Building Materials and Construction

(18CV34)

2019-2020 (ODD SEMESTER)

Name: Sri. Chandrashekar A R

Assistant Professor

Department of Civil Engineering

Revised Academic Calendar of VTU, Belagavi for ODD Semester of 2020-21 (Tentative)

	I Sem B. E. / B. Tech. / B. Arch./B.Plan	I sem M.Tech./MBA /MCA/M.Arch.	III, V B. E. /B. Tech./B.Plan/ B.Arch & VII sem BPlan /BArch & IX Sem B. Arch.	VII Sem B. E. /B. Tech	III & V Sem MCA	III Sem MBA	III Sem M. Tech.	III Sem M. Arch.
Commencement of ODD Semester	**14.12.2020**	**Will be announced later**	**01.09.2020**	**01.09.2020**	**01.09.2020**	**01.09.2020**	**01.09.2020**	**01.09.2020**
Last Working day of ODD Semester	**25.03.2021**		**16.01.2021**	**16.01.2021**	**16.01.2021**	**16.01.2021**	**16.01.2021**	**16.01.2021**
Practical Examinations	29.03.2021 Onwards#		21.01.2021 Onwards#	21.01.2021 Onwards#	08.02.2021 Onwards#	--	21.01.2021 Onwards#	--
Theory Examinations	12.04.2021 To 30.04.2021		08.02.2021 To 27.03.2021	08.02.2021 To 27.03.2021	21.01.2021 To 06.02.2021	21.01.2021 To 19.02.2021	28.01.2021 To 13.02.2021	21.01.2021 To 06.02.2021
Internship			---	**29.03.2021 To 10.04.2021**	---	---	---	---
Internship Viva-Voce			---	---	---	---	**15.02.2021 To 22.02.2021**	---
Professional training / Organization study			---	---	---	**22.02.2021 To 03.04.2021**	---	---
Commencement of EVEN Semester	**03.05.2021**		**29.03.2021**	**12.04.2021**	**15.02.2021**	**05.04.2021**	**23.02.2021**	**08.02.2021**

NOTE:

- VII Semester B. E. / B. Tech. students shall have to undergo **Internship** as per circular of University **VTU/Aca/2019-20/85, dated 12.05.2020**.
- I Semester B. E/ B. Tech / B. Arch Students shall compulsorily undergo **Induction Program** for 01 Weeks.
- The classroom sessions for all the semesters would be in **ONLINE mode/blended mode** until further orders.
- The Institute needs to function for **six days** a week with additional hours **(Saturday is a full working day).**
- The faculty/staff shall be available to undertake any work assigned by the university.
- If any of the above dates are declared to be a holiday then the corresponding event will come into effect on the next working day.
- (#) Notification regarding the Calendar of Events relating to the conduct of **University Examinations** will be issued by the Registrar (Evaluation) from time to time.
- Academic Calendar may be modified based on guidelines/directions issued in the future by MHRD/UGC/AICTE/State Government.
- Revised Academic Calendar is also applicable for **Autonomous Colleges.**
- The MBA students are permitted to carry out **project work** in blended mode (ONLINE/OFFLINE). More emphasis on OFFLINE mode wherever feasible.

04-12-2020.

REGISTRAR

Bapuji Institute of Engineering and Technology, Davanagere -577004

CALENDER OF EVENTS-ODD SEMESTER: JULY 2019 –JAN 2020

PARTICULARS	I sem BE/B Tech	III , V , VII sem BE/B.Tech	III & V sem MCA	III sem MBA	III sem M.Tech
Commencement of ODD sem	09-08-2019	29-07-2019	29-07-2019	08-08-2019	26-08-2019
Last Working Day	21-12-2020	30-11-2019	30-11-2019	05-12-2019	23-12-2019
1st IA Test Series	23-09-2019 30-09-2019	11-09-2019 17-09-2019	11-09-2019 17-09-2019	19-09-2019 25-09-2019	-----
2nd IA Test Series	04-11-2019 09-11-2019	14-10-2019 19-10-2019	14-10-2019 19-10-2019	21-10-2019 26-10-2019	-----
3rd IA Test Series	13-12-2019 19-12-2019	21-11-2019 27-11-2019	21-11-2019 27-11-2019	27-11-2019 03-12-2019	-----
Practical Examination	23-12-2019 03-01-2020	03-12-2019 13-12-2019	03-12-2019 07-12-2019	-----	-----
Theory Examination	06-01-2020 28-01-2020	16-12-2019 07-02-2020	09-12-2019 28-12-2019	09-12-2019 04-01-2020	27-12-2019 10-01-2020
Internship Viva-Voce/ Summer Project/ Professional training	-------	-------	-------		12-01-2020 19-01-2020
Commencement of even sem	10-02-2020	10-02-2020	27-01-2020	27-01-2020	27-01-2020

DEPARTMENT	EVENT	TENTATIVE DATE
Chemical Engineering	Inauguration of ACES	24-08-2019
	Alumni meet	31-08-2019
	Guest lecture-1	07-09-2019
	Industrial Visit	27-09-2019
	Guest lecture-2	22-10-2019
Electronics & communication	Orientation day	17-08- 2019
	EC Forum Inauguration	05-09-2019
	Lecture series	16-09-2019 to 21-09-2019
Basic Science	1st Sem Induction programme	1 to 10 August 2019

DEPARTMENT	EVENT	TENTATIVE DATE
Mechanical Engg.	Royal Mech forum inauguration	05-09-2019
	Technical Talk-I	11-10-2019
	Technical Talk-I	16-11-2019
Biotechnology	Biolit forum activity-I	07 to 21 Aug 2019
	Biolit Forum Activity Inauguration	17-08-2019
	Biolit forum activity-II	18-09-2019
	Biolit forum activity-III	30-10-2019
	Biolit forum activity-IV	11-11-2019

HoDs are informed to:

1. Submit list of open and professional electives offered along with students registered, on or before 10-8-2019.
2. Arrange parents meet after the 1st test series and send the proceedings to the Principals Office.

HOD

Dean Academic 31.7.2019

M. C. Managi

Principal

Vision of BIET

To be a center of excellence recognized nationally and internationally, in distinctive areas of engineering education and research, based on a culture of innovation and invention.

Mission of BIET

BIET contributes to the growth and development of its students by imparting a broad based engineering education and empowering them to be successful in their chosen field by inculcating in them positive approach, leadership qualities and ethical values

VISION OF THE DEPARTMENT

To train the students to become Civil Engineers with leadership qualities, having ability to take up professional assignments and research with a focus on innovative approaches to cater to the needs of the society.

MISSION OF THE DEPARTMENT

1. To provide quality education through updated curriculum and conducive teaching learning environment for the students to excel in higher studies, competitive examinations and professional career.
2. To impart soft skills, leadership qualities and professional ethics among the graduates to handle the projects independently with confidence.
3. To deal with the contemporary issues and to cater to the socio-economic needs.
4. To build industry-institute interaction and to establish good rapport with alumni.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

***PEO 1: Core Competence*:** Graduates will be able to plan, analyse, design and construct sustainable Civil Engineering Infrastructure.

***PEO 2: Professional Skills*:** Graduates will be professional engineers with a sense of ethics, creativity, leadership, self-confidence and independent thinking to cater to the needs of the society.

***PEO 3: Societal Needs*:** Graduates will be able to contribute effectively for the development of industry and professional bodies.

***PEO 4: Cognitive Intelligence*:** Graduates will be able to take up competitive examinations, higher studies and involve in research and entrepreneurship activities.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Students after the completion of the Program will be able to

1. Apply the fundamental concepts, software and codal provisions in the analysis, design and construction of sustainable civil engineering infrastructure.
2. Inculcate professional and leadership qualities, sense of ethics and confidence related to civil engineering.

Faculty will be able to

3. Contribute to the overall development of civil engineering community through the professional bodies and offer services to the society.

PROGRAM OUTCOMES (POs defined by NBA)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

BEA, BIET, Civil Engineering Department.ODD Sem: July-Dec 2019 Timetable

NAME: Sri. A R Chandrashekar, Assistant Proffesor

SUB I: 18CIV14, Elements of Civil Engineering & Mechanics (G-SEC) B 114

SUB II: 18CV34,Basic Materials and Construction (B-SEC) : Room no. CV 305

LABI:18CVL37,Computer aided building planning & Drawing(A1)

LABII:17CVL58,Concrete And Highway Material Lab(A1)

LABII:17CVL54,Computer Aided Building Planning and Drawing(B1 &B3)

Hours→ / Day↓	08.00 AM-09.00 AM	09.00 AM-10.00 AM	LEISURE	10.30 AM-11.30 AM	11.30 AM-12.30 PM	LUNCH BREAK	02.00 PM-03.00 PM	03.00 PM-04.00 PM	04.00 PM-05.00 PM
MON				18CV34			18CVL37-A1 ARC & RBV		
TUE	18CIV14				18CV34		17CVL58-A1 ARC&ADJ		
WED				18CV34			17CV54-B1 ARC&MER		
THU					18CIV14				
FRI		18CIV14		18CIV14			17CV54-B3 ARC&SHM		
SAT		18CIV14							

TIME TABLE INCHARGE **HOD** **PRINCIPAL**

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

BUILDING MATERIALS AND CONSTRUCTION

Course Code	**18CV34**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will develop a student;

1. To recognize good construction materials based on properties.
2. To investigate soil properties and design suitable foundation.
3. To understand the types and properties of masonry materials and supervise masonry construction.
4. To gain knowledge of structural components like lintels, arches, staircase and roofs.
5. To understand the finishes in construction like flooring, plastering, paining.

Module-1

Building Materials: Stone as building material; Requirement of good building stones, Dressing of stones, Deterioration and Preservation of stone work. Bricks; Classification, Manufacturing of clay bricks, Requirement of good bricks. Field and laboratory tests on bricks; compressive strength, water absorption, efflorescence, dimension and warpage.

Cement Concrete blocks, Autoclaved Aerated Concrete Blocks, Sizes, requirement of good blocks.

Timber as construction material.

Fine aggregate: Natural and manufactured: Sieve analysis, zoning, specify gravity, bulking, moisture content, deleterious materials.

Coarse aggregate: Natural and manufactured: Importance of size, shape and texture. Grading of aggregates, Sieve analysis, specific gravity, Flakiness and elongation index, crushing, impact and abrasion tests.

Module-2

Foundation: Preliminary investigation of soil, safe bearing capacity of soil, Function and requirements of good foundation , types of foundation , introduction to spread, combined , strap, mat and pile foundation

Masonry: Definition and terms used in masonry. Brick masonry, characteristics and requirements of good brick masonry, Bonds in brick work, Header, Stretcher, English, Flemish bond, Stone masonry, Requirements of good stone masonry, Classification, characteristics of different stone masonry, Joints in stone masonry. Types of walls; load bearing, partition walls, cavity walls.

Module-3

Lintels and Arches: Definition, function and classification of lintels, Balconies, chejja and canopy. Arches; Elements and Stability of an Arch.

Floors and roofs: Floors; Requirement of good floor, Components of ground floor, Selection of flooring material Procedure for laying of Concrete (VDF), Mosaic, Kota, Slate, Marble, Granite, Tile flooring, Cladding of tiles.

Roof: Requirement of good roof, Types of roof, Elements of a pitched roof, Trussed roof, King post Truss, Queen Post Truss, Steel Truss, Different roofing materials, R.C.C. Roof.

Module-4

Doors, Windows and Ventilators: Location of doors and windows, technical terms, Materials for doors and windows: PVC, CPVC and Aluminum. Types of Doors and Windows: Paneled, Flush, Collapsible, Rolling shutter, Paneled and glazed Window, Bay Window, French window. Steel windows, Ventilators. Sizes as per IS recommendations.

Stairs: Definitions, technical terms and types of stairs: Wood, RCC, Metal. Requirements of good stairs. Geometrical design of RCC doglegged and open-well stairs.

Formwork: Introduction to form work, scaffolding, shoring, under pinning.

Module-5

Plastering and Pointing: Mortar and its types. Purpose, materials and methods of plastering and pointing: Sand faced plastering, Stucco plastering, lathe plastering, defects in plastering . Water proofing with various thicknesses.

Damp proofing- causes, effects and methods.

Paints- Purpose, types, technical terms, ingredients and defects, Preparation and applications of paints to new and old plastered surfaces, wooden and steel surfaces.

Course outcomes: After a successful completion of the course, the student will be able to:

1. Select suitable materials for buildings and adopt suitable construction techniques.
2. Decide suitable type of foundation based on soil parameters
3. Supervise the construction of different building elements based on suitability
4. Exhibit the knowledge of building finishes and form work requirements

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

Textbooks:

1. Sushil Kumar "Building Materials and construction", 20th edition, reprint 2015,StandardPublishers
2. Dr. B. C. Punmia, Ashok kumar Jain, Arun Kumar Jain, "Building Construction, Laxmi Publications (P) ltd., New Delhi.
3. Rangawala S. C. "Engineering Materials", Charter Publishing House, Anand, India.

Reference Books:

1. S. K. Duggal, "Building Materials", (Fourth Edition)New Age International (P) Limited, 2016 National Building Code(NBC) of India
2. P C Vergese, "Building Materials", PHI Learning Pvt.Ltd
3. Building Materials and Components, CBRI, 1990,India
4. Jagadish. K.S, "Alternative Building Materials Technology", New Age International,2007.
5. M. S. Shetty, "Concrete Technology", S. Chand & Co. New Delhi.

Title & Code	Building Materials and Construction (18CV34)
CO	Statement
18CV34.1	**Explain** the building materials such as stones, bricks, aggregates and CC blocks
18CV34.2	**Decide** a suitable type of foundation based on soil and loading conditions
18CV34.3	**Explain** the characteristic of brick masonry, stone masonry and walls
18CV34.4	**Classify** and **describe** the functions of lintels, arches, floors and roofs
18CV34.5	**Explain** the types of openings in buildings, staircase and formwork for construction
18CV34.6	**Explain** the building finishes such as plastering, painting and damp proofing

Course Title		Building Materials and Construction										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
18CV34.1	2			1		1						2
18CV34.2	2	1		1		1						2
18CV34.3	2			1		1						2
18CV34.4	2			1		1						2
18CV34.5	2	1		1		1						2
18CV34.6	2			1		1						2
Average	2	1		1		1						2

CO	PSO1	PSO2
18CV34.1	2	2
18CV34.2	2	2
18CV34.3	2	2
18CV34.4	2	2
18CV34.5	2	2
18CV34.6	2	2
Average	2	2

LESSON PLAN

Subject : Building materials & Construction Subject Code : 18CV34 Class : III . B sec

