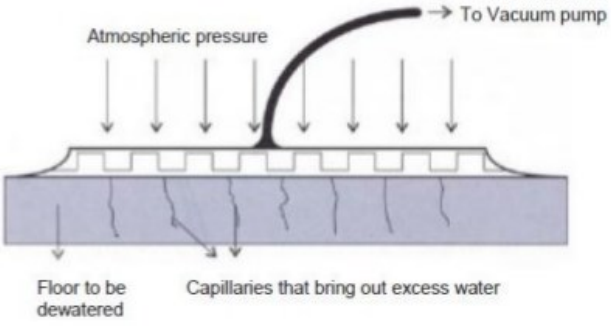


Fig 2.1: Schematic showing vacuum dewatering process

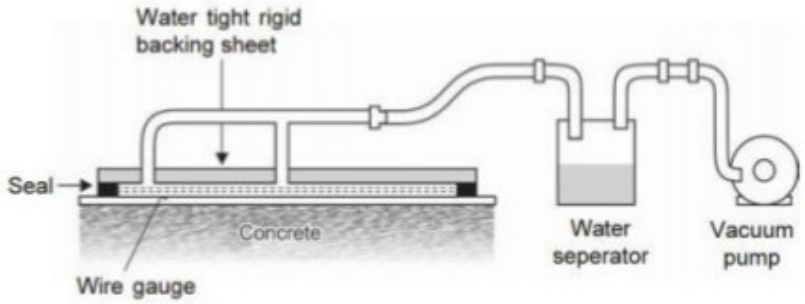


Fig:2-Vacuum dewatering of concrete

Fig 2.2: Vacuum De watering of Concrete

This technique is effectively used in industrial floors, parking lots and deck slabs of bridges etc. By the adoption of Tremix vacuum flooring. more workable concrete floors can be done than the normal flooring.In this above

figure the dewatering by using vacuum pump is being done, excess water is sucked through capillaries. Filter mat medium is used at the time of dewatering to prevent entry of cement other finer particles. Vacuum pump is connected on the top mat then process de watering is started and water is removed from the concrete floor/slab.

Tools and materials required

All mason tools and tackles required to available at site. However some special tools required as follows;

1. Vacuum de-watering pump
2. Floater machine
3. Tremix skin
4. Double beam screed vibrator

Vacuum de-watering pump

Vacuum de-watering machines removes excess water from the top layer of wet concrete without removing the cement of sand particles. Vacuum Pump is used to suck all the air bubbles that may have trapped during the laying of the concrete. A continuous discharge vacuum pump is a completely self contained unit. Two number of matted areas can be dewatered in one single operation. The pump is powered by 7. 5 hp 3 phase electric motor.

Fig.2.3: Vacuum de watering pump

Vacuum Pump is used to reduce water content in the concrete by l5-25‘Zé. The dewatered concrete is compacted and dried. Vacuum Pump is used to suck all the air bubbles that may have trapped during the laying of the concrete. It shows the cement to come up to upper layers and hence gives a superior strength to the floor. The three mats: filter mat, suction mat and top mat and these mats do not allow cement to come up but only sucks the extra water. Top mat size is 4.5 m x 5.5 m During working. it eludes a vacuum pressure of 450-500 mm/Hg. Maximum pump pressure which can be developed is 650 mm/Hg. It is powered by 7.5 HP motor.

Floater machine: This machine is used for rubbing and smoothing the surface area. Floating and Troweling take place right after dewatering. Floating operation is done with Floating disc. This makes the cement more compact and enabling to generate a wry smooth finish. Trowelling is done with Trowel blades in order to further improve the wear resistance, minimize dusting and obtain smoother finish. Important features of floater machine are as:

- Two speed operation for electric version.
- Dead man's grip for operator safety
- Adjustable and foldable handle
- Dual function ~ floating and trowelling
- Easy change over from disc to blades
- Blade angle adjustable while machine is in operation
- All controls on handle, easily accessible.
- Also ideally suitable for Epoxy Screed finishing.
- Available in two diameters 900 mm and 700 mm.

Fig.2.4: Floater Machine

3.Tremix screen

Vacuum is immediately created between the filter pads and the top cover. Atmospheric pressure compresses the concrete and the surplus water is squeezed out. Suction mat of special grade multilayered polymer sheets along with reinforced distance cushions on the Filter pads ensure sufficient cross-sectional area to squeeze out and remove excess water from the concrete. This design is a prerequisite for effective dewatering.

Fig 2. 5: Trimix skin (Top mat)

4. Double beam screed vibrator

Double beam screed vibrator consists of a Beam unit and a Vibrator unit. Double beam screed vibrator is used to vibrate the concrete to give a compact and leveled surface. These vibrators are self-travelling and only require guiding along the formwork, dragged at ends by two operators without working in the concrete. It is manufactured from M.S. channel or box pipe for durability. To get a really levelled & durable concrete surface the concrete should be compacted and levelled with Double Beam Screed Vibrator.

- Made from light weight hollow alluminium alloy beams.
- Vibrations adjustable from 30 to 100 %.
- Suitable for concrete depths up to 300 mm in conjunction with poker vibrators.
- Tensioning device for level correction.
- Specially designed vibrator motor and switches for operator safety.
- Sacrificial end ties for longer beam life

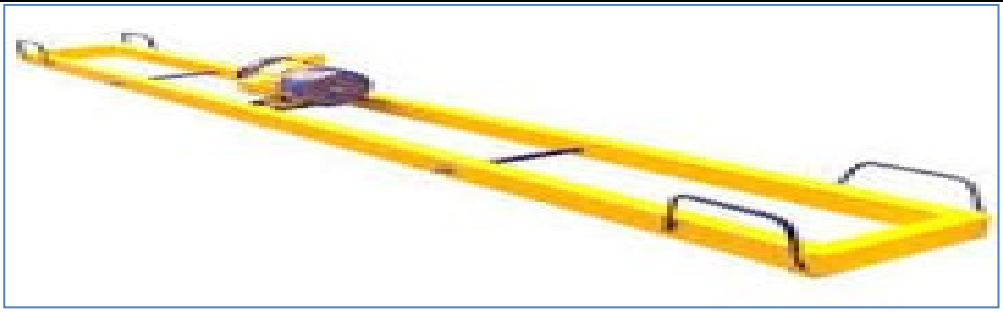


Fig.2.6 : Double beam screed Vibrator

Flooring procedure

- Prepare the sub-base by watering and ramming, properly ensure no loose material are left. Level the surface and lay 230 mm to 300 mm stone soling/boulder soling layer of 150 mm shall be provided and compacted properly.

- Floor slope should be maintained in PCC work, which shall be laid above the stone soling. Thickness of PCC shall be kept 100 mm.

Fig 2.7 : Termix laying

- Tremix has to be done in panel and each panel shall be of 3.5 meter and appropriate reinforcement bar shall be laid in layer of two or one keeping the concrete cover of 50 (it may differ as per standard).

- Vacuum de-watering machines are useful, which removes excess water from the top layer of wet concrete without removing the cement of sand particles. This is done soon after concerting, ramming or vibrating with screed vibrator and levelling first round troweling, when the concrete is fresh. It will not only increase the strength of the concrete but also increase abrasion resistance of the floor, also it is always good if hardener to be used to increase abrasion resistance of floor while using floater machine at the time of finishing the floor surface. Shrinkage cracks are also minimized by using this system. Further to avoid shrinkage cracks and increase the abrasion floor hardener and polyurethane fiberes are added to concrete in small amount. The quantity of the fibers and hardener are prescribed by the manufacturers.
- Casting of concrete flooring in panels to avoid shrinkage cracks and work as expansion joints, it is slow and time consuming process, especially when large area are to be floored. The concrete lay in panels without construction joint, then after panel joints shall be cut with help of cutting saw after 7 to 10 when concrete is not fully hardened. The gap so created is filled with poly sulfide or sealants.