Period	Date	Topics Planned	Date	Topics Covered	Remarks
1.	29/7/19	Stone as a building mat. Requirement of good stones, dressing & defects in stone	29/7/19	Introduction to building material. Stone as building material its requirement dressing & precautions	Module 1
2.	30/7/19	Prevention of stone work Bricks & its classification	30/7/19	Prevention of stone. Bricks & its requirement classification of bricks	
3.	31/7/19	Manufacturing of clay bricks, Requirement of good bricks.	31/7/19	Manufacturing of clay bricks ~~AAC blocks~~.	
4.	6/8/19	Field & laboratory tests on bricks	5/8/19	Field & laboratory tests on bricks	
5.	7/8/19	Blocks: Cement Concrete, Autoclaved aerated blocks Requirement of blocks	6/8/19	Blocks: Requirement of block. Cement concrete, ~~Aerated~~ AAC blocks	
6.	13/8/19	Timber as construction material. Fine & Coarse aggregates	7/8/19	Timber as an construction material. defects. Fine & coarse agg.	
7.	14/8/19	Fine aggregates:- Natural & manufactured sand Diff. Tests on fine aggregate	14/8/19	Fine aggregate :- material can be used, Tests on fine agg	
8.	19/8/19	Coarse aggregates:- Materials, Diff. tests on ~~Coarse~~ aggregates.	19/8/19	Coarse aggregates: Tests on coarse aggregate	Module 1
9.	20/8/19	Foundation:- Preliminary investigation of soil, SBC of soil, Functions & requirements of foundation	21/8/19	Foundations: Functional requirement, purpose of foundation.	Module 2
10.	21/8/19	Types of foundation:- Spread, Combined, Strap, Mat & Pile foundation	26/8/19	Bearing capacities, primi-nary investigations.	
11.	26/8/19	Masonry:- Definition & terms used in masonry, charecteristics - cs & Requirements for good brick masonry.	27/8/19	Types of foundations: Shallow & deep foundations	
12.	27/8/19	Bonds in masonry:- Header, Stretcher, English & Flemish bond.	28/8/19	Masonry: Technical terms charecteristics & requirements for bricks masonry	
13.	3/9/19	Stone masonry:- Types of Stone masonry.	4/9/19	Bonds in brick masonry: Header, Stretcher, English & Flemish bond	
14.	4/9/19	Joints in stone masonry (Types of Stone masonry)	9/9/19	Stone masonry:- Types of Stone masonry	
15.	9/9/19	Types of walls: Load bearing, Non load, partition walls	16/9/19	Types of stone masonry Joints in stone masonry	
16.	11/9/19	Rammed earth walls Cavity walls.	18/9/19	Types of walls: load & Non-load bearing walls Cavity walls	Module 2
17.	16/9/19	Lintels: Definitions, Types of lintels	24/9/19	Lintels:- Definitions, Types of lintels	module 3

LESSON PLAN

Subject : Subject Code : Class :

Period	Date	Topics Planned	Date	Topics Covered	Remarks
18.	17/9/19	Balconies, chajja & canopy Elements of an Arch	25/9/19	Balconies, chajja & canopy. Elements of an Arch.	
19.	18/9/19	Stability of Arches. Introduction to floors	3/10/19	Stability of Arches Introduction to floors.	
20.	23/9/19	Selection of flooring material procedure for laying of concrete, mosaic, Granite, marble	1/10/19	Selection of flooring material procedure for laying of diff materials for floor	
21.	24/9/19	Roofs: Requirement of good roof, Types of roofs: Flat roof	9/10/19	Roofs: Requirement of good roof, Types of roofs: Flat roof	
22.	25/9/19	Pitched roofs:- Elements of pitched roof & types of pitched roof	14/10/19	Pitched roofs:- Elements of pitched roof & its types	
23	30/9/19	Steel roofs:- King & Queen post trusses.	15/10/19	Steel roofs: King & Queen post	
24.	1/10/19	Different type of Roofing materials	16/10/19	Different types of roofing material, RCC roof	module 3
25.	9/10/19	Doors, windows & ventilators Technical terms, location & placing types of doors	22/10/19	Doors, windows & ventilators Technical terms, requirements of Doors & windows	module 4
26.	14/10/19	Types of doors:- Panel, Steel, PVC, Rolling shutter, etc.	4/11/19	Types of doors: Panel, Steel, PVC, Rolling shutter, etc.	
27.	15/10/19	Sizes recommended by IS Types of windows & Ventilators	5/11/19	Sizes Recommended by IS, Types of windows & Ventilators.	
28.	16/10/19	Stairs: Technical terms, elements of stairs Types of stairs. Requirements	6/11/19	Types of windows & their requirements	
29.	21/10/19	Problems: Geometrical design of dog legged Staircase	7/11/19	Staircase: Technical terms elements of stairs, Types based on materials, Geometry.	
30	22/10/19	Open newel Staircase Geometrical design	7/11/19	Geometrical design of dog legged Staircase	
31.	23/10/19	Scaffolding: Introduction to stone work :- Mivan Shuttering	11/11/19	Cont. Geometrical design of dog legged Staircase	
32	29/10/19	Scaffolding, Shoring, Under pinning.	13/11/19	Formwork, Scaffolding Shoring, underpinning	module 4
33	30/10/19	Plastering & pointing: Mortar & its types purpose of plastering	18/11/19	Introduction to plastering materials used, mortar & its types	module 5
34	2/11/19	materials, methods of plastering & pointing	19/11/19	methods of plastering	

LESSON PLAN

Subject : Subject Code : Class :

Period	Date	Topics Planned	Date	Topics Covered	Remarks
35.	4/11/19	Types of plastering. method of water proofing.	20/11/19	Defects in plastering, water proofing	
36.	5/11/19	Damp proofing: Causes, effects methods	20/11/19	Damp proofing :- Causes, effects & methods	
37.	6/11/19	Paints: Purpose, types Technical terms	21/11/19	Painting: introduction, materials, technical terms	
38.	11/11/19	Defects in painting.	21/11/19	Defects in plastering preparation & application of in old & new wall	
39.	12/11/19	Preparation & application of paints over old & new plastered surfaces	22/11/19	Painting for wood & steel surface.	M-5
40.	13/11/19	Painting over wooden & steel surfaces			Module 5

Text Books :

1. Dr. B.C. Punmia et. al., "Building Construction"
2. Rangwala S.C "Engineering materials"

Reference Books :

1. P.C. Verges, "Building Materials"
2. S.K. Duggal "Building materials"

Class : III, B.Sc Subject Code : 18CV34

Subject : Building Materials & Construction Total No. of Classes :

Sl No.	USN	NAME	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average ASSG	Total	Remarks
1.	4BD18CV002	Akhil Reddy M		26	18	23	30	25+30=	35	
2.	004	Anmol. M		14	15	24	25	22+10=	32	
3.	006	Archana. M.A		43	29	28	25	28+10	38	
4.	008	Arya. N. Jadhav		23	09	11	23	15+10 =	25	
5.	010	Banashree Pujar		30	29	25	26	27+10 =	37	
6.	012	Basavaraja. K		99	28	25	25	26+10 =	36	
7.	014	Bhavana. K.M			30	30	30	30+10	40	
8.	016	Chethan. R			21	27	18	22+10	32	
9.	018	Darshanlekh. B.M			21	15	26	21+10 =	31	
10.	020	Deepa. T.S			21	25	25	24+10 =	34	
11.	022	Dineshyadav. V			24	20	28	24+10 =	34	
12	024	Ganesh. B.G (D)			-	-	-	—	—	
13.	026	H. K. Varun			10	09	18	12+10	22	
14.	028	Hrithikesh (D)			-	-	—	—	—	
15.	030	Hrutik. S. Moradurmath			AB	17	23	14+10 =	24	
16.	032	Kiran. B.K			05	14	23	14+10 =	24	
17	034	Krishnasagar D.H			14	19	17	17+10=	27	
18.	036	Likith. G.S			22	22	29	25+10	35	
19.	038	Rakshitha. M.K			19	23	10	18+10=	28	
20	040	Manjunath. U			AB	20	18	13+10 =	23	
21.	042	Manj. T			23	27	26	26+10	36	
22.	044	Meghana. H. P			29	25	30	28+10 =	38	
23.	046	Mohammed Alghreem (D)			-	-	—	—	—	
24.	048	Mahaseera			14	26	06	15+10=	25	
25.	050	Nagaraj. S. Barkaji			29	26	30	29+10=	39	
26.	052	Naveen Kumar. A.S			03	02	26	11+10 =	21	
27.	054	Nikhil. D. Varnekar			15	28	30	23+10 =	33	
28.	056	Pooja			23	18	23	22+10=	32	
29.	058	Pradeep. G.K			17	AB	23	14+10=	24	
30.	060	Priya. H. P			20	29	30	29+10 =	38	
31.										

Initials of Teacher

Initials of H.O.D.

Initial of Principal

Class : VII B Subject Code : Subject : Total No. of Classes :

Sl No.	USN	NAME	DATE	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
31.	4BD18CV062	Rachana. M				13	15	18	16+10=26	
32.	064	Ranjitha. Y.B				27	27	28	27+10=37	
33.	066	Ruthu. S				24	26	30	27.5=37	
34.	068	Sagar. N. Betageli				29	29	30	29+10=39	
35.	070	Saikumar. H				20	24	27	24+10=34	
36	072	Sanjay Kumar. M.M				06	09	12	09+10=19	
37	074	Sathvik. H.M				07	09	090	12+10=22	
38.	076	Shivaraj. K.H (D)				-	-	-	-	-
39.	078	Siddathgouda. M.G (D)				-	-	-	-	-
40	080	Simran. A				24	25	17	22+10=32	
41.	082	Srinivas Nair (D)				-	-	-	-	-
42.	084	Sumanth. K.R				25	AB	23	16+10=26	
43	086	Sunil. M. Dargad				24	22	18	22+10=32	
44.	088	Tarun. G.V				10	AB	18	10+10=20	
45.	090	Tejesh B.R (D)				-	-	-	-	-
46.	092	Vday K.H (D)				-	-	-	-	-
47	094	Vageesh K.R				23	12	13	16+10=26	
48	096	Vidyakiran. M				22	28	30	27+10=37	
49.	098	Vinay. C.R				09	12	12	11+10=21	
50.	100	Vinayaka. M.A				12	20	15	17+10=27	
51.	102	Vishwanag. R.J				24	24	22	23+10=33	
52.	104	Yashwin. G				11	19	06	12+10=22	
53.	4BD16CV022	Bharath Kumar. L.K.M				12	15	15	14+10=24	
54	4BD16CV114	V. Kavya (D)				-	-	-	-	-
56.	✓ 18CV028	Dheeraj. P	←			15	13	28	18/10=21	
57.	17CV116	Vishwas S Kulkarni	←			12	09	20	14+10=24	
58.	19CV423	T.M. Rushik	←			16	15	20	17/10=27	
59.	19CV409	K.B. Vishak	←			10	25	25	20+10=30	
60.	19CV415	Mrudhyunjaya Swamy G.M	←			10	18	23	13+10=27	
		Initials of Teacher								
		Initials of H.O.D.								
		Initial of Principal								

Class : III B Subject Code : 18CV36

Subject : Building Material & Construction Total No. of Classes :

Sl No.	USN	NAME	DATE	28/8/19	4/9/19	9/9/19	16/9/19	18/9/19	24/9/19	25/9/19	31/9/19	1/10/19	9/10/19	14/10/19	15/10/19	16/10/19	22/10/19	4/10/19	5/11/19	6/11/19	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
61.	4BD17CV004	Mahesh Talwar		2	3	4	A	5	6	A	A	7	A	8	9	A	10	11	A	12			05	09	05	13+10=	23
62.	17CV080	S. H. Punith		A	2	3	4	5	6	A	A	7	A	8	9	A	10	11	A	12			05	07	18	10+10=	20
63.	19CV426	Sarfaraz Khan		2	3	A	4	5	6	7	8	9	10	11	12	13	14	15	A	16			04	21	27	18+10	= 28
64.	18CV109	Jyothika		A	A	A	4	5	6	7	8	9	A	10	11	12	13	14	15	16			00	00	14	18+10=	28
65.	19CV419	Nithin. H.S		→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			08	20	20	16+10 =	26
66.	19CV429	Shreyas. C.D		→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			24	20	21	24+10=	32
67.	19CV406	Gajendra M.		→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			09	25	30	22+10=	32
68.	CV426	Santhosh B		→	1	A	2	A	3	4	A	5	6	7	8	9	10	11	12	13			AB	22	27	17+10 =	27
69.	CV434	Yuvaraja. N.T		→	1	2	3	A	3	4	5	6	7	8	9	10	11	12	13	14			10	28	22	20+10=	30
70.	CV408	Hemanth Kumar. M		→	1	2	A	3	4	5	6	7	8	9	10	11	12	13	14				08	20	15	25+10 =	25
71.	CV433	Vinutha T		→	1	2	3	4	5	A	6	A	7	8	9	10	11	A	12				05	28	23	22+10=	32
72.	CV425	Santhosh M		→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				16	24	27	33+10 =	33
73.	CV417	Nikhil. S.P		→	(	A	2	A	3	A	4	A	05	06	07	08	09	A	A				11	26	29	22+10=	32
74.	CV432	Vinay Kattik. H.M		→	1	A	2	3	4	A	5	6	7	8	9	10	A	A					11	23	25	20+10 =	30
75.	CV414	Mohammed Siddiq Hussain		→	(	2	3	A	4	A	5	6	A	10	8	A	9						AB	23	15	13+10=	23
76.	CV428	Shashank Koliwad		→	1	2	3	A	4	5	6	7	8	9	10								AB	22	30	18+10 =	28
77.	CV401	Amoghavarsha K.S. Koleka		→	1	2	3	4	5	A	A	6	7	8	9								AB	18	19	13+10=	23
78.	CV406	H.J. Mathad		→	1	A	2	3	4	A	5	6	A	7									AB	10	26	12+10 =	22
		Initials of Teacher																									
		Initials of H.O.D.																									
		Initial of Principal																									

-: BUILDING MATERIALS :-

Stones:

Stones are the basic & old building materials which can be obtained from various rocks @ disintegration of rocks.

Stones as a building material:

→ Stones are more freely available than clay bricks & no need to be manufacture so that stone masonry becomes cheaper than brick masonry.

→ Stones were used to build dwellings in early days & also in old roads with heavy traffic.

→ All old beautiful monuments are build with stone masonry

→ Stones are used for ornamental work in imp places like temples & places of assembly.

→ Stones were preferred before ~~the~~ using of concrete for heavy engg constructions like bridge piers, harbour walls, seaside walls & they are like used for facing work for tall buildings.

→ On situations of flooded area stone work is used instead of brickwork.

→ Stone as a imp source of aggs.

Classification of Rocks:

1) Geological classification:

- Igneous rocks → cooling of molten lava / magma
  Eg: Quartz, Dolerite, Gneiss.
- Sedimentary rocks → Sedimentation of rocks by internal pressure.
- Metamorphic rocks → Alteration of original structure to excessive heat & pressure
  Eg: Sandstone to Quartzite
  Shale to slate
  Granite to Gneiss.

5) Physical classification:
→ Stratified rocks
→ Unstratified rocks
→ Foliated rocks

c) Chemical classifications.
→ Silicious – Consists of Quartz, Sand
→ Agrilacious – Consists of clay minerals.
→ Calcalious – Consists of Carbonate of lime.

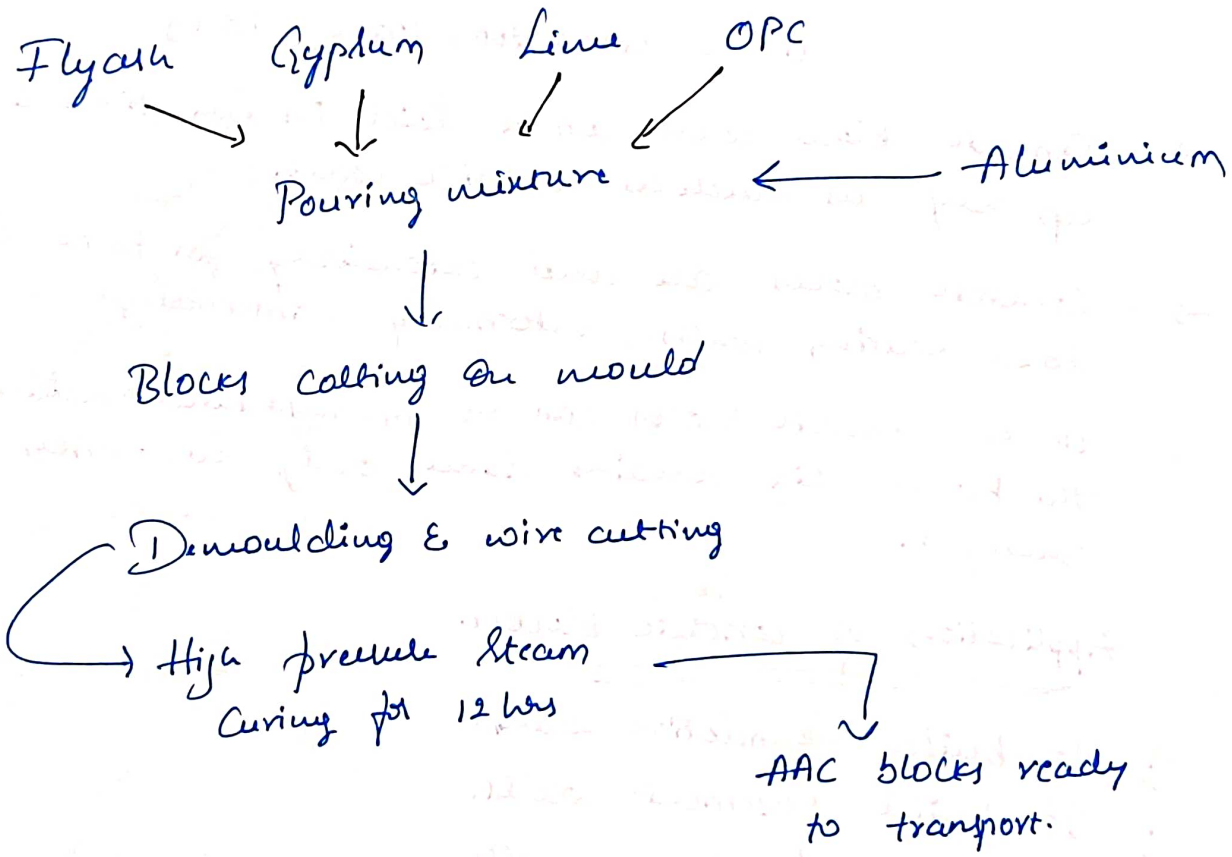
Common building Stones & their uses:

1) Fine grained granite & gneiss – Heavy eng., works such as building bridge piers, breakwaters, etc.,
2) Granite, quarzite & compact sandstone – Industrial area exposed to smoke & fumes.
3) Facing works – Marble, Granite, sandstone.
4) General building work – Limestone & sandstone.
5) Carvings & ornamental work – Fine grained granite, marble & Soft sandstone.
6) Fire-resistant masonry – Compact limestone & sandstone.
7) Floor pavings – Marble, Slate, sandstone & Granite
8) In foundations of building in placed with high ground water level – Granite, Quartzite.

-: Autoclaved Aerated Concrete Blocks:

This is a light weight building material produced by autoclaving a set mix of fine siliceous materials such as ground sand @ flyash & a binder like portland cement. It is 4 times lighter than regular blocks.

Manufacturing process:



Cement Concrete blocks

Due to growing demand & changing trends the structure have been changed from bricks to concrete blocks.

→ Concrete blocks are made using concrete which is a mixture of portland cement, water & sand

→ Block size 8" – 400 × 200 × 200 – 36 kg
6" – 400 × 200 × 150 – 29 kg
4" – 400 × 200 × 100 – 18 kg

→ Concrete block wall can be laid in less time & may cover up half as much as a brick wall.

→ Concrete blocks are used extensively for both load & non-load bearing walls, externally & internally.

→ Hollow concrete blocks can be manufactured to reduce the wt. of the blocks, size remains same only hollowness & weight is changed.

Applications of concrete blocks:

- To build foundation walls.
- To build basement walls.
- To build partition walls.
- To build exterior & for parking applications.
- Also used for construction of water storage tanks.

Advantages:

- In expensive & low maintenance
- Block walls are thinner & lighter weights
- Durable, fire proof, low maintenance.
- Adequate strength & structural stability
- Reduce cement mortar consumption by 60%.
- Eco friendly.

BRICKS :-

One of the most & oldest masonry unit manufactured & used in construction of brick. Compared to stones, bricks are light in wt., economical & easy to construct.

A brick is a rectangular block made of clay & burnt in kilns to give vitreous body, standard size acc., to IS code 90 x 90 x 190 mm, density: 18 - 19 KN/m³, Avg wt. :- 3 - 3.5 kg.

Classification of bricks:

Bricks are classified in 3 ways.

1) Acc., to usage
   - (a) Common bricks
   - (b) Engineering bricks
   - (c) Facing bricks
   - (d) Fire bricks
   - (e) Spacial bricks

2) Acc., to General physical requirements
   - (a) Class I bricks
   - (b) Class II bricks
   - (c) Class III bricks
   - (d) Class IV bricks.

a) Class I bricks / First class bricks:

a) Bricks should be uniformly burnt & should have uniform color. They should show up copper red colour.
b) The surface should be smooth rectangular parallel edges, sharp & straight at corners.
c) Bricks should be free from cracks, stones.
d) Should have uniform structure.
e) Should not be scratched by fingernail
f) Water absorption (w.A) should be in the range of 12-15% of its dry wt., after immersing in cold water for 24 hrs.
g) Bricks should give clear ringing ringing sound when they struck each other.
h) The crushing strength of class-I brick should not be less than 10.5 N/mm².

b) Class II bricks

a) These specifications are almost similar to first class bricks but extensions like a small crack & distorted with round edge
b) water absorption should be in the range of 16-20%.
c) Crushing strength - 7 N/mm².
d) Slightly overburnt [Uniform color]
e) It can be used for important & other type of work.

c) Class III / Third class bricks:

- They bricks are underburnt.
- Dull color almost similar to clay.
- Produces dull sound when struck each other.
- Water absorption is more than 25%.
- Used only for temporary structures.

d) Class IV / Fourth class bricks:

- These bricks are overburnt.
- Distorted badly & very brittle
- Temporary structures - in lime & surkhi concrete.

3) IS classification of bricks:

IS code specified class of bricks depending upon crushing strength of brick.

Class design	Avg. comp strength N/mm²
350	35
300	30
250	25
200	20
175	17.5
150	15
125	12.5
100	10
75	7.5
50	5
35	3.5

Prof & Head of Civil Engg. Dept
V. I. E. T. Hyderabad - 4

Manufacture of Clay Bricks:-

1) Clay deposit is excavated by removing the vegitation & allowed the excavated clay to open air for a considerable period. So that the lumps of clay breakdown into smaller particles & get matured.
2) Refinement of clay is done by washing.
3) Moulding process stores depending on the moulds i.e., [Hand mould @ machine mould]
4) Moulds are loaded either intermittent @ continous kilns @ temporary clamps.
5) Loaded moulds are slowely dried & burned to high temperature & cooled one cycle of loading → drying → burning → cooling → Emptying may done in 8 weeks. This processes are carried out intermittently in intermittent kilns & in cyclic order in cont., kiln.
6) The bricks are produced in kilns are better make uniform quality than bricks produced in clamps [And also less cost for fuel].

Requirements of Good bricks:

1) Size & Shape:- The bricks should have uniform size & shape
2) Colour:- The colour of brick should be uniform & copper red in colour.
3) Texture & compactness:- The brick should be compacted well during moulding. It should showup uniform texture. A fracture surface should not show up cracks, pebbles, holes inside the bricks.

4) Hardness & Soundness: The brick should be hard enough & should not be scratched by finger nail. Soundness is tability of brick that can be observed by clear ringing sound (Metallic sound) when struck each other.

5) Water absorption: A good brick should not absorb more than 20% of its dry wt., after immersing in water for 24 hrs.

6) Crushing Strength: A crushing strength of good bricks should not be less than 10.5 N/mm².

7) A good brick should free from the saltish appearance [Efflorescence].

Tests on Bricks:

Following tests are conducted on bricks to determine its suitability for construction.

1) Absorption test
2) Crushing strength test
3) Hardness test
4) Shape & size
5) Color test
6) Soundness test
7) Structure of brick
8) Presence of soluble salts @ efflorescence test

Timber :-

Timber denotes wood which is suitable for building @ carpentry & for various engineering & other purposes.

Characteristics of Good timber :-

Appearance: Freshly cut surface of timber should exhibit hard & of shining appearance.

Color: Preferably dark.

Defects: Good timber free from knots, flaws, etc.,

Durability: Capable of resisting the action of fungi, insects, chemicals & physical agencies.

Elasticity: Good timber returns its original shape when load causing its deformation is removed.

Fire resistance: A dense wood offers good resistance to fire.

Hardness: A good timber should be hard

Mechanical wear: Good timber should not wear easily with abrasion

Shape: A good timber should have a capacity of retaining its shape during conversion @ seasoning.

Smell: A good timber should have sweet smell. Unpleasant smell indicates decayed wood.

Strength: Good timber should be sufficiently strong for working as a structural member.

water permeability: A good timber should be of low permeability.

Advantages of seasoned timber:

→ It has reduced weight.
→ It is strong & durable
→ It has resistance to decay
→ It takes high polish
→ It is easier to work
→ Its life is more

Uses of timber:

1) Used in building construction
2) Construction of beams.
3) Construction of rafters
4) Construction of bridges
5) Construction of piles, poles & railway sleepers
6) Furniture making
7) For light packing cases
8) For making veneers & ply woods.

SPECIFIC GRAVITY OF FINE AGGREGATES

Object: Determination of specific gravity of fine aggregate

Theory and scope: The specific gravity of an aggregate is defined as the ratio of the mass of a given volume of sample to the mass of an equal volume of water at the same temperature.

The specific gravity of fine aggregate is generally required for calculations in connections with concrete mix design, for determination of moisture content and for the calculations of volume yield of concrete. The specific gravity also gives information on the quality and properties of aggregate. Departure of specific gravity from its standard value indicates change in shape and grading.

Absorption: It influences the behaviour of aggregate in concrete in several important aspects. A highly absorptive aggregate, if used in dry condition, will reduce effective water- cement ratio to an appreciable extent and may even make the concrete unworkable unless a suitable allowance is made. Hence determination of absorption of aggregate is necessary to determine net water – cement ratio.

Apparatus: Balance (Capacity not less than 3 kg), weight box, Le-chatelier flask of 500 mm capacity calibrated at specified temperature or a pycnometer; distilled water; conical mould (64 mm diameter at top and 90 mm diameter at bottom and 73 mm in height); tamping rod 25 mm in diameter; drying over to operate between 100 –110o C; metal tray (area 32500 mm2); a source of supplying a current of warm air;, such a hair drier.

Procedure:

1. Calibrate the flask by weighing it empty, and full with water at room temperature. Roll and agitate the flask gently in an inclined position, to eliminate air bubbles.

2. Take a sample of the fine aggregate and soak it in water and keep it for $24 \pm 1/2$ hours. The temperature should be $27 \pm 5°C$.

3. Take out and spread the sample (approximately 1.5 kg) on a clean flat surface exposed to gently moving current of warm air until the material just reaches free running condition (flowing freely).

4. Place the sand loosely in conical mould and tamp it on surface 215 times. Lift the mould vertically. If the sand retains its shape, it means free surface moisture is present. Continue the drying with constant stirring until the cone of sand slumps on the removal of the mould. This indicates that sand has reached a surface dry condition.

5. Immediately weigh 500 gm of saturated surface dry sand in the flask.

6. Fill the flask with water to the top cone. Roll the flask in an inclined position to eliminate all air bubbles and replace with water by means of foundation pen filler.

7. Wipe the flask dry and weigh it accurately.

8. Calculate the specific gravity.

$$\text{Bulk Specific Gravity} = \frac{W_2}{W_2 - (W_3 - W_1)}$$

Observations and Calculations:

Mass of empty dry flask,	W gm		
Mass of flask + water	W_1 gm		
Mass of saturated surface dry sample,	W_2 gm		
Mass of flask + sample + water	W_3 gm		
Bulk Specific gravity $\frac{W_2}{W_2 - (W_3 - W_1)}$			

Precautions:

(i) The entire sample should be frequently stirred to secure uniform drying.
(ii) The air trapped in the aggregate should be brought to surface by rolling the flask in inclined position.
(iii) All weighing should be accurate to the nearest gm.
(iv) Sand should not be allowed to stick to the sides of the jar or flask.
(v) The results of different repetitions should not differ more than 0.02 for specific gravity and 0.005 percent for absorption.
(vi) The meniscus should be at flask mark.

Discussions: Since concrete aggregate are normally used in a wet condition, the bulk specific as determined for field use is based on the mass of saturated surface dry sample, rather than an oven dry sample.

Questions:

1. Define bulk density and specific gravity. Which one is most oftenly used in concrete calculations in the field? Why?
2. Is specific gravity ever a requirement for concrete aggregate? Why? Where do you need the values of bulk density and specific gravity?

BULKING OF FINE AGGREGATES

Object: To determine the bulking effect of sand due to moisture content and to determine the necessary adjustments for bulking of fine aggregate and to draw curve between moisture content and increase in volume of sand.

Apparatus: Balance, cylindrical graduated container, measuring jar, metal tray.

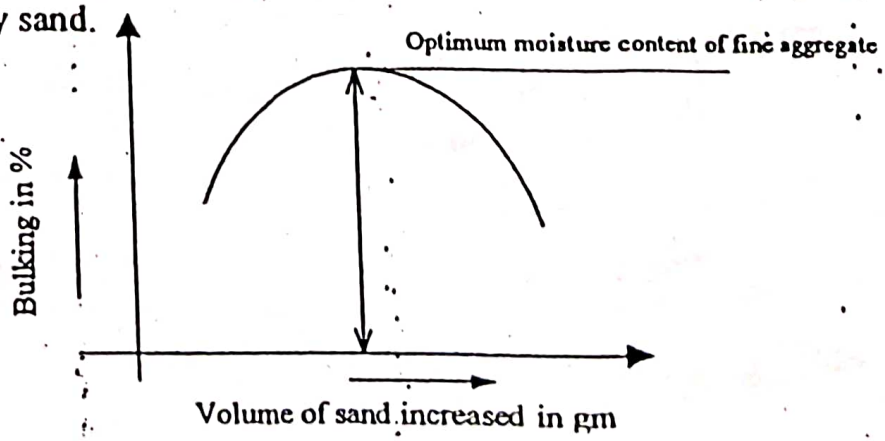
Theory:

In concrete mix design, the quantity of fine aggregate used in each batch should be related to the known volume of cement. The difficulty with measurement of fine aggregate by volume is the tendency of sand to vary in bulk according to moisture contents. The extent of this variation is given by this test.

If sand is measured by volume and no allowance is made for bulking, the mix will be richer than that specified because for given mass, moist sand occupies a considerably larger volume than the same mass of dry sand, as the particles are less closely packed when the sand is moist. If, as is usual, the sand is measured by loose volume, it is necessary in such a case to increase the measured volume of the sand, in order that the amount of sand put into concrete may be the amount intended for the nominal mix used based on the dry sand. It will be necessary to increase the volume of sand by the percentage bulking. The correction to be made is only a rough method at the best, but a correction of the right order can easily be determined and should be applied in order to keep the concrete uniform.

Procedure:

1. Put sufficient quantity of the dry sand loosely into the container until it is about two – third full. Level off the top of sand and weigh the container. Calculate the mass of sand by deducting the mass of container.
2. Measure the height of sand. Let it be 'h' cm.
3. Empty the sand out into a clean metal tray without any loss.
4. Add 1% of water by mass of sand. Mix the sand and water thoroughly by hand.
5. Put the wet sand loosely into the container without tamping it.
6. Smooth and level the top surface of the inundated sand and measure its depth. Let 'h' be the depth in 'cm'.
7. Repeat the above procedure with 2% of water by mass and so on. Go on increasing the percentage by one till bulking is maximum and starts falling down and ultimately bulking is zero, i.e., saturated sand occupies the same volume as dry sand.



SIEVE ANALYSIS OF FINE AGGREGATES

Aim: To determine fineness modulus and grain size distribution of the given fine aggregate.

Apparatus: Indian standard test sieves:- 4.75mm, 2.36mm, 1.81mm, 600μm, 300μm, 150μm, weighing balance, sieve shaker, trays, rice plate.

Theory: Fine aggregate is use the sand used in mortars. Coarse aggregate that is the broken stone or gravel, and the mixed aggregate, which is the combination of coarse and fine aggregate are used in concrete. The coarse aggregate, unless mixed with fine aggregate, does not produce good quality concrete for construction works. The size of the fine aggregate is limited to maximum of 4.75 mm gauge beyond which it is known as coarse aggregate.