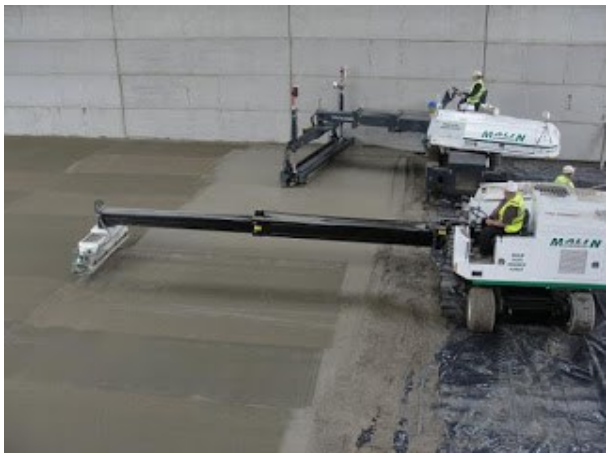


Fig 2.8 : Laying tremix

Steps for laying Tremix

- First tying line threads as per the slope requirements
- Laying guide rail to every 4 meters using MS channels or as required in straight lines along the line thread, taking levels as per the slope and fixing them using concrete also called grouting and left to set for a minimum of 24 hours
- Pouring the concrete in between the channels and spreading using shovel or hoe
- Vibrating the concrete with a poker vibrator especially to the sides of the panels
- Surface Vibration the concrete using Double Beam Screed Vibrator running over the guide rails twice to achieve maximum compaction for RCC with double mats
- Final leveling of the concrete using the straight edge.
- De-watering by vacuum pump.
- Application of power floater on the surface until the surface is sufficiently compacted and levelled with no major lines appearing any more
- Final finishing using Power Trowel and trowelling untill the required finish is achieved. Finish could be any of the smooth finish, sand finish or Line Finish.

Procedure for making Tremix

Generally the mix of concrete used for Tremix is l: 1:5:3 (l cement: 1.5 sand m and 3 stone aggregates) mostly rich mix of l:l:2 preferred for better wear and tear. ln this flooring necessary reinforcement provides depending upon the thickness of the flooring, whereas the thickness of concrete is decided from 100 to zoo mm over PCC t 1:4:8) and well prepared stone soling base ranging from 230 to 300 mm. ln industrial flooring PCC base should be kept

up to l00 mm and same as floor concrete 150mm. It may be satisfactory for heavy duty was such as warehouses, garage and machine shops. The key of the method is dewatering concrete by the vacuum process. Through vaccum dewatering the surplus water is removed from the concrete, which means that water cement ratio automatically leads to a noticeable improvement of almost each of the concrete properties.

Immediately after vacuum dewatering the flatness of the concrete surface is checked and adjusted with a control tool and the finishing operation with a power trowel can start.

Vacuum pump is used for the dewatering process a top cover and filter pads. The top cover is made of special reinforced airtight plastic sheet with a suction channel on the bottom side. It is provided with two lifting tubes which makes it easier to unroll the top cover to the required length. The filter pad is made of perforated plastic sheet with distance cushions on the top side. It acts as a filter between the fresh concrete and the top cover.

Fig2.8 and2.10 :

Fig:7-The filter pads are placed so that there will be a sealing edge around the entire filter pad surface

Fig. 2.11: The top cover is unrolled over the filter pads

After compaction by surface vibrator, filter pad are placed leaving all sides. The top cover is then placed on the filter pods and rolled out till it covers the strips of exposed concrete on all sides.

The Top cover is then connected to the vacuum pump through a suction hose and the pump is started. Vacuum is immediately craned between the filter pads and the top cover.

Fig.2.12 : Top cover is connected to the suction of the vacuum pump. It is important to check that top cover seals against the fresh concrete outside the filter pads

Fig.2.13: While vacuum is on, surface that has already been vacuum dewatered is floated with a power trowel fitted with a disc

The finishing operation Floating & Trowelling take place right after de watering. Floating operation is done with Floating disc. This ensures after mixing of' sand & cement particles. Further compaction and closing the pores on the surface. Floating operation generates skid-free finish. Trowelling is done with trowelling blades in order to further improve the wear resistance, minimize dusting and obtain smoother finish

Tremix vacuum system stages

In the figure 11, we can understand easily the procedure of the tremix vacuum system. Construction is divided in to different stages like clearing, placing of reinforcement, placing of concrete, leveling and compacting by using double beam screed vibrator, placing of the mats, de watering is done by vacuum de-watering pump and top mat (Tremix skin). Finishing works are to be carried out by using Floater machine and Trowelling machine.

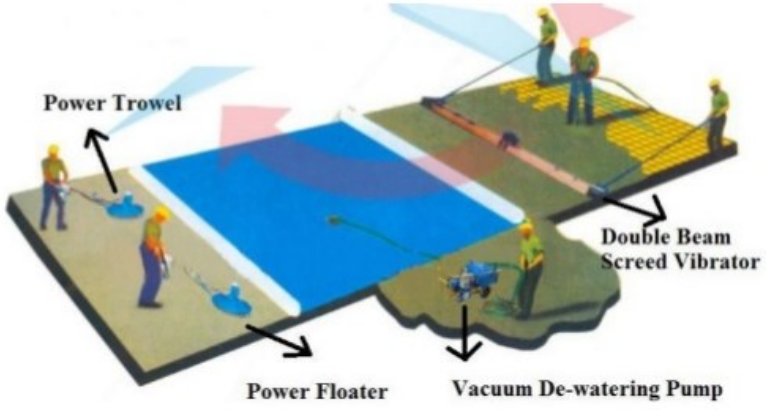


Fig.2.14 : Tremix vacuum system stages

Need of vacuum dewatering concrete flooring

l) The mixing water added to a concrete mix exceeds the amount of water required to fully hydrate the cement constituent.

2) The additional water functions as a lubrication medium to allow mixing, placing. leveling and consolidation. In conventional concreting practice, an important challenge is the prevention or limiting of evaporation of mixing water out of the freshly placed concrete.

3) The uncontrolled removal of water from the concrete matrix can result in adverse effects such as plastic shrinkage cracking. Excessive bleeding of concrete can negatively interfere with surface characteristics such as resistance to wear. Thus the durability and service life of the flooring

element is in question. Concreting in areas exposed to the elements, specifically in hot and windy conditions poses even higher demands in order to produce quality , durable concrete.

Advantages and disadvantages

1. Reduction in W/C ratio leads to early setting and high strength.
2. This system removes the excess water after pouring of the concrete & thus an ideal water cement ratio can be achieved
3. Increase in compressive strength of concrete by 40-70%.
4. The surface hardness of the slab increases by l30% .
5. Water absorption is reduced enormously.
6. Minimum dusts.
7. Level floor, high flatness accuracy.
8. Minimized crack formation. Shrinkage reduced by 50%.
9. Improved wear resistance.
10. Elimination or minimization of overtime.
11. High and early strength. minimize damage to newly cast floors.
12. Void-freed and denser concrete.