Fineness modulus is only a numerical index of fineness giving some idea of the mean size of particles in the entire body of aggregate. Determination of fineness modulus may be considered as a method of standardization of the grading of the aggregates. It is obtained by sieving a known mass of a given aggregate on a set of standard sieves and by adding cumulative percentages of mass of material retained on all the sieves and dividing the total percentage by 100.

The object of finding the fineness modulus is to grade the given aggregate for obtaining a most economical and workable mix with minimum quantity of cement. Certain limits of fineness modulus is given in table .the sample under test should satisfy these results so that the aggregate may give good workability under economical conditions.

Limits of fineness Modulus for Aggregate

Type of aggregate	Maximum size of a aggregate	Fineness Modulus	
		Minimum	Maximum
Fine Aggregate	4.75	2.00	3.50

If the test aggregate gives higher fineness modulus, the mix will be harsh and if on the other hand gives a lower finess modulus, it results in an uneconomical mix. Fix a given workability coarse aggregate require lesser water – cement ratio.

Procedure:

1. Take 1 kg of sand from a laboratory sample of 10 kg by quartering and break clay lumps, if any, in a clean dry rice plate.
2. Arrange the sieves in order of IS sieves no's 4.75 mm, 2.36 mm, 1.18 mm, 600μm, 300μm, 150μm, keeping 4.75 mm at the top and 150μm at the bottom. Fix them in the sieve shaking machine with the pan at the bottom and cover at the top.
3. Keep the sand in the top sieve , carry out the sieving in the set of sieves as arranged before for not less than 10 minutes.
4. Find the mass retained on each sieve and tabulate the results.


AGGREGATES

TESTS ON AGGREGATES

- Sieve analysis or Gradation
- Specific gravity and water absorption test
- Crushing test
- Abrasion test
- Impact test
- Flakiness & Elongation Test (Shape Test)

1. Specific Gravity And Water Absorption Test

- Weight of saturated aggregate suspended in water with basket = $\mathbf{W_1 g}$
- Weight of basket suspended in water = $\mathbf{W_2 g}$
- Weight of saturated surface dry aggregate in air = $\mathbf{W_3}g$
- Weight of oven dry aggregate = $\mathbf{W_4 g}$
- Weight of saturated aggregate in water = $\mathbf{W_1 - W_2 g}$
- Weight of water equal to the volume of the aggregate = $\mathbf{W_3 - (W_1 - W_2)g}$

Formulas:

(1) Specific gravity = $\mathbf{W_3 / (W_3 - (W_1 - W_2))}$

(2) Water Absorption = $\mathbf{((W_3 - W_4) / W_4) \times 100}$

Recommended Values of Specific Gravity and Water Absorption for Aggregates

- The specific gravity of aggregates normally used in road construction ranges from about **2.5 to 3.0 with an average of about 2.68.**
- Water absorption shall not be more than **0.6 per unit by weight**

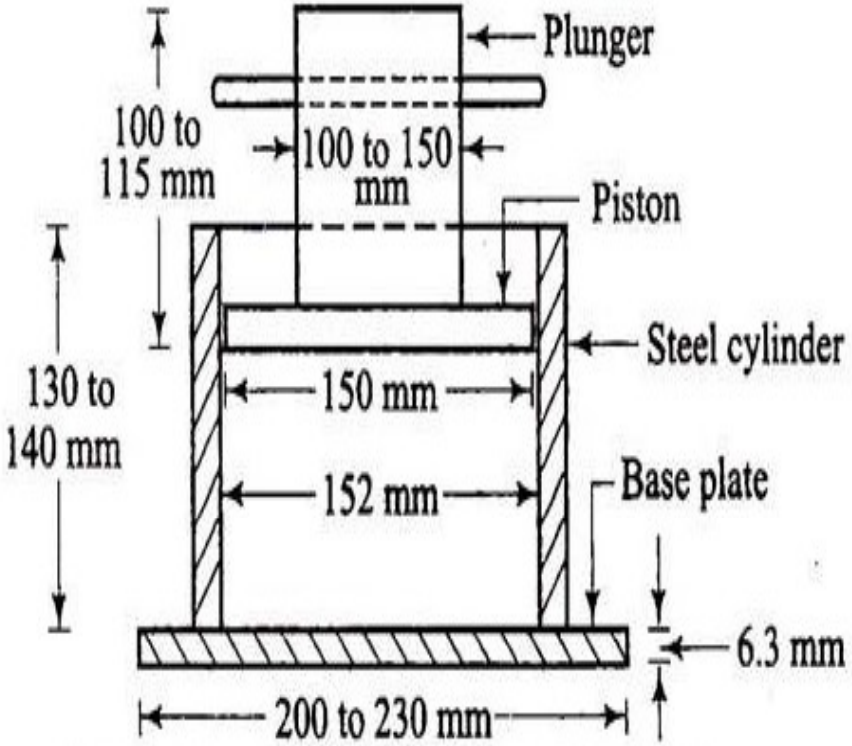
Apparatus for testing Specific Gravity and Water Absorption of Aggregates

2. Crushing Test

•Aggregate crushing value test on coarse aggregates gives a relative measure of the resistance of an aggregate crushing under gradually applied compressive load.

•Aggregate crushing value is a numerical index of the strength of the aggregate and it is used in construction of roads and pavements.

•Crushing value of aggregates indicates its strength. Lower crushing value is recommended for roads and pavements as it indicates a lower crushed fraction under load and would give a longer service life and a more economical performance.



Aggregate crushing test apparatus

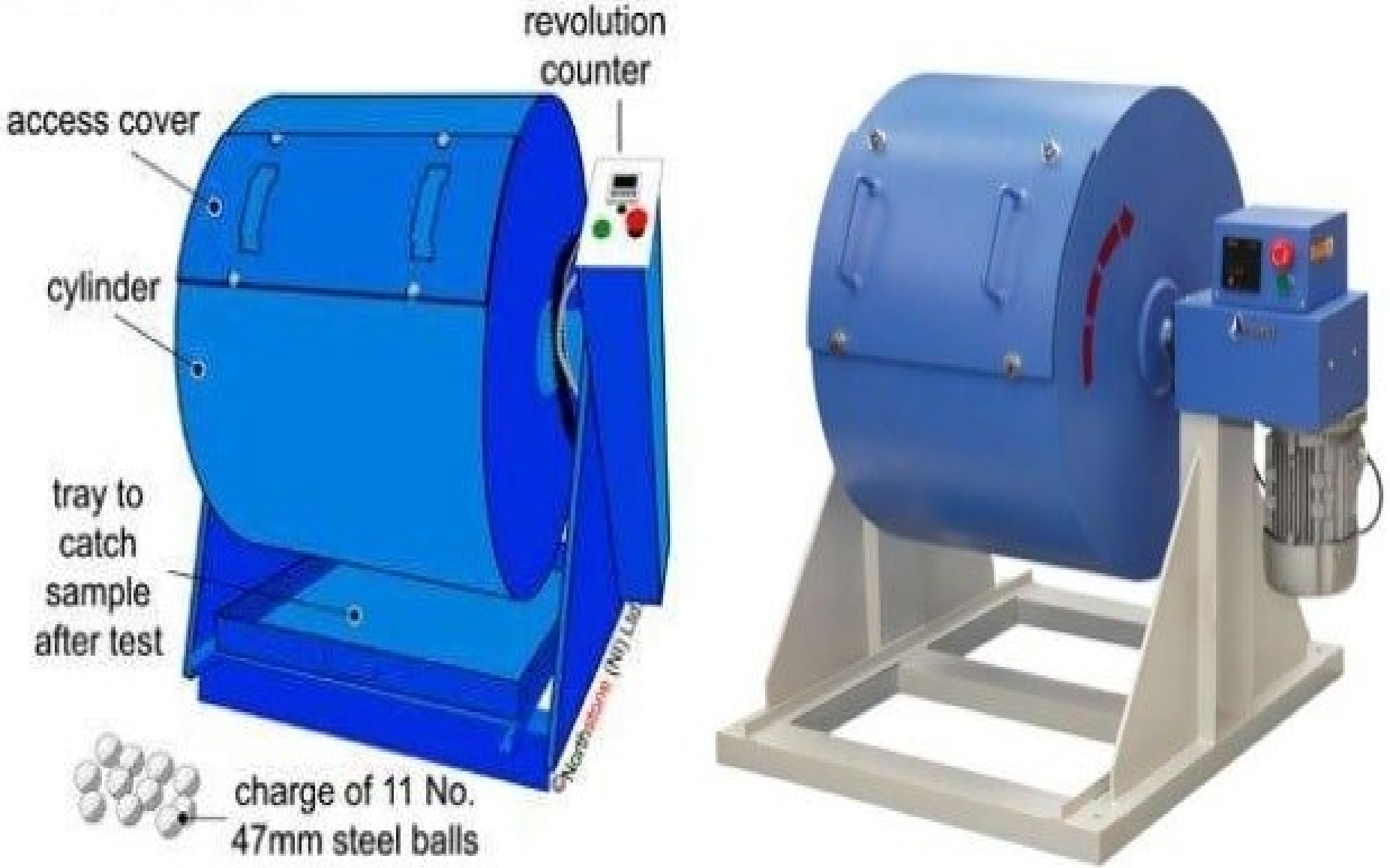
- Dry aggregates passing through 12.5 mm sieves and retained 10 mm sieves are filled in a cylindrical measure of 11.5 mm diameter and 18 cm height in three layers.
- Each layer is tamped 25 times with at standard tamping rod. The test sample is weighed and placed in the test cylinder in three layers each layer being tamped again.
- The specimen is subjected to a compressive load of 40 tonnes gradually applied at the rate of 4 tonnes per minute.
- Then crushed aggregates are then sieved through 2.36 mm sieve and weight of passing material (W2) is expressed as percentage of the weight of the total sample (W1) which is the aggregate crushing value.
- Aggregate crushing value = (W1/W2)*100
- A value less than 10 signifies an exceptionally strong aggregate while above 35 would normally be regarded as weak aggregates.

Type of road construction	Aggregate crushing value not more than (%)
1. Flexible pavements	50
(a) Soiling	40
(b) Water bound macadam	40
(c) Bituminous macadam	30
(d) Bituminous surface-dressing or thin premix carpet	30
2. Rigid pavements	
(a) Other than wearing course	45
(b) Surface of wearing course	30

3. Los Angeles Abrasion Test

Due to movements of traffic, the road metals used in the surface courses are subjected to wearing action at the top. Resistance to wear or hardness is hence an essential property for road aggregates. The road metals or aggregates should be hard enough to resist the abrasion due to traffic.

Los Angeles machine



Los Angeles abrasion test setup

SPECIFICATIONS FOR LOS ANGELES TEST

No.	Sieve size		Weight (in gm) and grading of test samples						
	Passing on mm	Retained on mm	A	B	C	D	E	F	G
1.	80	63	–	–	–	–	2500	–	–
2.	63	50	–	–	–	–	2500	–	–
3.	50	40	–	–	–	–	5000	5000	–
4.	40	25	1250	–	–	–	–	5000	5000
5.	25	20	1250	–	–	–	–	–	5000
6.	20	12.5	1250	2500	–	–	–	–	–
7.	12.5	10	1250	2500	–	–	–	–	–
8.	10	6.3	–	–	2500	–	–	–	–
9.	6.3	4.75	–	–	2500	–	–	–	–
10.	4.75	2.36	–	–	–	5000	–	–	–
Number of spheres to be used			12	11	8	6	12	12	12
Number of revolutions			500				1000		

- Select the grading to be used in the test such that it conforms to the grading to be used in construction, to the maximum extent possible.
- Take 5 kg of sample for gradings A, B, C & D and 10 kg for gradings E, F & G.
- Place the aggregates and abrasive charge on the cylinder and fix the cover.
- Rotate the machine at a speed of 30 to 33 revolutions per minute. The number of revolutions is 500 for gradings A, B, C & D and 1000 for gradings E, F & G. The machine should be balanced and driven such that there is uniform peripheral speed.
- The entire stone dust is sieved on 1.70 mm IS sieve.
- The material coarser than 1.7mm size is weighed correct to one gram.

Observations of Los Angeles Test

- Original weight of aggregate sample = $\mathbf{W_1}$ **g**
- Weight of aggregate sample retained = $\mathbf{W_2}$ **g**
- Weight passing 1.7mm IS sieve = $\mathbf{W_1 - W_2}$ **g**

$$\textbf{Abrasion Value} = (W_1 - W_2) / W_1 \times 100$$

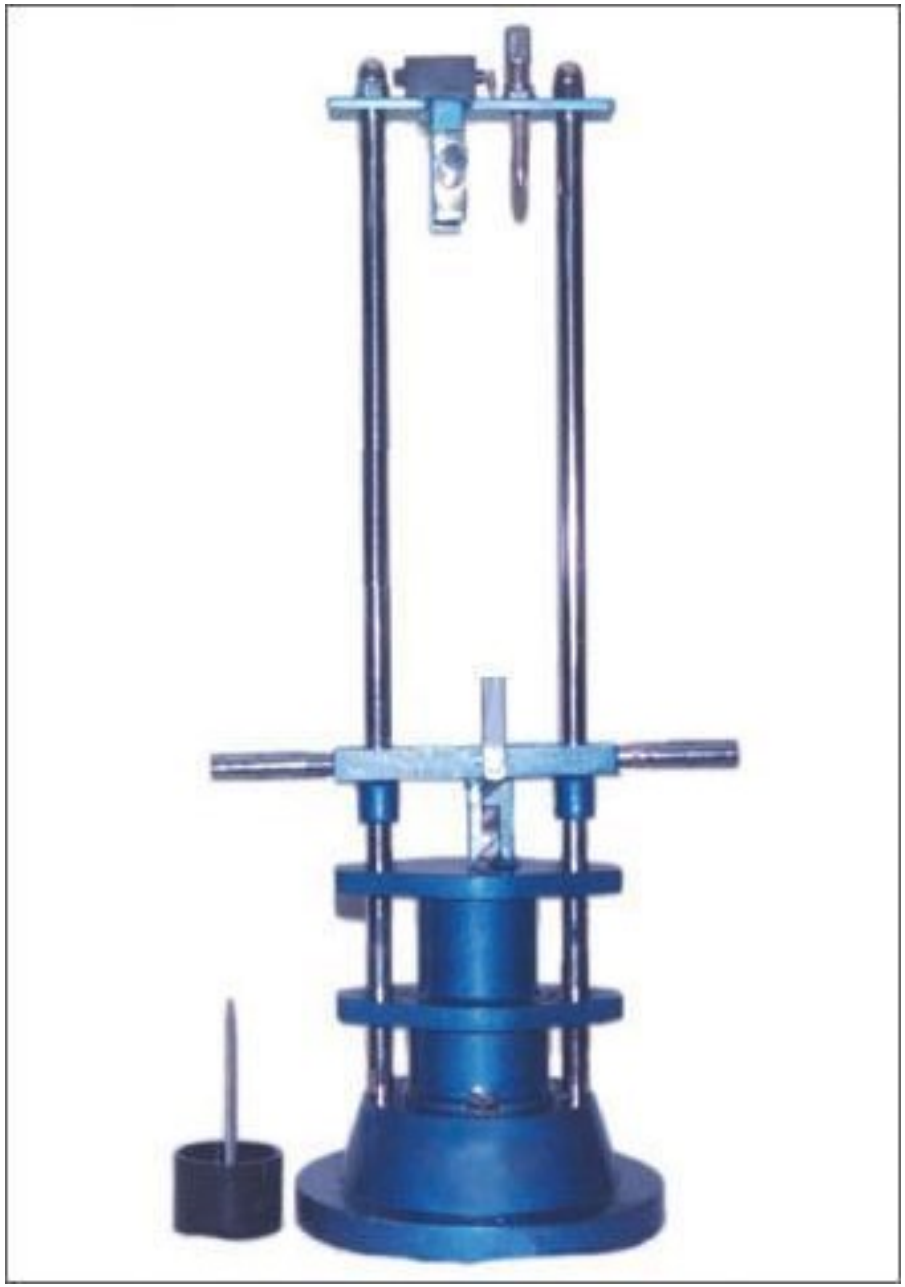
Recommendations:

A maximum value of **40 percent** is allowed for **WBM base course** in Indian conditions. For **bituminous concrete**, a maximum value of **35 percent** is specified.

4. Impact Test

The property of a material to resist impact is known as toughness. Due to movement of vehicles on the road the aggregates are subjected to impact resulting in their breaking down into smaller pieces.

The aggregates should therefore have sufficient toughness to resist their disintegration due to impact. This characteristic is measured by impact value test.



- The aggregate impact test is carried out to evaluate the resistance to impact of aggregates.
- Aggregates passing 12.5 mm sieve and retained on 10 mm sieve is filled in a cylindrical steel cup of internal dia 10.2 mm and depth 5 cm which is attached to a metal base of impact testing machine.
- The material is filled in 3 layers where each layer is tamped for 25 numbers of blows.
- Metal hammer of weight 13.5 to 14 Kg is arranged to drop with a free fall of 38.0 cm by vertical guides and the test specimen is subjected to 15 numbers of blows.
- The crushed aggregate is allowed to pass through 2.36 mm IS sieve and weighed.

AGGREGATE IMPACT VALUE = (B/A)*100

- Initial weight of dry aggregates taken in the measuring the cylinder of (A)
- Weight of fraction passing 2.36mm IS sieve (B)

Aggregate Impact Value	Classification
Less than 10%	Exceptionally strong
10 – 20%	Strong
10 – 30%	Satisfactory for road surfacing
Greater than 35%	Weak for road surfacing

5. Shape Test

- The particle shape of the aggregate mass is determined by the percentage of flaky and elongated particles in it. Aggregates which are flaky or elongated are detrimental to higher workability and stability of mixes.
- The **flakiness index** is defined as the percentage by weight of aggregate particles whose **least dimension is less than 0.6 times their mean size**.
- The Elongation index of an aggregate is the percentage by weight of particles whose greatest dimension (length) is greater than nine-fifths (1.8times) their mean dimension. This test is not applicable for sizes smaller than 6.3mm.

- Take sufficient quantity (W_1) of coarse aggregate sample by quartering so as to provide atleast 200 pieces of any fraction.
- Carry out sieving by hand
- Pass the separated aggregate fractions as retained on the sieves in step 2 through the corresponding slots in the thickness guage.
- Find the total mass W_2 of the materials passing through the slots of the thickness guage.
- Calculate the flakiness index as defined below. The flakiness index is an empirical factor expressing a total material passing through the slots of the thickness guage as the percentage of the mass of sample taken for testing.

- The weight of particles not passes through the thickness gauge is recorded for each fraction. This is the weight $W_3$of aggregate considered to calculate the Elongation index.
- Pass the separated aggregate fractions as retained on the sieves in step 2 through the corresponding slots in the thickness guage.
- Find the total mass W_4 of the material retained on the length gauges.
- Determine the elongation index as percentage material retained by the length gauges to the total weight of non flaky aggregate sample.

- **Flakiness Index of Coarse Aggregate = (W2/W1)x 100**

  Where,

  W1 = Weight of aggregate retained on each sieve

  W2 = Weight of aggregate passing through slot

- **Elongation Index = (W4/W3) X 100**

  Where,

  W3 = Weight of aggregate retained on each sieve

  W4 = Weight of aggregate passing through slot

M-2

-: FOUNDATION :-

Every building consists of 2 basic components: The Super-Structure & the Substructure @ foundations. The Superstructure is usually that part of the building which is above the ground, & which serves the purpose of its intended use. The substructure (or) foundations is the lower portion of the building, usually located below ground level which transmits the load of the superstructure to the subsoil

"A foundation is therefore that part of the structure which is in direct contact with the ground to which the loads are transmitted". The soil which is located immediately below the base of the foundation is called the subsoil (or) foundation soil, while the lowermost portion of the foundation which is in direct contact with the subsoil is called the footing.

Preliminary investigation of Soil:

Inspection of the construction site, topographical features near the site & open excavations near the site can reveal some aspects required for construction of foundations.

In general inspection of site work serves as a good factor to determine the type of foundation, to be adopted for the purpose of work & in addition it helps in getting the data w.r.t the following items.

a) Behaviour of ground due to variations in depth of W.T
b) Disposal of storm water at site.
c) Nature of soil by visual examination.
d) Movement of ground due to any reason etc.,
e) Subsoil water contains sulphates (or) other chemicals.
f) Type of foundation layed to the near by buildings.

Purpose of Priliminary investigation / Site exploration:-

1) To fix the value of safe bearing capacity of soil
2) To select an economical safe type of foundation.
3) To fix depth upto which the foundation taken.
4) To predict the likely settlement of the selected foundation & to make allowance for same in design.
5) To know the underground water level & to solve the ground water problem.

Bearing Capacity of Soil:

Soil behaves in a complex manner when load is applied when the load is applied over the soil it deforms. The resistance to deformation of the soil depends upon

i) water content
ii) Bulk Density
iii) Angle of internal friction
iv) Manner in which load is applied on soil.

"Maximum load per unit area which the soil @ rock can carry without displacement is termed as Bearing capacity of soil".

1) Ultimate bearing capacity of soil:-

The intensity of loading at the base of foundation, at which soil fails in shear

2) Safe bearing capacity:-

The max., intensity of loading that the soil will safely carry without risk of shear failure.

$$SBC = \frac{\text{Ultimate Bearing capacity}}{\text{Factor of Safety.}}$$

3) Gross pressure Intensity (q)

It is the total pressure intensity at the base of the footing due to the weight of the Super-structure, self wt., of the footing & wt., of earth fill.

4) Net pressure intensity: (q_n)

It is defined as the excess pressure @ difference in intensities of the gross pressure after the construction of the structure & the original overburden pressure.

$$q_n = q - \gamma D$$

γ → Unit wt. of foundation ; D → Depth of footing.

5) Allowable Bearing pressure:

It is the max., allowable net loading intensity which can be applied to the soil taking into the account of ultimate bearing capacity, the amount of settlement, ability of the structure to withstand the settlement.

A.B.P dependent on both sub-soil & the type of building proposed to be erected thereon. The allowable bearing pressure adopted in the design of foundation is lesser of following 2 values

a) Safe bearing capacity of soil.

b) The max., allowable bearing pressure that the soil can take without exceeding the specified limits of permissible settlement.

Methods to estimate bearing capacity.

1) Analytical method by using soil parameters.
2) Plate load test on the soil.
3) Penetration test.
4) Presumptive bearing capacity values from codes.

Plate Load Test:-

Plate load test is a field test to determine the ultimate bearing capacity of soil & the probable settlement under a given loading.

Plate load test is a semi-direct method to measure the allowable pressure of soil to induce a given amount of settlement. Plates - round (or) square varying in sizes from 30-75 cm & thickness of about 2.5 cm are employed for the test. The load on the plate is applied by making use of hydraulic jack. The reaction of the jack load is taken by a cross beam @ steel truss at both the ends. The settlement of the plate is measured by a set of 3 dial guage of sensitivity 0.02 mm placed 120° apart. The dial guages are fixed to independent supports which donot get disturbed during test.

Foundation:

Foundation is the lowest portion of the building usually located below ground level which transmits the loads of the superstructure to the supporting soil. A foundation is therefore that part of the structure which is in direct contact with the ground to which loads are transmitted.

Functions & Requirements of good foundation:

1) Reduction of load intensity:

Foundation distributes the loads of the superstructure, to a larger ~~depth~~ area so that the intensity of the load at its base doesnot exceed the safe bearing capacity of sub-soil.

2) Even distribution of load:

Foundation distributes the non-uniform load of the super-structure evenly to the sub-soil.

3) Provision of level surface:

Foundation provides levelled & ~~non-uniform~~ hard surface over which the superstructure can be built.

4) Lateral Stability:

It anchors the super-structure to the ground, thus imparting lateral stability to the super-structure.

5) Safety against undermining:

It provides the structural safety against undermining @ scouring due to burrowing of animals & flood water.

6) Protection against soil movements:

Special foundation prevents @ minimize the differ @ cracks in the super structure due to expansion @ contraction of the subsoil bcz of moisture movement in the problematic soil

Requirements of Good Foundation:

1) The foundation should be strong & durable to sustain all the loads coming over it & transmit these loads, safely to the ground.
2) The foundation structure should be sufficient in size & designed for intended loading conditions, made by minimizing the settlements.
3) The foundations should be deep enough to anchor the building to withstand lateral loads.
4) Foundations should be located such that they should not effect the planning of building.

Purpose of foundation:

All the structures are provided with foundation at the base to fulfill the following objectives & purposes

1) To distribute the load of the structure over a large bearing area so as to bring intensity of loading within the safe bearing capacity of the soil lying underneath.
2) To load the bearing surface at the uniform rate so as to prevent unequal settlement.
3) To prevent the lateral movement of the supporting material
4) To secure a level & firm bed for building operations.
5) To increase the stability of the structure as a whole.

Types of Foundation :

Foundation

- Shallow Foundation
  - i) Spread footing
  - ii) Grillage foundations
  - iii) Raft foundations
  - iv) Stepped foundation
  - v) Inverted arch foundation
  - vi) Combined footing
- Deep Foundation
  - i) Pile foundation
  - ii) well foundation
  - iii) Caisson foundation

SHALLOW FOUNDATIONS :-

A shallow foundation is a type of building foundation that transfers building loads to the earth very near to the surface, rather than to a subsurface layer @ a range of depths as does a deep foundations.

i) Spread footing :-

- Spread footing is just a bit wider than the wall @ structure directly above it. It's a very precise, direct- form of foundation where only the actual structure is supported instead of having any left over
- Foundations are constructed by increasing the area at the base of the offsets, are called Spread footings.
- Spread footings spreads the super imposed load of a column over a large area & is used where loads are very light & there are strong shallow soils

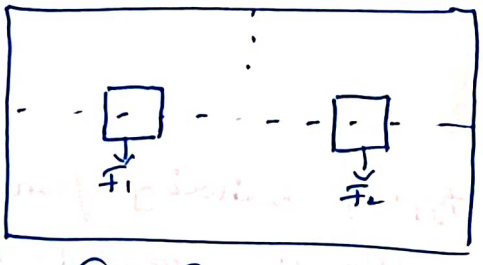
2) Combined footings

a) Two/more columns in a straight line are carried on a single spread footing - is termed as combined footing.

b) This type of footings are provided when the footing is near to the property line, distance b/w 2 columns is less.

c) The design of rigid rectangular combined footing should be done in such a way that the centre of gravity of column loads coincide with the C.G of footing area

d) When the bearing capacity of soil is less, requiring more area under individual footing.



(a) Rectangular footing.

3) Strap footing:

a) If the independent footings of 2 columns are connected by a beam, it is called as strap footing.

b) A strap footing may be used when the distance b/w the columns is so great that a combined trapezoidal footing becomes quite narrow with high B.M.

c) Strap beam does not remain in contact with soil, & thus does not transfer any pressure to the soil.

4) Mat foundation:-

① Mat footing is a foundation that is fortified by steel beams. This is different than combined footing as it is a wide foundation compared to column.

② The beams are laid into place, then has concrete poured inside. This gives the foundation extra strength & helps to hold the weight.

③ Mat foundations spreaded over a large area & it is adopted because it distribute the loads equally to prohibit differential settlement.

Deep foundations:

Deep foundations is a type of foundation which transfers building loads to the earth farther down from the surface than the shallow foundation does, to a subsurface layer @ a range of depths.

Pile foundations:

(1) Pile foundation is the type of deep foundation which taken to a low level by means of vertical members which may be a timber, concrete, steel.

(•) It is adopted instead of raft foundation where no firm bearing strata exists at any reasonable depth & the loading is uneven.

Piles are used to build the foundation are of 4 types

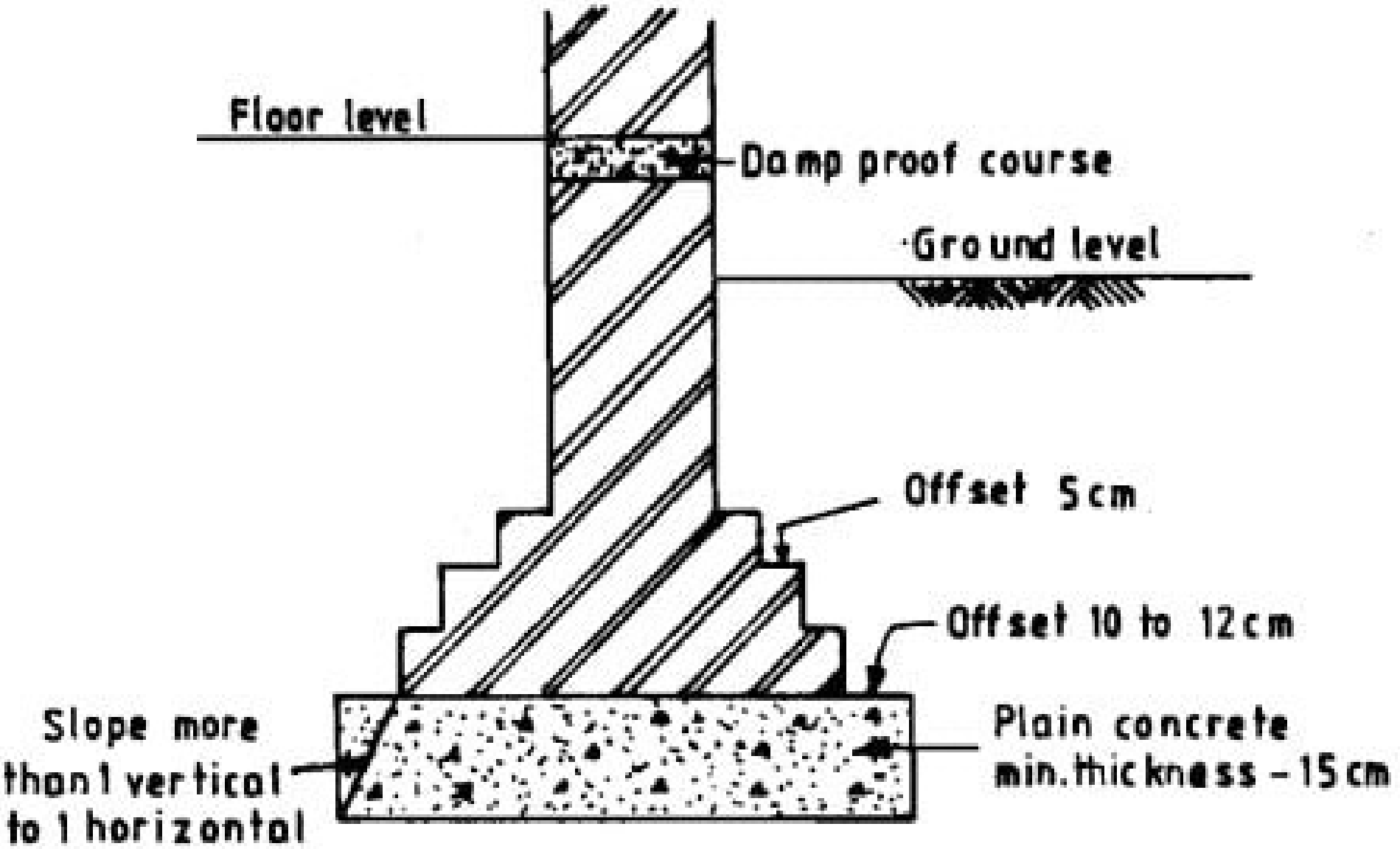
(i) End bearing pile
(ii) Frictional pile
(iii) Combined end bearing & frictional
(iv) Compaction pile

End bearing piles are used to transfer the load through water @ soft soil to a suitable bearing stratum. Such piles carried heavy load safely to hard strata.