Disadvantage of vacuum die-watering confide flooring method

1. High initial cost.
2. Need trained labour for the vacuum dewatering process.
3. Need specific equipment for vacuum dewatering like vacuum pump.
4. Need power consumption during dewatering process

Typical application areas

1. Warehouses
2. Roads. Sports Courts
3. Cellars. Parking Areas
4. Production Areas.
5. Industrial Shop floors

CHECK YOUR PROGRESS

Answer the following:

1. What is the use of vacuum de-dewatering pump and screen vibrator?
2. Enlist the different types of aggregates with their uses.
3. Give the different grades of concrete used for flooring work.
4. What are the various admixtures used in concreting?

5. Which are the different types of vibrators used for concrete?
6. Explain the different types of construction and expansion joints.
7. Enlist the hardeners used in IPS and Tremix flooring.

Fill in the blanks:

1. The thickness of Tremix floor is ____ mm.
2. The binding material used in concrete is _____.
3. ____ tool is used to remove air bubbles from wet concrete.
4. Concrete cover for reinforcement is required to protect the rebar against .....

Multiple choice Questions:

1. Bricks shall have maximum crushing strength of

a) 10.5 N/mm^2. b) 12.0 N/mm^2. c) 10.0 N/mm^2. d) 11.5 N/mm^2.

2. For Beam the nominal cover should not be less than

a) 30 mm b) 25 mm c) 35 mm d) 40 mm

3.W/C ratio should be kept

a) 0.3-0.5 b) 0.2-0.6 c) 0.25-0.55 d)0.4-0.5

4. When the aggregate is sieved through 4.75mm sieve, the aggregate retained is called

a) coarse aggregate b) Fine aggregate c) Random aggregate d) None

Unit 3 : Rate Analysis of different items of work

Analysis of Rates

Definition: In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis.

The rate of particular item of work depends on the following.

1. Specifications of works and material about their quality, proportion and constructional operation method.
2. Quantity of materials and their costs.
3. Cost of labour and their wages.
4. Location of site of work and the distances from source and conveyance charges.
5. Overhead and establishment charges
6. Profit

Cost of materials at source and at site of construction.

The costs of materials are taken as delivered at site inclusive of the transport local taxes and their charges.

Purpose of Analysis of rates:

1. To work out the actual cost of per unit of the items.
2. To work out the economical use of materials and processes in completing the particulars item.
3. To work out the cost of extra items which are not provided in the contract bond, but are to be done as per the directions of the department.
4. To revise the schedule of rates due to increase in the cost of material and labour or due to change in technique.

Cost of labour -types of labour, standard schedule of rates

The labour can be classified in to

1) Skilled 1st class

2) Skilled IInd Class

3) un skilled

The labour charges can be obtained from the standard schedule of rates 30% of the skilled labour provided in the data may be taken as Ist class, remaining 70% as II class. The rates of materials for Government works are fixed by the superintendent Engineer for his circle every year and approved by the Board of Chief Engineers. These rates are incorporated in the standard schedule of rates.

Lead statement: The distance between the source of availability of material and construction site is known as "Lead" and is expected in Km. The cost of conveyance of material depends on lead. This statement will give the total cost of materials per unit item. It includes first cost, conveyance loading, unloading stacking, charges etc. The rate shown in the lead statement are for metalled road and include loading and staking charges. The environment lead on the metalled roads are arrived by multiplying by a factor :

a) for metal tracks - lead x 1.0

b) For cartze tracks - Lead x 1.1

c) For Sandy tracks - lead x 1.4

Note: For 1m3 wet concrete = 1.52m3 dry concrete approximately

SP. Wt of concrete= 1440 kg/m3 (or) 1.44 t/m3

1 bag of cement = 50 Kg

Calculations of materials for various items of works

Example 1:- Calculate the Quantity of material for the following items.

a) R.C.C. (1:2:4) for 20 m^3 of work

b) R.C.C. (1:3:6) for 15 m^3 of work

a) Quantity of cement required = (1: 2 : 4)

1) For 10 m^3 of wet concrete = 15.20 m^3 of dry cement concrete

Add, 1 + 2 + 4 = 7

Qty. of Cement $= \frac{20 \times 15.20}{10 \times 7}$ = 4.34 m^3 x 30 nos =130.20 bags

2) Quantity of Sand required = 2× 4.34 = 8.68m^3

3) Quantity of coarse aggregate = 4 x 4.34 = 17.36 m^3

a) Quantity of cement required in bags
1) For 10 m^3 of wet concrete = 15.20 m^3 of dry cement concrete

Add, 1 + 3 + 6 = 10 = Volume

Qty. of Cement $= \frac{15 \times 15.20}{10 \times 10}$ = 2.28 m^3 x 30 nos (1m^3 of cement = 30 nos.)

= 68.40 bags

2) Quantity of sand required

3 x 2.28 = 6.84 m^3

3) Quantity of Coarse Aggregates required

6 × 2.28 = 13.68 m^3

Example 2:-Calculate the Quantity of Cement required in bags for the following items.

a) Brick Masonry in CM (1:3) for 15 cum of work using
For 1m^3 of brick work 0.3 m^3 of C.M. required

Sol : a) 10 m^3 of Brick work = 3 m^3 of dry Cement Mortar (1 : 3) required.

For , 15 m^3 of Brick work = $\frac{15 \times 3}{10}$ = 4.5 m^3

1) Quantity of cement required in bags
$= \frac{4.5}{1+3}$
= 1.125 m^3
= 1.125 x 30 (1m^3 = 30 bags)

= 30.75 bags

2) Quantity of sand required

= 3 x 1.125

= 3.375 m^3

3) Quantity of Bricks required =

For, 10 m^3 of brick work = 5000 nos required

For, 15 m^3 of brick work = 7500 nos required

Or (METHOD 2)

1) Quantity of Bricks required =

Standard size of brick = 19 cm x 9 cm x 9 cm

Standard size of brick with mortar = 20 cm x 10 cm x 10 cm (as 1cm mortar thickness)

Qty. of bricks = $\frac{15}{0.20 \times 0.10 \times 0.10}$

= 7500 nos required

Actual volume of bricks = 7500 x .19 x .09 x .09

= 11.54 m^3

Qty. off mortar required = 15 - 11.54

= 3.46 m^3

Add 15 % for wastage = 3.46 x 15/100 + 3.46

= 3.979 m^3

Add 1/4 for dry volume = 3.979 x 1/4 + 3.979

= 4.97 m^3

2) Quantity of cement required in bags

$= \frac{4.97}{1+3}$

= 1.24 m^3 = 1.24 x 30 (1m^3 = 30 bags)

= 37.27 bags

3) Quantity of sand required

= 3 x 1.24

= 3.72 m^3

Example 3:-

Calculate the quantity of cement required in bags for the following items of work.

a) R.C.C. (1:4:8) use, 40mm HBG metals for 30 m^3 of work

b) RR masonry in CM (1:5) for 20 m^3 of work

Solution :

a) Quantity of cement required = RCC (1: 2 : 4)

1) For 10 m^3 of wet concrete = 15.20 m^3 of dry cement concrete,

For 30m^3= ?

Add, 1 + 2 + 4 = 7

$= \frac{30 \times 15.20}{10 \times 7}$= 6.51 m^3 x 30 nos

=195.42 bags

2) Quantity of Sand required =

2× 6.51 = 13.02 m^3

3) Quantity of coarse aggregate = 4

4 x 6.51 = 26.04 m^3

b) 1m^3 of Random Rubble masonry = 0.34m^3 of CM (1:5) for, 20 m^3 of Random Rubble masonry required = ? 20 x 0.34= 6.80 m^3

1) Quantity of cement required ,

$= \frac{6.80}{6}$ = 1.13m^3 x 30 bags = 34 bags

2) Quantity of Sand required =
1.13 x 5 = 5.65 m^3

3) Quantity of stones required =
For, 10 m^3 of stonework = 12.50 m^3 stones required.
For, 20 m^3 stonework = 25.00 m^3 stones required.