Frictional piles are used to transfer the loads to a depth of friction-load-carrying material by means of skin friction along the length of the pile. Such piles are generally used in granular soil.

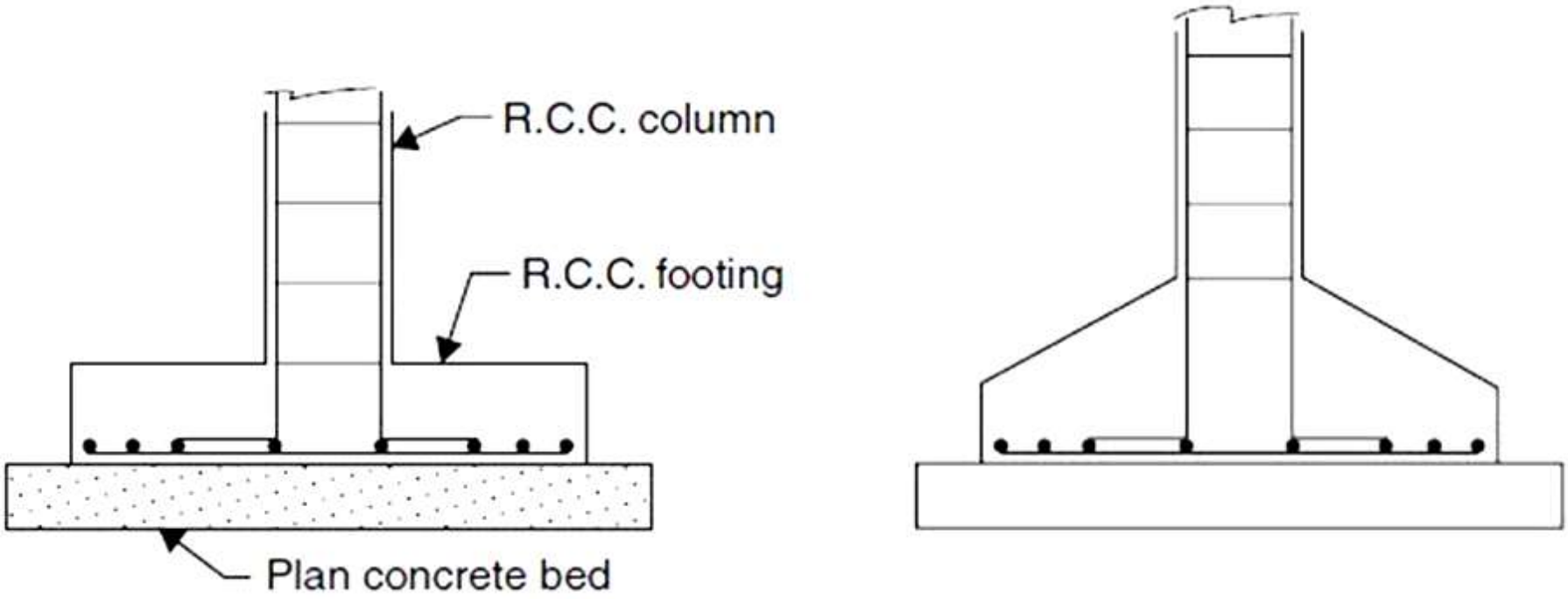
1. Wall Foundation

- Wall footings are pad or spread and strip footings which are used to support structural or nonstructural walls to transmit and distribute the loads to the soil in such a manner that the load-bearing capacity of the soil is not surpassed.
- Wall footing runs along the direction of the wall. The size of the footing and the thickness of the foundation wall are specified on the basis of the type of soil at the site. The width of the wall footing is generally 2-3 times the width of the wall.


Floor level
Damp proof course
Ground level
Offset 5cm
Offset 10 to 12cm
Slope more than 1 vertical to 1 horizontal
Plain concrete min. thickness - 15cm

2. Individual Footing Or Isolated Footing

- Individual footing or an isolated footing is the most common type of foundation used for building construction.
- Shape of the footing – Square or Rectangle and is used when loads from structure is carried by the columns.
- Size is calculated based on the load on the column and safe bearing capacity of soil.



(a) Footing with uniform thickness

(b) Sloping footing

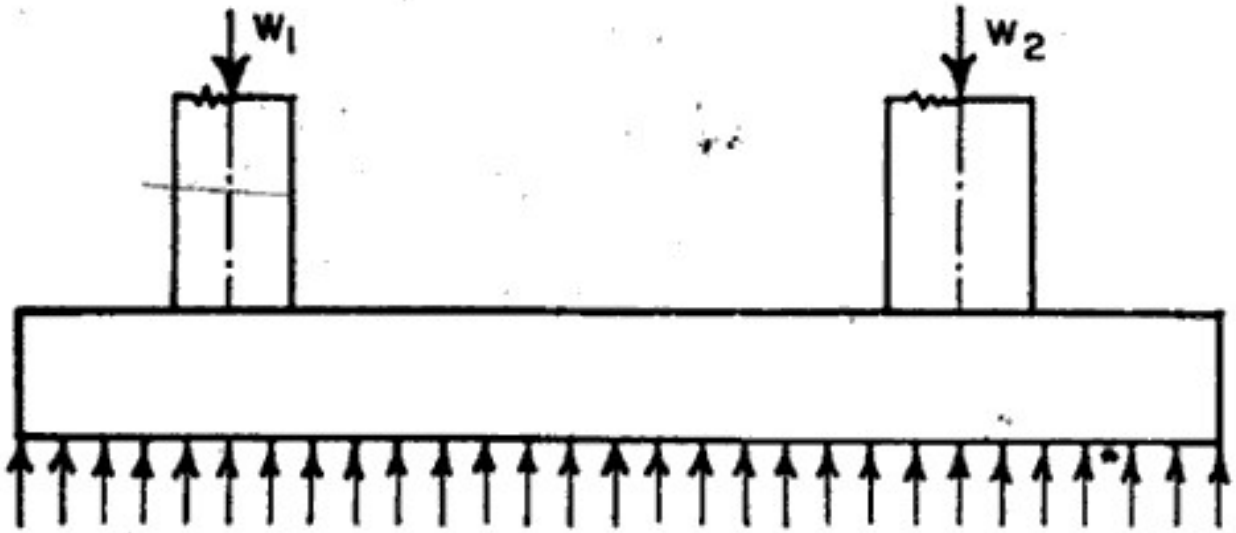
Isolated R.C.C. footing

3. Combined Footing

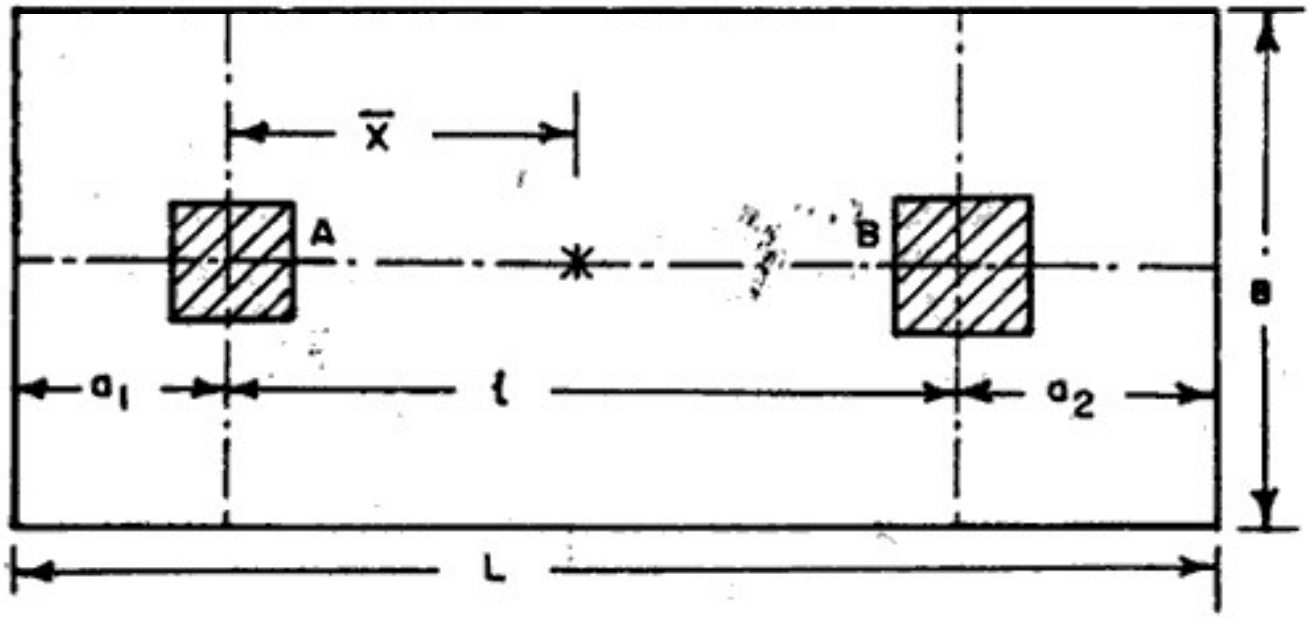
- A combined footing is the one which supports two columns and it may be rectangular or trapezoidal in plan.
- The aim is to get uniform pressure distribution under the footing. For this the center of gravity of the footing area should coincide with the center of gravity of the combined loads of the two columns.

Combined Footings Are Used In The Following Situations:

- When the columns are very near to each other so that their footings overlap.
- When the bearing capacity of the soil is less, requiring more area under individual footing.
- When the end column is near a property line so that its footing cannot spread in that direction.



(a) LONGITUDINAL SECTION



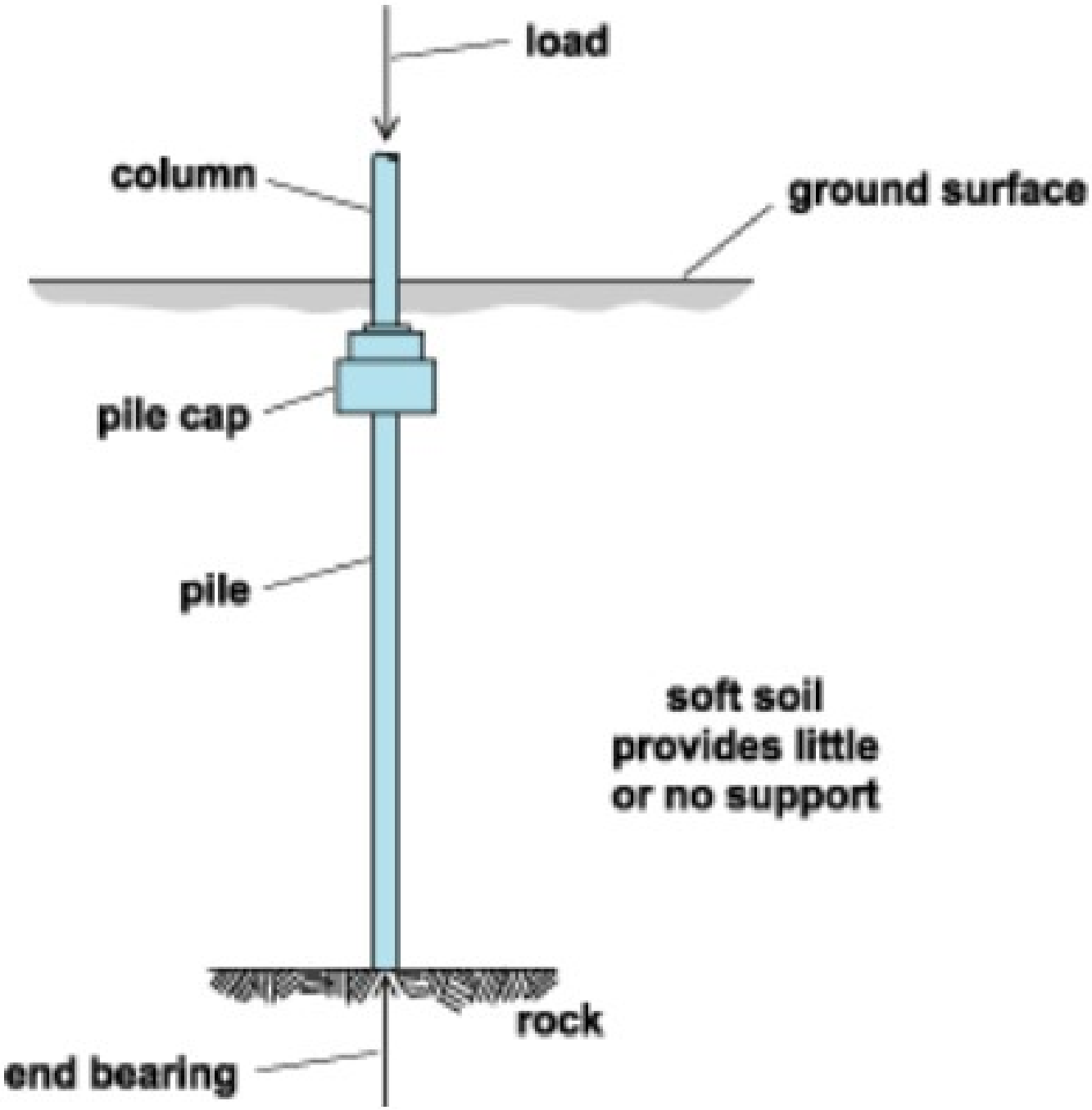
(b) PLAN

4. Raft or Mat Foundations

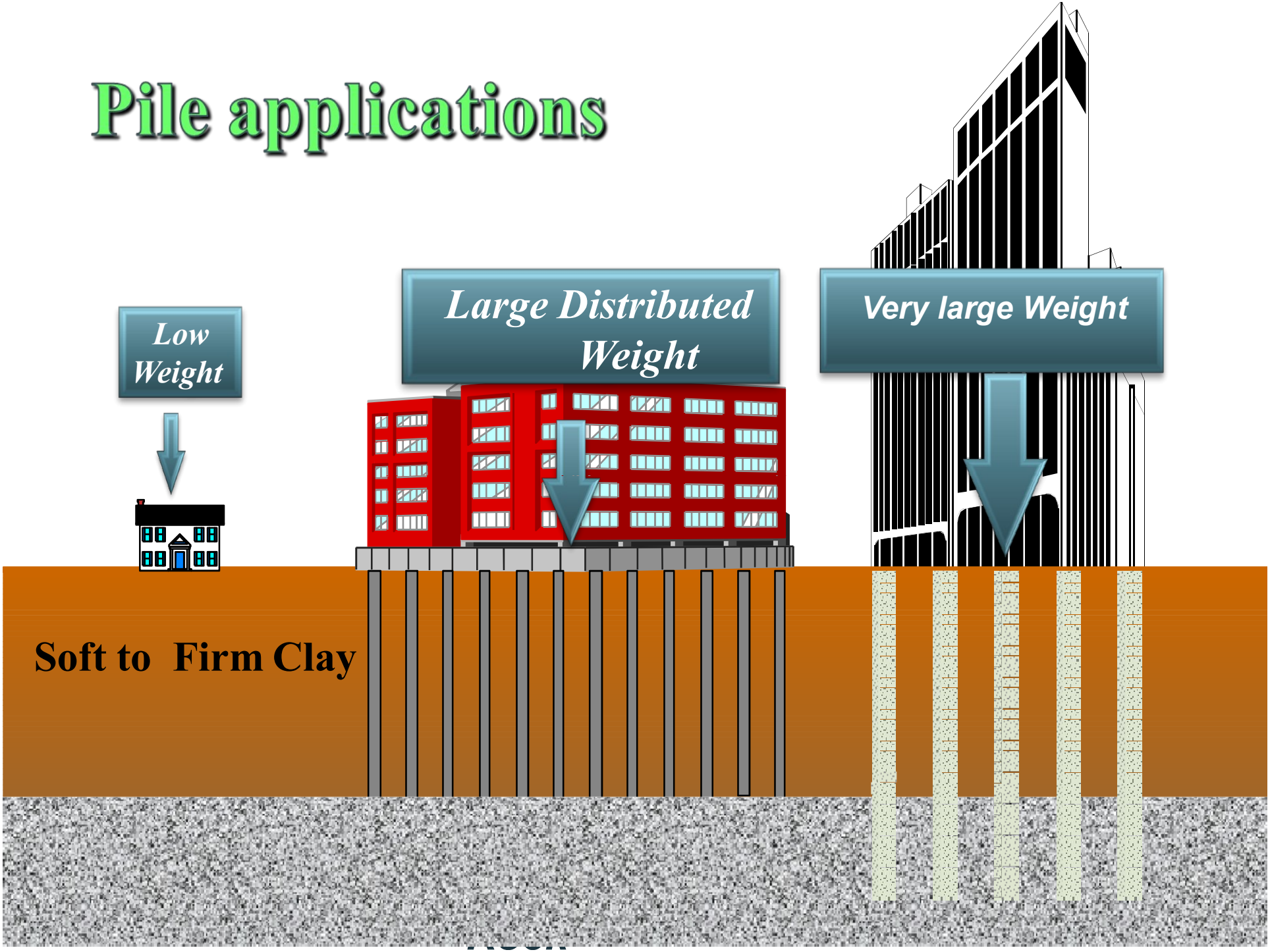
- Raft or mat foundations are the types of foundation which are spread across the entire area of the building to support heavy structural loads from columns and walls.
- The use of mat foundation is for columns and walls foundations where the loads from structure on columns and walls are very high.
- This is used to prevent differential settlement of individual footings, thus designed as a single mat (or combined footing) of all the load bearing elements of the structure.

Pile foundation???

Pile foundation a kind of deep foundation, is actually a slender column or long cylinder made of materials such as concrete or steel which are used to support the structure and transfer the load at desired depth either by end bearing or skin friction.


load
column
ground surface
pile cap
pile
soft soil
provides little
or no support
rock
end bearing

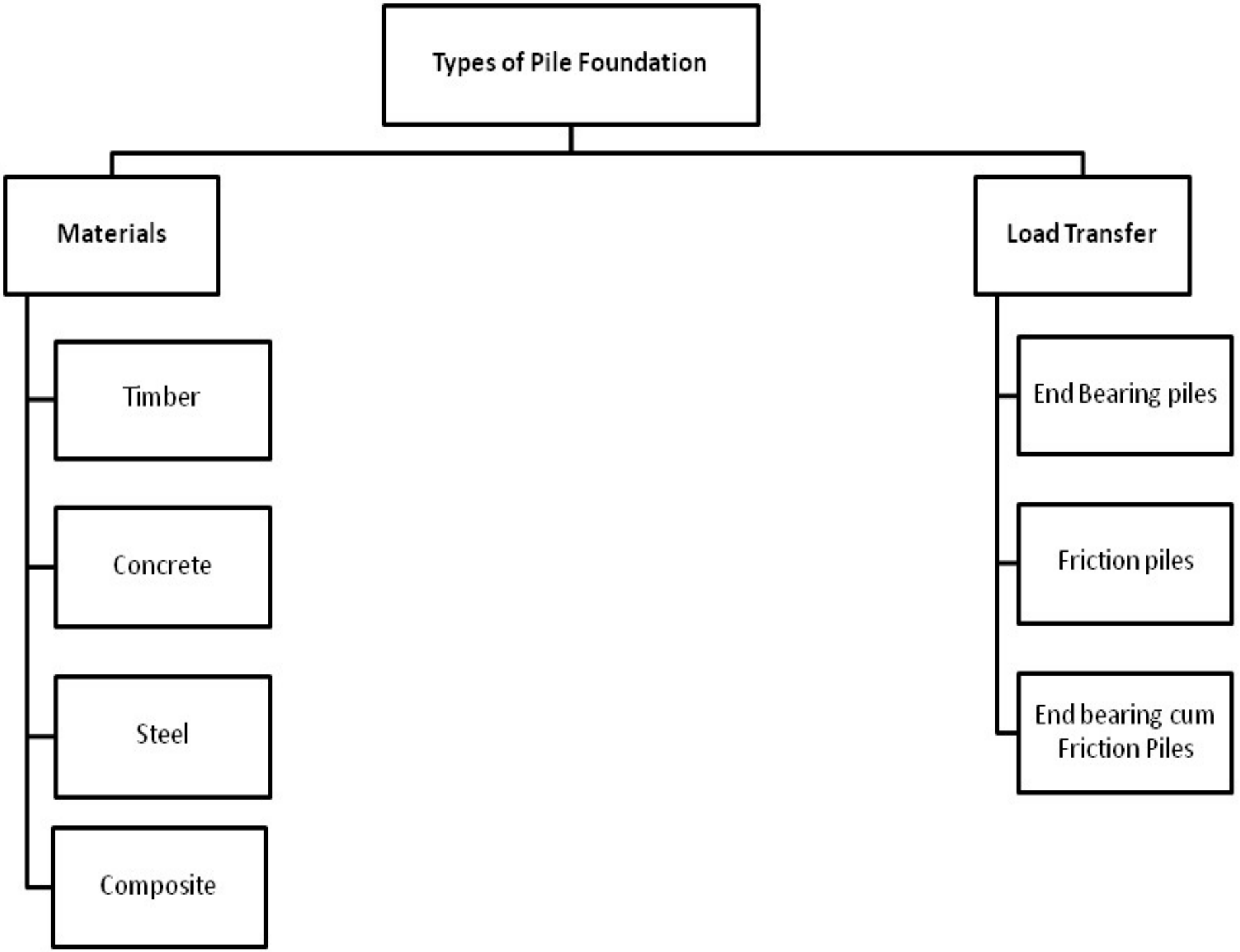
Pile applications



When to Use Pile Foundation??

Following are the situations when using pile foundation system can be

- When groundwater table is high.
- Heavy and un-uniform loads from superstructure are imposed.
- Other types of foundations are costlier or not feasible.
- When the soil at a shallow depth is compressible.
- When there is the possibility of scouring, due to its location near river bed or sea shore etc.
- When there is a canal or deep drainage systems near the structure.
- When soil excavation is not possible up to the desired depth due to poor soil condition.

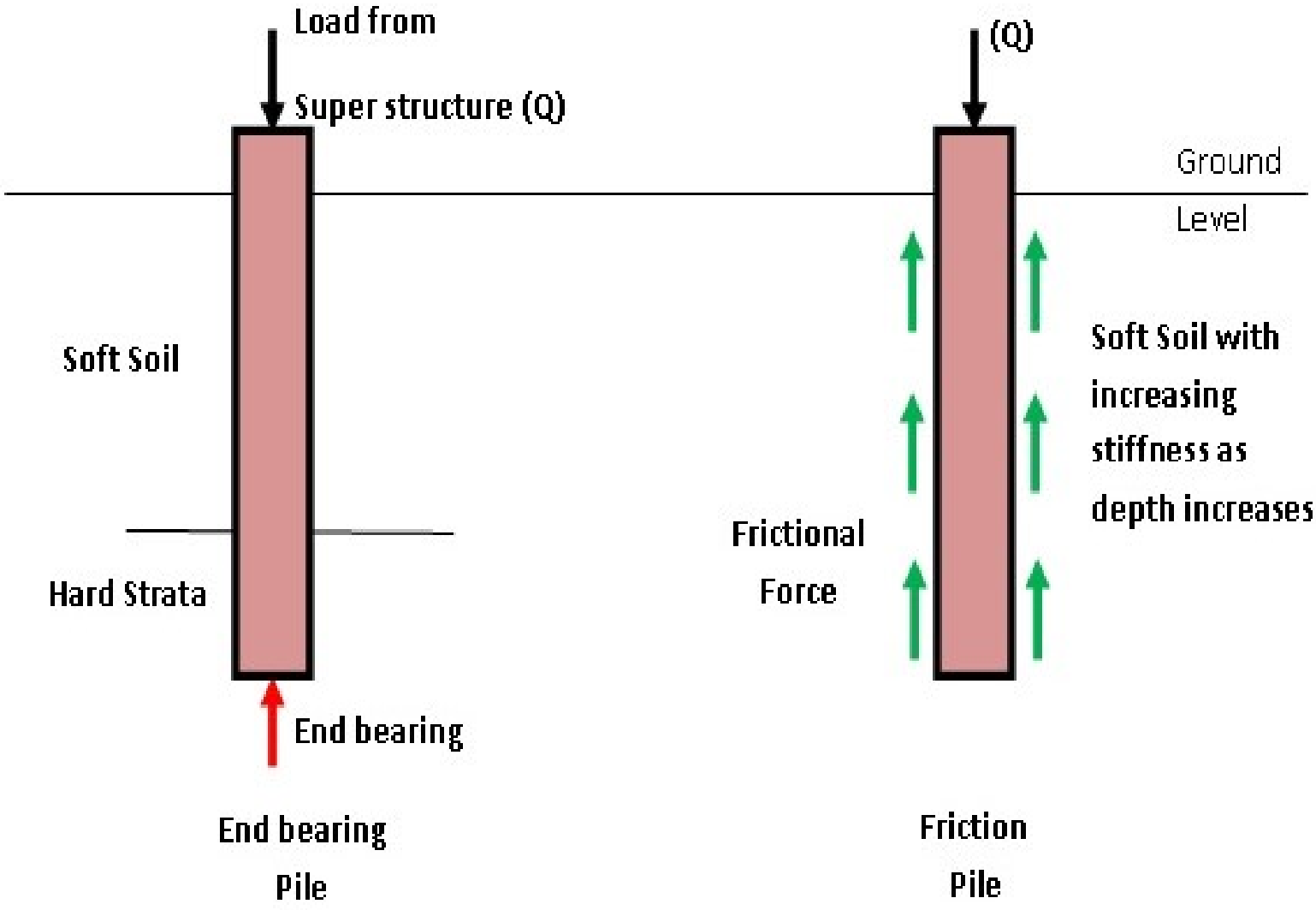

Types of Pile Foundation
Materials
Timber
Concrete
Steel
Composite
Load Transfer
End Bearing piles
Friction piles
End bearing cum Friction Piles

End Bearing Piles

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

Friction Piles

- Friction piles work on a different principle. The pile transfers the load of the building to the soil across the full height of the pile, by friction.
- To visualize how this works, imagine you are pushing a solid metal rod of say 4mm diameter into a tub of frozen ice cream. Once you have pushed it in, it is strong enough to support some load. The greater the *embedment depth* in the ice cream, the more load it can support


Load from
Super structure (Q)
Soft Soil
Hard Strata
End bearing
End bearing
Pile
(Q)
Ground
Level
Soft Soil with
increasing
stiffness as
depth increases
Frictional
Force
Friction
Pile

Sheet Piles

This type of pile is mostly used to provide lateral support. Usually, they resist lateral pressure from loose soil, the flow of water etc.

Timber piles:

- Timber can be used for manufacture of temporary piles and also for permanent ones in regions where timber is readily and economically available. It's most suitable for long cohesion piling and piling under embankments.

Steel Piles:

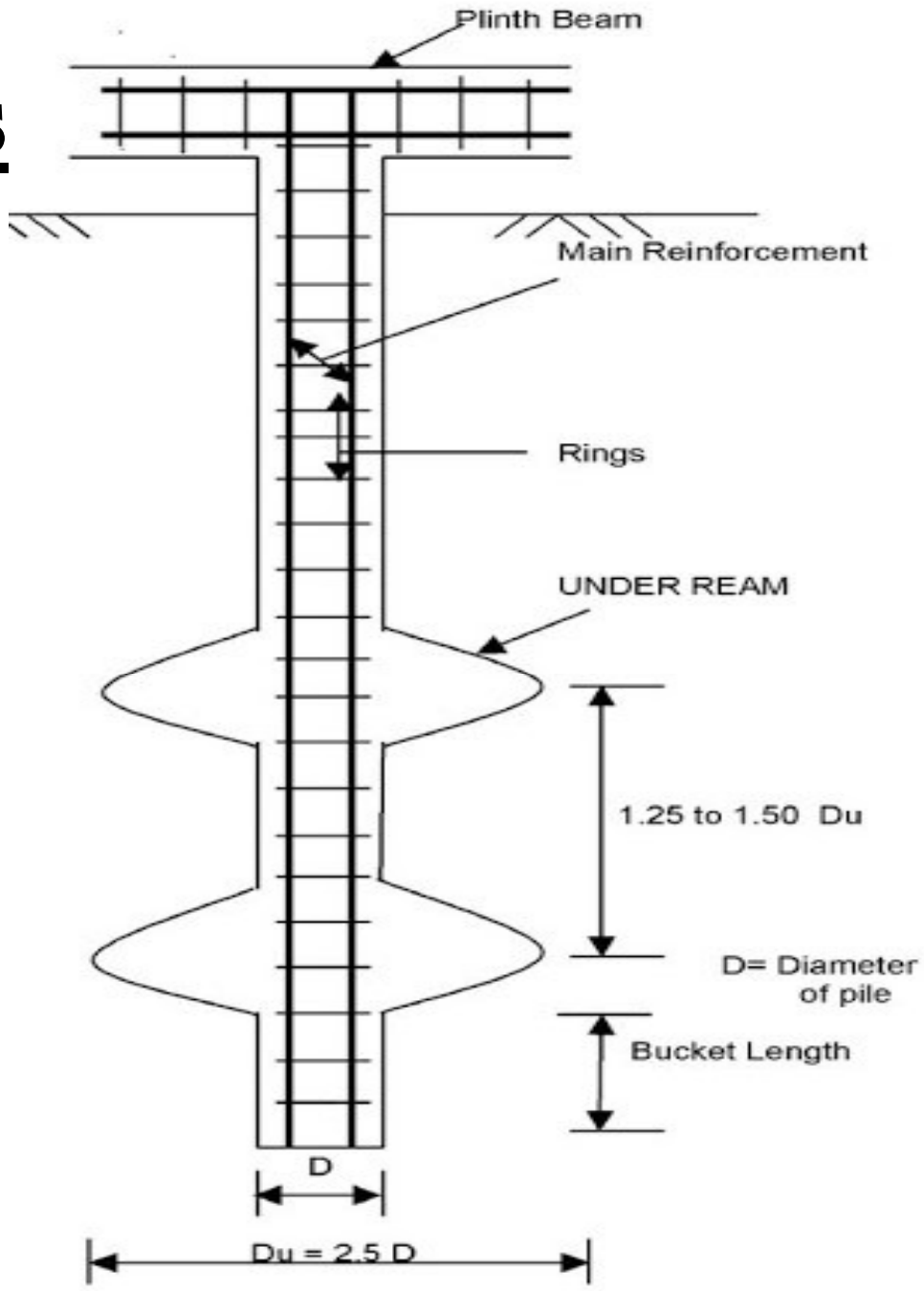
- Steel can be used for both temporary and permanent works. They are suitable for handling and driving for piles with prolonged lengths.
- Their relatively small cross sectional area along with the high strength makes penetration easier in firm

Concrete piles:

Concrete is used to manufacture of precast concrete piles, cast in place and pre-stressed concrete piles. Pre-stressed concrete piles are becoming more approved than the ordinary pre-cast as less reinforcement is required.

Under Reamed Piles

- These are bored, cast in-situ, concrete piles with one or more bulbs formed by enlarging the pile stem.
- They are suitable for loose and filled up sites, or where soils are weak or expansive like black cotton soil.
- The length of under-reamed piles varies from 3 to 8 meter and their centre to centre spacing should normally be not less than 2 times the under-reamed diameter.