Example 4:-Calculate the Quantity of UCR masonry in C.M. (1:6).

Sol : a) 10 m^3 of stone work = 12.50 m^3 stones required.

For , 10 m^3 of stone work = 4.0 m^3 dry cement mortar required.

1) Quantity of cement required in bags

$$= \frac{4.0}{1+6}$$

= 0.571 m^3

= 0.571 x 30 ($1m^3$ = 30 bags)

= 16.32 bags

2) Quantity of sand required

= 6 x 0.571 = 3.4265 m^3

Example 1:-Prepare rate analysis for 1st class brickwork in superstructure with 20 cm x 10 cm x 10 cm brick size with CM. (1:6)

Solution : Take 10 cu. M of brickwork

Rate Analysis for Brickwork (1:6) **use unit = 1 m^3**

A) Cost of Materials					
Sr. No.	Particulars	Quantity (Rs.)	Rate	Per	Amount (Rs.)
1.	Brick	5000	6	No.	30000
2.	Cement	(0.45 cu. M.) 13.50 nos.	300	bag	4050
3.	Sand	2.70	1500	M^3	4050
				Total	**38100/-**
B) Cost of Labours					
Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Head Mason	1	600	day	600
2.	Mason	10	500	day	5000
3.	Mazdoor (male)	7	350	day	2450
4.	Mazdoor (female)	10	300	day	3000
5.	Bhisti	2	300	day	600
6.	Scaffolding	Lumpsum	400	L.S.	400
7.	Sunderies T & P	Lumpsum	200	L.S.	200
				Total	**12250/-**
				Total (A + B) Rs.	**50350/-**

Water charges 1.5 %	755
Contractor's Profit 10 %	5035
Grand Total Rs.	**56140 /-**

Rate per cu. m. for brickwork = $\frac{56140}{10}$ = 5614 /- (Rs.) per cu.m.

Example 2 :- Prepare rate analysis for 12 mm thick cement plaster in cement mortar (1:6) in superstructure for 100 sq.m.

Solution :

Rate Analysis for Cement Plaster Take unit = 100 sq. m.

A) Cost of Materials					
Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Cement	09 (0.30 cu.m)	300	Bag	2700
2.	Sand	1.80 cu. M.	2250	M^3	4050
				Total	**6750/-**
B) Cost of Labours					
Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Head Mason	1/3	600	day	200
2.	Mason	10	500	day	5000
3.	Mazdoor (male)	15	350	day	5250
4.	Bhisti	2	300	day	600
5.	Scaffolding	L.S.	400	L.S.	400
6.	Sunderies For tools and plants	L.S.	200	L.S.	200
				Total	**11650/-**
				Total (A + B) Rs.	**18400/-**

Water charges 1.5 %	276
Contractor's Profit 10 %	1840
Grand Total Rs.	**20516/-**

Rate per sq. m. for Cement Plaster = $\frac{20516}{100}$ = 205.16 /- (Rs.) per sq. m.

Example 3 :- Prepare rate analysis for cement pointing in cement mortar (1:2) in superstructure for 100 sq.m.

Solution :

Rate Analysis for Cement Pointing Take unit = 100 sq. m.

A) Cost of Materials					
Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Cement	06	300	Bag	1800

		(0.20 cu.m)			
2.	Sand	0.40 cu. M.	2250	M^3	900
				Total	**2700/-**
	B) Cost of Labours				
Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Head Mason	1/3	600	day	200
2.	Mason	10	500	day	5000
3.	Mazdoor (male)	10	350	day	3500
4.	Bhisti	2	300	day	600
5.	Scaffolding	L.S.	400	L.S.	400
6.	Sunderies For tools and plants	L.S.	200	L.S.	200
				Total	**9900/-**
				Total (A + B) Rs.	**12600/-**

Water charges 1.5 %	189
Contractor's Profit 10 %	1260
Grand Total Rs.	**14049/-**

Rate per sq. m. for Cement Pointing $= \frac{14049}{100}$ **= 140.49/- (Rs.) per sq. m.**

Example 4 :- Prepare rate analysis for 2.5 cm., thick cement concrete floor, (1:2:4) for 100 sq.m.

Solution :

Rate Analysis for Cement concrete floor Take unit = 100 sq. m.

	A) Cost of Materials				
Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Stone ballast (20 mm gauge)	2.40 cu m.	2000	Cu m.	4800
2.	Sand	1.20 cu. m.	2250	M^3	2700
3.	Cement	18 nos. (0.60 cu.m)	300	Bag	5400
4.	Cement for surface finishing	06 nos. (0.20 cu.m)	300	Bag	1800
				Total	**14700/-**
	B) Cost of Labours				
Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Head Mason	3/4	600	day	450
2.	Mason	10	500	day	5000

3.	Mazdoor (male)	05	350	day	1750
4.	Mazdoor (male)	05	300	day	1500
5.	Bhisti	2	300	day	600
5.	Side forms	L.S.	400	L.S.	400
6.	Sunderies For tools and plants	L.S.	200	L.S.	200
				Total	**9900/-**
				Total (A + B) Rs.	**24600/-**

Water charges 1.5 %	369
Contractor's Profit 10 %	2460
Grand Total Rs.	**27400/-**

Rate per sq. m. for Cement Concrete floor = $\frac{27400}{100}$ = 274 /- (Rs.)

Example 5 :-Prepare rate analysis for Coursed rubble stone masonry with CM. (1:6) in superstructure.

Solution : Take 10 cu. M of C.R. stone masonry

Rate Analysis for Coursed rubble masonry (1:6) use unit = 10 m³

A) Cost of Materials

Sr. No.	Particulars	Quantity (Rs.)	Rate	Per	Amount (Rs.)
1.	Stone	12.50 cu. M.	1500	No.	18750
2.	Cement	(0.60 cu. M.) 18 nos.	300	bag	5400
3.	Sand	3.60 cu.m.	1500	M^3	5400
				Total	**29550/-**

B) Cost of Labours

Sr. No.	Particulars	Quantity	Rate	Per	Amount (Rs.)
1.	Head Mason	1/2	600	day	300
2.	Mason	16	500	day	8000
3.	Mazdoor (male)	16	350	day	5600
4.	Mazdoor (female)	8	300	day	2400
5.	Bhisti	2	300	day	600
6.	Scaffolding	Lumpsum	400	L.S.	400
7.	Sunderies T & P	Lumpsum	200	L.S.	200
				Total	**17500/-**
				Total (A + B) Rs.	**47050/-**

Water charges 1.5 %	705
Contractor's Profit 10 %	4705
Grand Total Rs.	**52460 /-**

Rate per cu. m. for brickwork $= \frac{52460}{10} =$ **5246 /- (Rs.) per cu.m.**

CHECK YOUR PROGRESS

Answer the following:

1. Define the term rate analysis and mention its purposes.
2. What is the importance of rate analysis?
3. What are the essentials necessary for the person carrying out the rate analysis?
4. What is meant by the standard costing?
5. What does the task work per day represent? How is it calculated?
6. Describe the factors affecting the rate analysis of an item.
7. Work out the rate analysis of the following items:
    i) R.C.C work for beams proportion (1:2:4) with steel reinforcement
    ii) Brickwork in II class in c.m. (1:6) upto plinth
    iii) Cement plaster 12 mm thick in c.m. (1:4)

Fill in the blanks:

1. one bag of cement weighs ____ kg.
2. For 1m3 wet concrete approximately _____dry concrete is needed.
3. ____ % of total cost is added for contractor's profit.
4. Labor which carries water during construction work is called as .....

Multiple choice Questions:

1. The expected out turn of 2.5 cm cement concrete floor per mason per day

a) 2.5 sqm b) 5.0 sqm. c) 7.5 sqm. d) 10 sqm.

2. The order of booking dimensions is

a) Length, breadth, height b) Breadth, length, height

c) Height, breadth, length d) None of these.

3. Brick walls are measured in sq. m if the thickness of the wall is

a) 10 cm b) 15 cm c) 20 cm d) 25 cm

4. For 12 mm thick cement plastering 1: 6 on 100 sq.m new brick work, the quantity of cement required, is

a) 0.200 m3 b) 0.247 m3 c) 0.274 m3 d) 0.295 m3

UNIT 4: Plan and organize work to meet expected outcomes

Work effectively in a team :

While working in team fallowing skills should be developed.

Communication Skill

Method of oral and written communication skills with co-workers, trade seniors while handling and carrying out visual checks on various power or hand tools such as power saw, power wet saws, vibrators, tile cutters etc.

Listening Skills

Being able to listen and take instruction are critical to the construction worker. Having good listening skills allows the construction worker to receive the direction he needs to complete his tasks. A construction worker who doesn't include good listening skills in his work repertoire will quickly find himself without a job. If the construction worker is unclear about a directive, he must be able to interpret that quickly and ask the questions on which he needs clarification to complete his job successfully.

Reading Skills

As part of the communication process in construction, a construction worker reviews blueprints that describe how the job must be completed. A construction worker needs to be able to effectively read and interpret the blueprints to know how to meet engineer or code specifications. Without reading communication skills, a construction worker cannot complete the work he is assigned.

Vocabulary Skills

A construction worker needs to have a working knowledge of the vocabulary associated with his particular discipline. He needs to know and understand the proper names of tools, processes, methods and techniques used by the construction trade in which he works. For instance, if he is a carpenter, he needs to understand the terms used when framing, such as the meaning of toe-nail, hip, stud and California corner.

Written Skills

Modern construction workers need good written communication skills because of the communication technology available in the field. Construction

workers often receive direction or information in the field through e-mail and text messaging. A successful construction worker masters written communication skills to interact with supervisors or clients via these means. This requires accurate spelling, grammar and punctuation skills to communicate ideas clearly and succinctly.

Verbal Communication Skills

To take or give orders on a job site, a construction worker must communicate with others effectively. When he speaks, others must be able to understand what he is saying and apply the information he is conveying to their work. He must be able to talk with people from different backgrounds and education levels. This requires the skill to communicate to a person's level of understanding without being condescending or insulting.

Reading and interpretation of masonry works formats, permits, protocols, checklists

Method statements, formats, permits, protocols / Specifications for Brick masonry in Cement Mortar **:**

1. The bricks shall be of first class, regular in shape, size and colour.
2. The bricks should be free from flaws, cracks and lumps of any kind.
3. Shall have minimum crushing strength 10.5N/mm2.
4. The bricks shall not absorb the water more than one sixth of the weight of the brick.
5. The sand used shall be medium coarse, clean, sharp, free from clay, mica and other organic matter.
6. The cement used shall satisfy the requirement of Bureau of Indian Standard.
7. The mortar is designated in specified proportion of cement and sand. The materials are weighed or measured and mixed on watertight platform after allowing bulkage of sand.
8. Bricks before laying shall be thoroughly soaked in water.
9. The bricks laid truly horizontal in course with frogs upwards.
10. The brickwork shall be raised 1m in height at a strength all round the building.
11. Only fresh mortar within ½ hour for cement mortar, the time of adding water shall be used.

12. During rains, no brickwork is carried out when special arrangements are made.
13. The brickwork shall be kept wet for at least 10 days.

Checklist for brick / block work :

1. The bricks used should confirm with the requirements of specification of work.
2. The bricks should be soaked in water for 2 hours before use to prevent absorption of moisture from the mortar.
3. The brick should be properly laid on their beds with mortar covering the bed and the sides of the brick and keeping frog upwards side.
4. The bricks should be carried out in proper bond.
5. The mortar used should be of good quality and proportion as specified.
6. The wall should be raised uniformly and upto 1.5 m in a day.
7. As far as possible brick bats should not be used except closers.
8. Single scaffolding should be adopted to carry brickwork at higher level.
9. The brickwork should be carried out as per line and level, verticality should be maintained with plumb bob.
10. The brickwork should be cured for at least 2 – 3 weeks.

Method of providing instruction to subordinates or reporting to seniors clearly and promptly

- The standard practice of providing instruction to subordinates or reporting to Seniors should be followed clearly and promptly.
- This can be either in written or verbal instructions.
- The day's work record should be kept on a daily diary regularly.

Seek necessary support and complete assigned tasks within stipulated time duration

- Under the guidance from the Superiors, with necessary supports , all the assigned work should be completed as per task projected in schedule of work.

- Time schedule should be followed and applied strictly to complete the work in time.
- All resources should be made available in advance.

Keep good relation and maintain well behavior with co-worker

The following steps should be followed to maintain the good relation and behavior with the co workers :

Practice common courtesy

- Use effective communications
- Respect other people's time
- Help yourself
- Stay on the level
- Proceed with caution on social media

Plan and organize work to meet expected outcomes

To plan brick / block, rubble masonry, plastering, waterproofing and IPS / Tremix flooring activities within defined scope of work

- Schedule the work completion within the stipulated time.
- Manage certain activities during a define period.
- Forecast material and manpower requirement.
- Coordinate sequence of every work activity.
- Material procurement within minimum lead time.
- Manage labour procurement and other manpower requirement during this period.
- Maintain updated progress of work in comparison with scheduled programme.

Fig 4.1 : Project Planning

Basic concept of productivity, sequence of working and implementation of safety and organizational norms while working

Basic concept of productivity :

Productivity describes various measures of the efficiency of production. A **productivity** measure is expressed as the ratio of output to inputs used in a production process, i.e. output per unit of input.

Fig 4.2 : Project discussion

Sequence of working :

Processes :

A process is a more general notion than workflow and can apply to physical or biological processes, for instance; whereas a workflow is typically a process or collection of processes described in the context of work, such as all processes occurring on the construction site.

Planning and scheduling :

A plan is a description of the logically necessary, partially ordered set of activities required to accomplish a specific goal given certain starting conditions. A plan, when augmented with a schedule and resource allocation calculations, completely defines a particular instance of systematic processing in pursuit of a goal. A workflow may be viewed as an (often optimal or near-optimal) realization of the mechanisms required to execute the same plan repeatedly.

Flow control is a control concept applied to workflows, to distinguish from static control of buffers of material or orders, to mean a more dynamic control of flow speed and flow volumes in motion and in process. Such orientation to dynamic aspects is the basic foundation to prepare for more advanced job shop controls, such as just-in-time or just-in-sequence.

In-transit visibility is a monitoring concept that applies to transported material as well as to work in process or work in progress, i.e. workflows.

Upkeep, storing and stacking methods of tools, materials used for domain specific works

Fig 4.4 : Stacking of cement in Godown Fig.4.5:Stacking of bricks

- **Keep your tools in a dry place**. It seems obvious, but garages and basements and other enclosed spaces can have humidity issues, especially if they are not heated or air-conditioned.
- **Hang your garden tools**. Even if you keep your garden tools inside the garage or your shed, hang them so that they don't rest on the floor. Moisture can easily creep up from concrete floors.
- **Store power tools in their original cases**. Unless you have a climate-controlled workshop, your best bet for storing power tools in the hard plastic cases they usually come with. Not only are they better-protected from humidity, they're just better-protected in general.

Requisition of resources, reporting for requirement of resources orally and in written to concerned authority - (t/p)

- Requisition (indent) is the requirement of material submitted in standard format by the site to purchase department with self explanatory information about the materials.

- Indent should be given well in advance as per work schedule of each work.
- Decide on particular days in week when indent can be sent to Head office / purchase department.
- It should be written out neatly and submitted to Senior Authority.
- Follow the procedure flow chart for submission of indent.

Questions

Answer the following:

1. How the oral communication is carried out with co-workers regarding the following points :
    a) Handling and carrying out materials
    b) Handling and carrying out tools and equipment
2. Enlist the different checklists for construction works..
3. What are the instructions adhered for plastering and rubble masonry work?.
4. Mention the method of reporting to seniors.
5. Prepare a work plan of activities for following items of work :
    b) Waterproofing
    c) Tremix flooring
    d) Brick masonry
    e) Rubble masonry
    f) Plastering

6. What are the safety and organizational norms implemented while working on site?

7. Enlist the resources for construction industry.

8. Mention the storing and stacking methods of tools and materials on site.

Unit 5

Work according to personal health, safety and environment protocol at construction site

Types of hazards involved in construction sites

Types of main hazards were identified through the literature review namely

- Scaffold,
- Power access equipment,
- Ladder
- Roof work,
- Manual handling,
- Plant and machinery,
- Excavation,
- Fire and emergency,
- Hazardous substances,
- Noise
- Protective clothing
- And protecting the public
- Design hazards
- Hazards due to the use of unqualified persons.
- Hazards due to use of construction materials
- Hazards due to Falls
- Hazards due to Equipment
- Hazards due to construction methods
- Electrical hazards

Types of hazards involved in masonry works

- Hazardous substances - cement, lime and mortar mixing, chemical grouts and additives.
- Collapse - caused by unpropped construction, overloaded elements, movement joints, storage and stacking of irregular units, horizontal chases etc.
- Handling hazards - caused by the weight, shape, transportation of units, handling at height, insufficient working space etc.
- Cuts and abrasions - caused by masonry texture, wall ties, insulation such as glass fibre etc.

- The cutting or chasing of stonework.

Some Control Measures

- Plan to minimize manual handling.
- Ensure provision of adequate personal protective clothing and equipment including weather protection.
- Where possible use blocks of less than 20 Kg to allow ease of manual handling.
- Ensure adequate storage, working and handling space.
- Plan for the cutting and chasing of stonework off-site under controlled condition

Emergency safety control measures and actions to be taken under emergency situation

Actions to be taken under emergency situation :

In the case of any emergency situation at construction site the following actions should be taken:

- Stay calm.
- Assess the situation.
- Take command.
- Provide protection.
- Aid and manage.
- Maintain contacts.
- Guide emergency services.

Stay calm – Your example can influence others and thereby aid the emergency response.

Assess the situation – Determine what happened and what the emergency is. Look at the big picture. What has happened to whom and what will continue to happen if no action is taken? Try to identify the cause that must be controlled to eliminate immediate, ongoing, or further danger.

Take command – The most senior person on the scene should take charge and call, or delegate someone to call, emergency services—generally 911—and

explain the situation. Assign tasks for controlling the emergency. This action also helps to maintain order and prevent panic.

Provide protection – Eliminate further losses and safeguard the area. Control the energy source causing the emergency. Protect victims, equipment, materials, environment, and accident scene from continuing damage or further hazards. Divert traffic, suppress fire, prevent objects from falling, shut down equipment or utilities, and take other necessary measures. Preserve the accident scene; only disturb what is essential to maintain life or relieve human suffering and prevent immediate or further losses.

Aid and manage – Provide first aid or help those already doing so. Manage personnel at the scene. Organize the workforce for both a headcount and emergency assignments. Direct all workers to a safe location or command post. This makes it easier to identify the missing, control panic, and assign people to emergency duties. Dispatch personnel to guide emergency services on arrival.

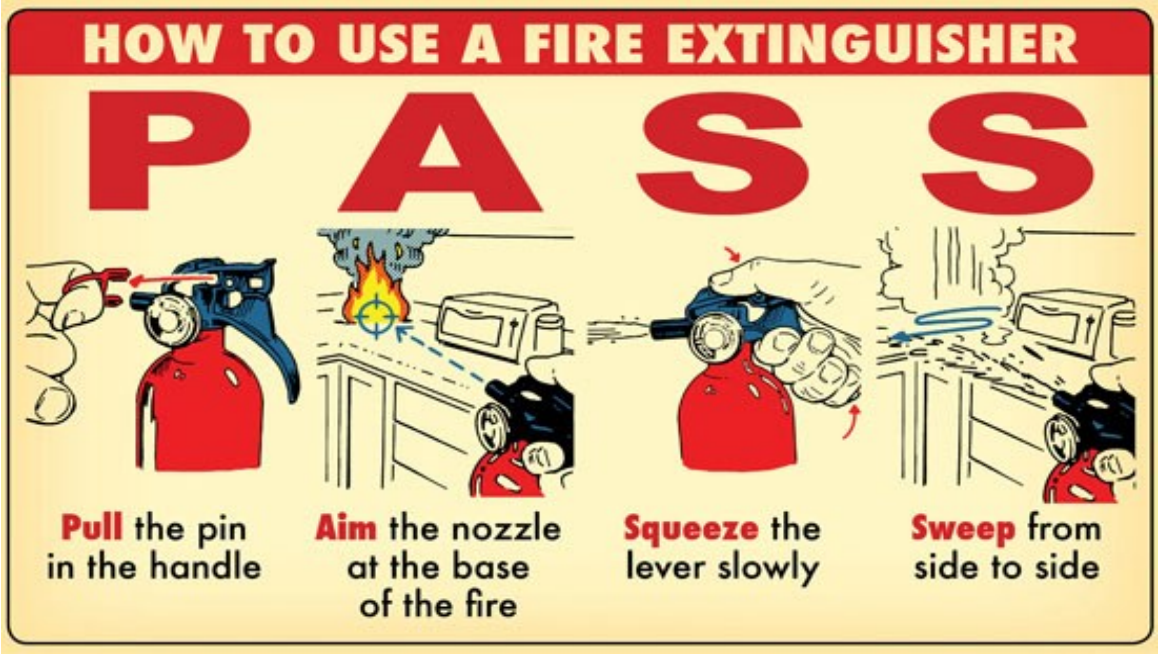
Maintain contact – Keep emergency services informed of situation. Contact utilities such as gas and hydro where required. Alert management and keep them informed. Exercise increasing control over the emergency until immediate hazards are controlled or eliminated and causes can be identified.
Guide emergency services – Meet services on site. Lead them to emergency scene. Explain ongoing and potential hazards and cause(s), if known.

Concept of First Aid process- To ensure that an injured or ill worker receives appropriate and timely first aid treatment, an employer should have a written first aid procedure as part of their Health and Safety Program. The procedure should cover

- Mandatory reporting and recording requirements
- Provision of first aid kits
- Availability of trained first aid providers and training recertification
- Transportation to medical treatment
- Document posting requirements.

Fig.5.1: Providing First Aid during leg injury

Use of fire extinguisher- FIRE is a big hazard at construction site, it kills and injuries people, destroys property and may seriously disrupt production and the construction process. Practical steps can be taken to prevent and minimize the risk of fire in the site.



Classification of fires and fire extinguisher

Fire Classifications

There are 5 main classifications of fire. Below we will look at the different types.

Class A fires involve free burning solid substances. This is often burning organic matter such as wood or paper.
They are best dealt with using water, foam or multipurpose powders extinguishers.

Class B fires are liquid or liquefiable substances solids. They are fuelled by liquids like petrol, paints or fats that are solid at room temperature and melt when heated. Dry powder extinguishers, carbon dioxide, foam (including the AFFF type) are suitable for this class of fire.

Class C fires are gas fires. These should **not** be tackled. However, if you are able to stop without any risk to yourself, like knowing how to turn off the gas, you should do so.

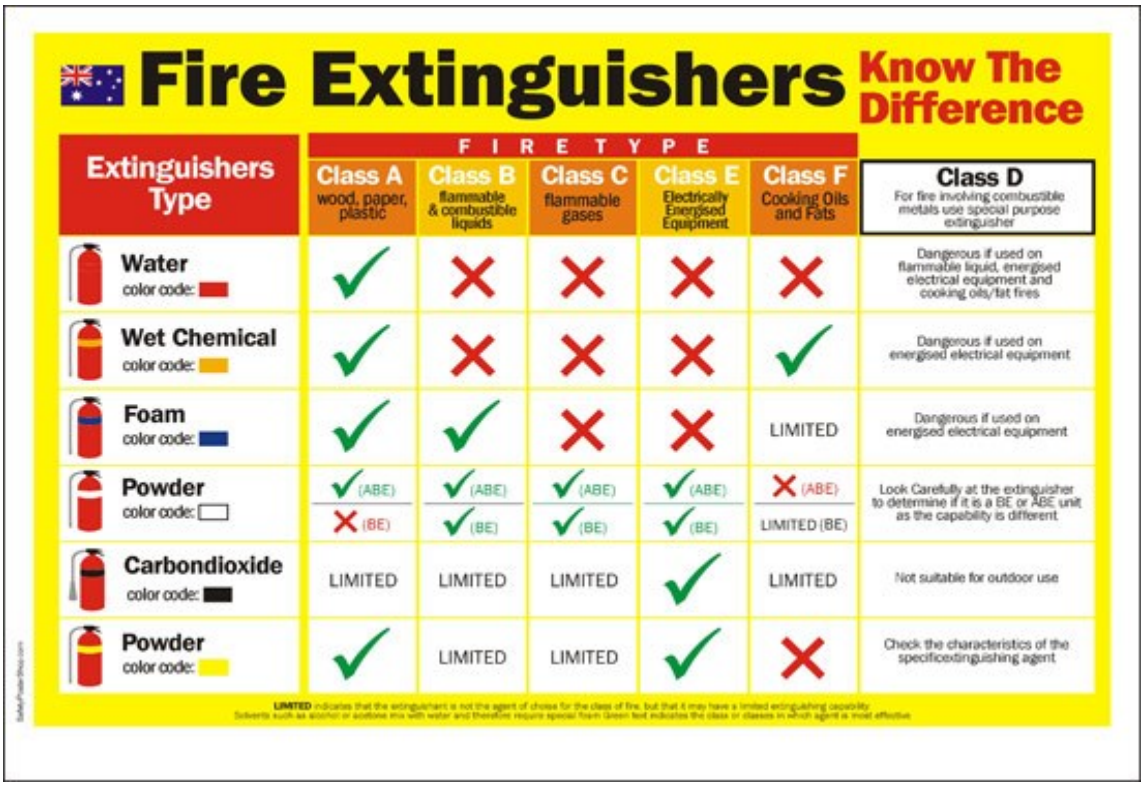
Class D fires involve flammable metals. These should not be tacked. They must be dealt with by specially trained personnel.
Metals that are usually at risk are; aluminium, magnesium, sodium, and potassium

Class F fires are fires fuelled by cooking oils and fats. According to statistics, cooking appliance fires make up 25% of all fires in the work place. With a large proportion of those are related to cooking oil. Because this hazard is so great, a whole new classification of fire was introduced

Classification of fires

A		Common Combustibles	Wood, paper, cloth etc.
B		Flammable liquids and gases	Gasoline, propane and solvents
C		Live electrical equipment	Computers, fax machines (see note!)
D		Combustible metals	Magnesium, lithium, titanium
K		Cooking media	Cooking oils and fats

Classification of fire extinguisher



Fire Extinguishers Know The Difference

Extinguishers Type	FIRE TYPE Class A wood, paper, plastic	Class B flammable & combustible liquids	Class C flammable gases	Class E Electrically Energised Equipment	Class F Cooking Oils and Fats	Class D For fire involving combustible metals use special purpose extinguisher
Water color code:	✓	✗	✗	✗	✗	Dangerous if used on flammable liquid, energised electrical equipment and cooking oils/fat fires
Wet Chemical color code:	✓	✗	✗	✗	✓	Dangerous if used on energised electrical equipment
Foam color code:	✓	✓	✗	✗	LIMITED	Dangerous if used on energised electrical equipment
Powder color code:	✓ (ABE) / ✗ (BE)	✓ (ABE) / ✓ (BE)	✓ (ABE) / ✓ (BE)	✓ (ABE) / ✓ (BE)	✗ (ABE) / LIMITED (BE)	Look Carefully at the extinguisher to determine if it is a BE or ABE unit as the capability is different
Carbondioxide color code:	LIMITED	LIMITED	LIMITED	✓	LIMITED	Not suitable for outdoor use
Powder color code:	✓	LIMITED	LIMITED	✓	✗	Check the characteristics of the specificextinguishing agent

LIMITED indicates that the extinguishant is not the agent of choice for the class of fire, but that it may have a limited extinguishing capability.
Solvents such as alcohol or acetone mix with water and therefore require special foam Green text indicates the class or classes in which agent is most effective.

Safety drills:- Safety drills help your employees be prepared in case of emergency. A **safety drill** helps you practice your evacuation route for fires and other serious emergencies. The following are the different types of safety drills:

- **Chemical Spill Drill** – In the event that a hazardous chemical is spilled in your facility, everyone needs to know what to do. This type of drill needs to include both the responses of the general employees, and the responses of any emergency cleanup or containment crews.
- **Fire Drill** – Of course, fire drills are extremely important as this is one of the more common types of emergencies. Make sure everyone in the facility knows the best path out of the area, and where they should meet once they are outside.
- **Severe Weather –** If there is a tornado, hurricane or other strong storm you will need to make sure everyone knows to get to a

location within the building that is safe. Like a fire drill, people need to know where to go and how to get there.

- **Toxic Fumes** – If toxic fumes, gasses or vapors escape their normal containment, people in the facility will need to know how to respond. Notifying the proper authorities is also important, and should be part of your drill.
- **Electrocution** – If someone is being electrocuted in the facility, people should know how to respond. Hitting the emergency power shutoff switch (if one exists) and notifying paramedics. Making sure people know not to try to go in and rescue the individual is also important, as this could lead to additional victims.

Types and use of PPES as per general and electrical safety norms

PPE - Personal protective equipment is a safeguard against job hazards. When used as intended along with other preventative measures, PPE minimizes or eliminates risks to employees. **Safety helmet & Safety shoes** are Mandatory PPE. Following are the some important PPEs

- Safety glasses / Face shields – Flying particles
- Hand Gloves – Protection from sharp objects and chemicals
- Ear muffs/ plugs – Protection against hearing loss
- Dust Mask / Escape Mask – Dust, Mist, Gas Hazards
- Harness – Protection from falling

Fig.5.2 : Various Types of Personal protective equipment

Reporting procedure to the concern Authority in Emergency situations

In Emergency situations / incidents / unhappenings like Accidents happened on site, following reporting procedure to Site In charge / Higher Authority (H.O.) should be followed :

In case of Accident :

1) In above emergency situations , Mason should report to Site In charge immediately.
2) The information includes place, type of injuries, the cause of incident occurred.
3) First Aid box / kit should be made available, given to the victim of accident until the treatment of doctor can made available.
4) Follow the instructions given by Site In charge.

In case of theft :

1) In case of theft, immediately reporting done to the Site Incharge and Higher Authority regarding the type of theft, materials or machinery missing from site.

Standard procedure of handling, storing and stacking material

1) Preliminary inquiry is done with detail inspection by Storekeeper and then by Engineer.

2) This information given to Project Engineer and allow the vehicle inside the project with watchmen's entry notebook.
3) Unloading of material at required place and also measurement checking for truck and material.
4) Preparation of challen and corrections.
5) After that one challen with Storekeeper and preparation of exit Gate pass to truck driver.
6) Watchman's noting with stamp and exit time / receipt of Gate Pass.
7) Then vehicle is allowed to go out.
8) Storing and stacking procedure of materials :

Cement :

- It should be stored on raised platform about 15 cm above Ground level.
- Flooring should be damp proof.
- Ventilator should be as minimum as possible in size and numbers.
- Water should not seep into the store through doors and windows.
- Max. 10 bags should be stored in each stack.

2. Sand / metal / dust / grit :
   - All these materials should be stacked separately.
   - Avoid excess lead by unloading the truck at a minimum distance from the work place.
   - Dust and grit should be unloaded near the block making machine.
   - A base surface of shahabad flooring or P.C.C. bed of 7.5 cm laid in leveled surface should be prepared to avoid any possible direct contact of materials with the soil.
   - Proper access road should be provided upto the stacking place.
3. Bricks :
   - While unloading the truck, bricks should not be thrown.
   - They should be stacked systematically, for easy use and counting.
   - They should be unloaded on fairly leveled ground.
   - Stacking arrangements should be as to prevent it from collapsing.
   - The stacking place should be located so that the debris / scrap thrown from the building does not fall on the bricks below.
4. Tiles :
   - Store room should be free from dampness.
   - Floor should be in level.
   - Stacking should be done lot-wise, quality-wise, colour-wise & size-wise.
   - It should be stored under locking arrangements.
   - This procedure followed same like stone materials such as marble, granite etc.

What is safe disposal of waste, type of waste and their disposal

Waste disposal :

It is all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things, collection, transport, treatment and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling etc.

Types of waste :

Generally, waste could be liquid or solid waste. Both of them could be hazardous. Liquid and solid waste types can also be grouped into organic, re-usable and recyclable waste.

Let us see some details below :

Liquid type :

Waste can come in non-solid form. Some solid waste can also be converted to a liquid waste form for disposal. It includes point source and non-point source discharges such as storm water and wastewater. Examples of liquid waste include wash water from homes, liquids used for cleaning in industries and waste detergents.

Solid type :

Solid waste predominantly, is any garbage, refuse or rubbish that we make in our homes and other places. These include old car tires, old newspapers, broken furniture and even food waste. They may include any waste that is non-liquid.

Hazardous type :

Hazardous or harmful waste are those that potentially threaten public health or the environment. Such waste could be **inflammable** *(can easily catch fire),* **reactive** *(can easily explode),* **corrosive** *(can easily eat through metal) or* **toxic** *(poisonous to human and animals).* In many countries, it is required by law to involve the appropriate authority to supervise the disposal of such

hazardous waste. Examples include fire extinguishers, old propane tanks, pesticides, mercury-containing equipment (e.g, thermostats) and lamps (e.g. fluorescent bulbs) and batteries.

Organic type:

Fig 5.3 : Organic Food

Organic waste comes from plants or animals sources. Commonly, they include food waste, fruit and vegetable peels, flower trimmings and even dog poop can be classified as organic waste. They are biodegradable (this means they are easily broken down by other organisms over time and turned into manure). Many people turn their organic waste into compost and use them in their gardens.

Type of cutting tools, their standard and area of application

Fig 5.4 Tile Cutting Machine Fig 5.5 Stone cutting Chisel Fig5.6Brick cutting chisel

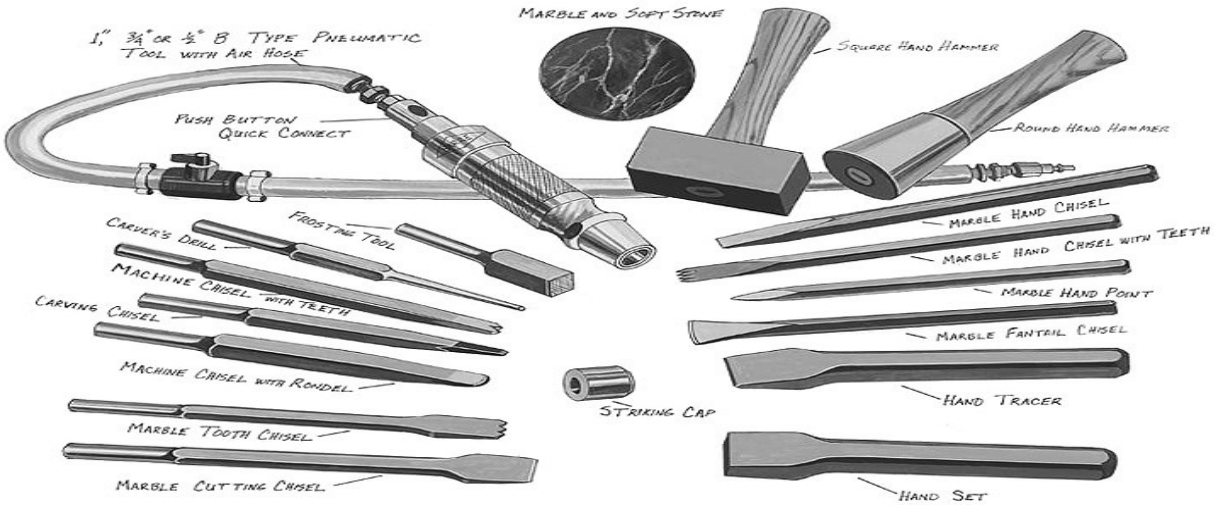


Fig 5.7: Tools

Basic ergonomic principles as per applicability:

- Ergonomics is defined as the study of work and is based on the principle that the job should be adapted to fit the person rather than forcing the person to fit the job.
- Ergonomics focuses on the work environment, such as its design and function, as well as items—such as the design and function of work stations, controls, displays, safety devices, tools, and lighting to fit the employees' physical requirements and to ensure their health and well being.
- Ergonomics includes restructuring or changing workplace conditions, to make the job easier, and reducing stressors that cause musculoskeletal disorders.
- In the area of materials handling and storing, ergonomic principles may require controls such as reducing the size or weight of the objects lifted, installing a mechanical lifting aid, or changing the height of a pallet or shelf.
- Although no approach completely eliminates back injuries resulting from lifting materials, you can prevent a substantial number of lifting injuries by implementing an effective ergonomics program and by training your employees in appropriate lifting techniques.

Questions

Answer the following:

1. Enlist the types of hazards involved in construction sites?

2. What are the emergency safety control measures & actions to be taken under emergency situation?
3. Give the standard procedure for storing & stacking of materials on site?.
4. What is safe disposal of waste? Enlist the types of disposal.

Fill in the blanks:

1.Cement should be stored on raised platform about …….above Ground level.
2. Max. ……. bags of cement should be stored in each stack.
3. For sand the base surface of shahabad flooring or P.C.C. bed of ……cm laid in leveled surface.

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Acknowledgements

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