Under reamed pile with two under reams

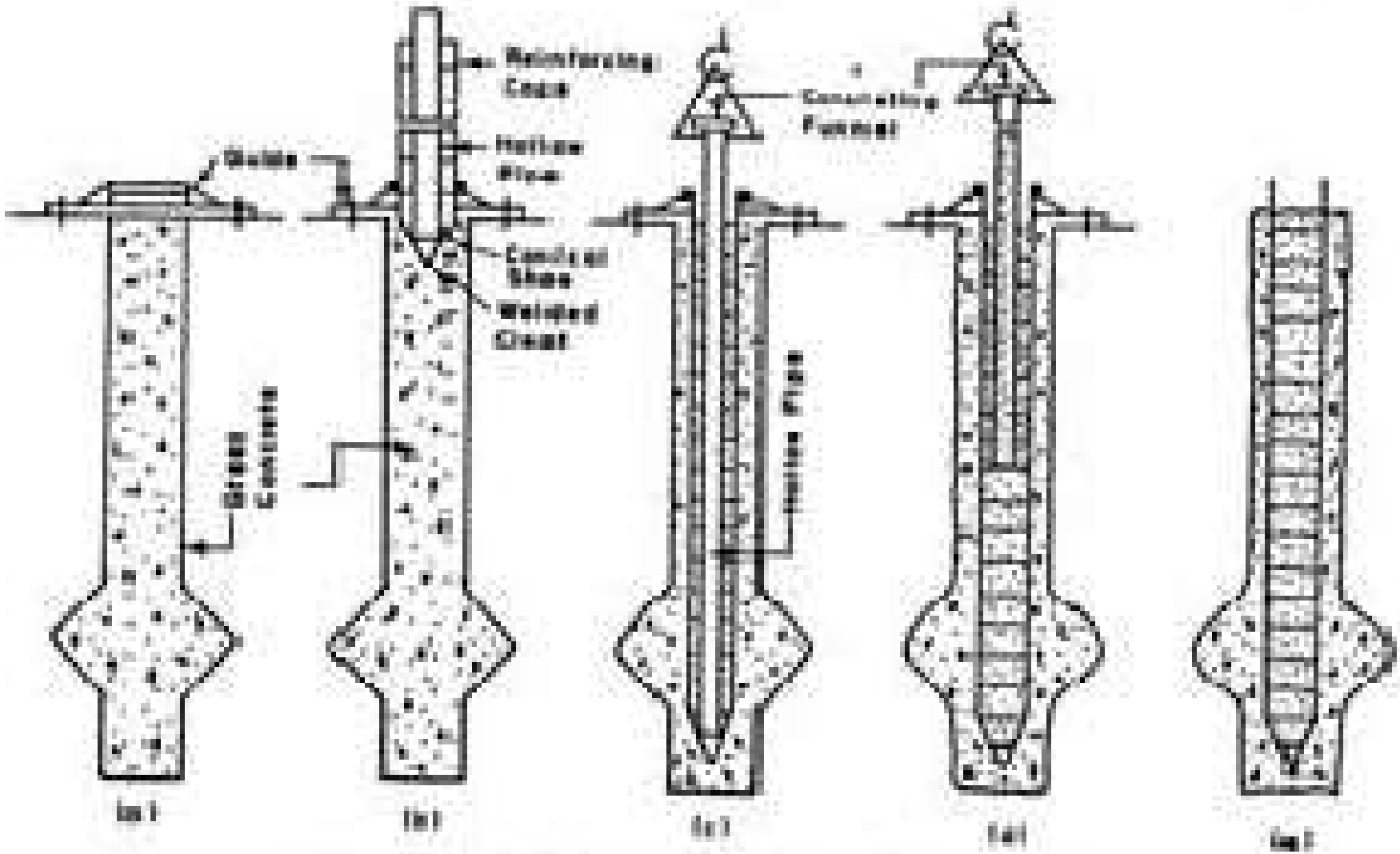
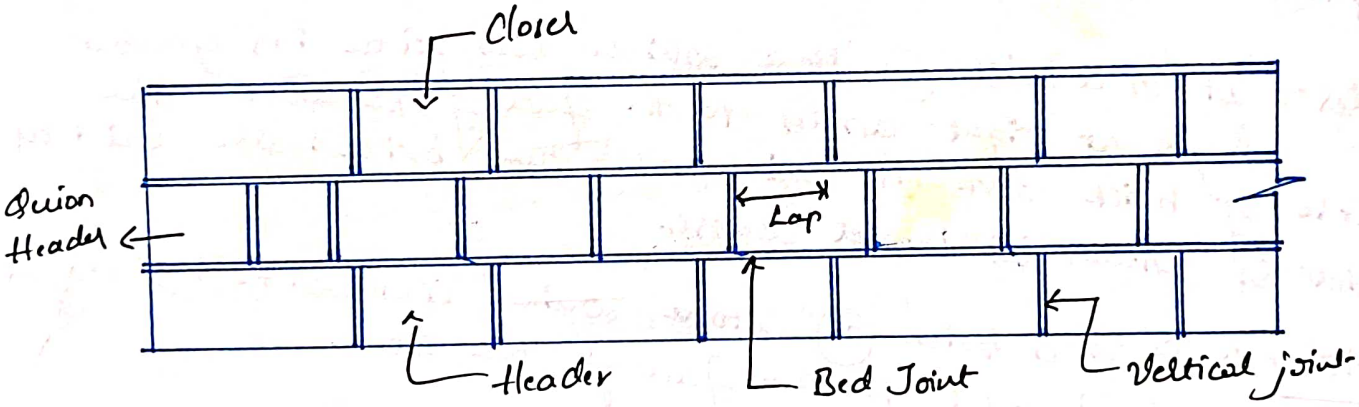


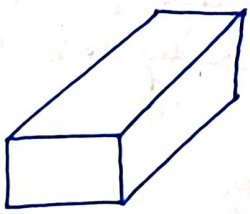
FIG. 4.27. CONSTRUCTION OF BORED COMPACTION PILES

:- MASONRY :-

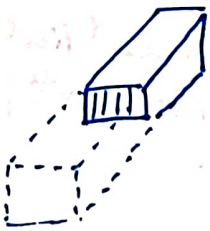
Masonry is a systematic arrangement of building units bonded together with the help of mortar. Building units may be bricks, stones (or) concrete blocks. If brick is used as a building unit then it is said to be brick masonry. Similarly the stone is used as building unit then the masonry is said to be stone masonry. If concrete is used as a building unit it is termed as a concrete Masonry.

Terms used in Masonry :

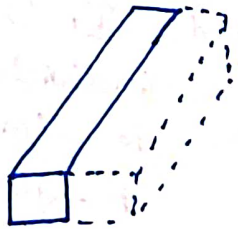




(i) Full Brick

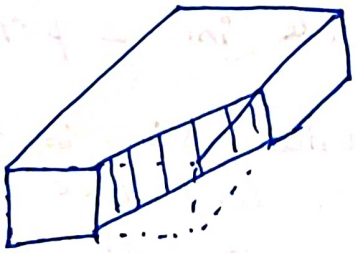


(ii) Half brick



(iii) Queen closer

(iv)



King closer

1) Course: A course is a horizontal layer of bricks (or) stones

2) Bed: It is a surface of stone perpendicular to the line of pressure. It indicates the lower surface of bricks (or) stones in each course.

3) Back: The inner surface of a wall which is not exposed is called the back.

4) Face: The exterior of wall exposed to weather is known as face.

5) Hearting: It is the interior portion of a wall b/w the facing & backing.

6) Joints: It is the junction of two (or) more bricks (or) stones. If the joint is parallel to the bed of bricks (or) stones in a course it is termed as bed joint. The joints which are perpendicular to the bed joints are termed as vertical joints

7) Header: It is a brick (or) stone which lies with its greatest length at right-angles to the face of the work. The course of brick work in which all the bricks are laid as header is known as header course.

8) Stretcher: It is a brick (or) stone which lies with its longest side parallel to the face of the work.

9) Bond: It is the method of arranging bricks so that the individual units are tied together. Bonding is required to eliminate continuous vertical joints both in body as well as on the face of wall.

10) Closer: It is the portion of a brick cut in such a manner that its one long face remains uncut.

11) Queen closer: It is the portion of a brick which is obtained by cutting a brick length-wise into 2 portions.

12) King closer: It is the portion of a brick which is so cut that width of one of its end is half that of a full brick while the other end with is equal to full width

Bonds brick Masonry:

It is the arrangement of bricks in each to avoid the continuity of vertical joint in any of adjacent courses.

Necessity of Bonds:

1) To break the continuity for the following of vertical joints in consecutive courses.
2) To ensure longitudinal & lateral Strength to masonry work.
3) To distribute the load uniformly over Structural wall.
4) To ensure the quality of the work
5) To ensure the Systematic work
6) To provide good aesthetic
7) To economize the work.

Rules of Bonding:

1) Bricks Should be uniform in size.
2) Mortal thickness Should be consistant.
3) Vertical joints in alternative courses Should be in a single plumb line
4) Headers Should be exactly in the middle of Stretcher in a consequtive course
5) Brick bats Should be avoided to maximum.
6) Bricks arrangements are in uniform manner throughout the wall.
7) The lap not more than one & one fourth inches.

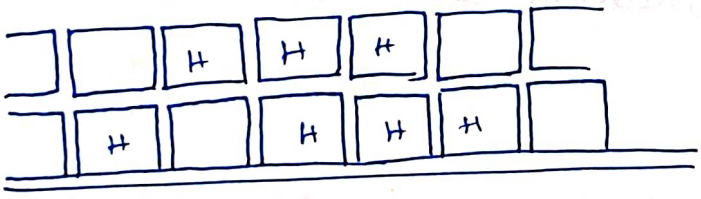
Bonds in Brickwork:

Bonding is the method of arranging the bricks in courses so that individual units are tied together & the vertical joints of successive courses do not lie in same vertical line.

Types of Bonds:

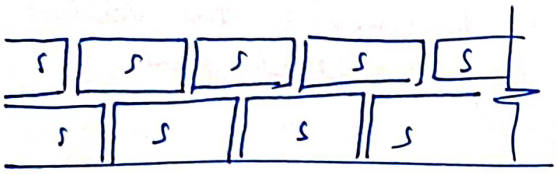
1) Header bond
2) Stretcher bond
3) English bond
4) Flemish bond
5) Facing bond
6) English facing bond
7) Brick on edge bond
8) Dutch bond
9) Raking bond
10) Zigzag bond
11) Garden wall bond.

1) Header bond:



a) Header bond is the one in which all the bricks are laid as headers on the face of wall.
b) The width of the brick are there along the direction of the wall.
c) This pattern is used only when the thickness of the wall is equal to one brick
d) This is used in construction of footing with wall.

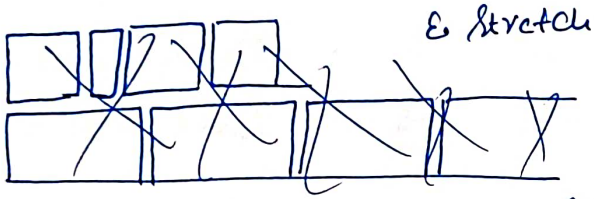
2) Stretcher Bond:



i) This pattern is used only for those walls which have thickness of half bricks such as partition walls, steeper walls division walls.

ii) In this type of bond all the courses are having stretcher only but at each course no overlaping of quion stretcher joint.

3) English Bond: This is commonly used for all wall thickness This bond is considered to be strongest. The bond consist of alternative course of headers & stretchers.



In this bond the vertical joints of header course comeover each other similarly the vertical joints of stretcher course also comes over each other.

4) Flemish Bond:

i) Flemish bond have one stretcher b/w every headers, with the headers centred over the stretcher as shown in fig.

ii) Course begins with a quion stretcher & terminate with a quion stretcher at the end.

iii) The next course begins with a quion header with regular run of alternative header & stretcher is laid.

Flemish bond are 2 types
a) Double flemish bond
b) Single ——

In the double flemish bond each course presents the same appearance both in the front face as well as in the back face Alternative headers & stretchers are laid in each course. It is better appearance than English bond

In Single Flemish bond, it comprised of double Flemish bond facing & english bond backing & hearting in each course. This bond uses the strength of english bond & appearance of Flemish bond. The wall thickness atleast equal to 1½ brick. Double Flemish bond with facing is done with good quality expensive bricks.

Difference b/w English & Flemish Bond:

1) English bond is much stronger than Flemish bond for the walls thicker more than 1½ bricks.
2) Flemish bond shows more attractive & pleasing appearance.
3) Flemish bond is economical as it uses broken brick bats, although it requires some extra mortar for additional joints.
4) Uses of Flemish bond is a bit difficult than english bond.
5) Flemish bond requires more skilled labour & Supervision

Classification of Stone masonry:

Depending upon the arrangement of stones in the construction degree of reinforcement used in shaping the stone & finishing adopted.

Stone masonry can be classified as,

a) Rubble Masonry b) Ashlar masonry.

- Random rubble masonry
  - Coursed
  - Uncoursed
- Square rubble
  - Uncoursed
  - Built to coursed
  - Regular coursed
- Dry rubble
- Miscellaneous
  - Polygonal walling
  - Flint walling

- Ashlar fine @ cocalled ashlar
- Random coarse ashlar
- Rough tooled ashlar
- Rock @ quarry faced ashlar
- Chamfered ashlar
- Block in coarse masonry
- Ashlar facing.

Random Rubble Masonry:

This is the roughest & cheapest form of stone walling. In this type of masonry the stone used are of widely diff sizes.

a) Uncoursed Rubble masonry: (U.R.M)

- Stones are not uniform sizes & shapes & they are directly obtained from quarry.
- This is the cheapest, roughest form of stone masonry. URM are arranged in such a way that they adequately distribute the pressure over the max., area the V.L joints are avoided.

b) Coursed Rubble masonry:

·) In this type of rubble masonry the ht. of the stones may vary from 50 - 300mm. The stones are leveled one before starting work.

·) Masonry work is then started in courses with a particular course of equal ht.,.

·) Quions are built first & line is stretched to the top of quions. This form of masonry is better than uncoursed random rubble masonry.

SQUARE RUBBLE MASONRY:

The rubble masonry in which is face of stones are squared on all joints & beds by hammer dressing @ chisel dressing before their actual laying.

a) Coursed Square Rubble masonry:

The square rubble masonry in which chisel dressed stones laid in courses is called as coursed square rubble masonry. This is a superior variety of rubble masonry. It consists of stones which are squared on all joints & laid in courses of equal layers & joint should be uniform.

b) Uncoursed square rubble masonry:

The squared rubble masonry hammer dressed stones are laid without making courses is called uncoursed square rubble masonry. All the stones are of different sizes.

Dry Rubble masonry:

The rubble masonry in which stones are laid without using any mortar is called as dry rubble masonry. @ sometimes "dry stones". It is ordinary masonry & is recommended for constructing walls not more than 6mtr ht. also used for non load bearing walls.

ASHLAR MASONRY:-

The stone masonry in which finely dressed are laid in cement @ lime mortar is known as ~~ashlar~~ ashlar masonry.

In this masonry all the courses are of uniform ht., all the joints are regular thin & have uniform thickness. This type of masonry is much costly as it requires dressing of stones.

1) Ashlar fine @ coursed ashlar masonry:

In this type of stone masonry stone blocks of same ht in each courses are used. Every stone is fine tooled on all sides. Thick -ness of mortar is uniform throughout. It is expensive type of stone masonry as it requires heavy labour & wastage of material while dressing.

2) Random coursed ashlar masonry:

This type of ashlar masonry consists of fine @ coursed ashlar but the courses are of varying thickness, depending upon the character of the building.

3) Rough tooled ashlar masonry:

This type of ashlar masonry the sides of the stones are rough tooled & dressed with chisels. Thickness of joint is uniform, which doesnot exceed 6mm.

4) Rock @ quarry faced ashlar masonry:

This type of ashlar masonry is similar to rough tooled type except that there is chisel-draged margin left rough on the face which is known as quarry faced.

5) Chamfered ashlar masonry:

It is similar to quarry faced except that the edges are beveled @ chamfered to 45° for depth of 2.5cm @ more

6) Ashlar facing:- Ashlar facing is the best type of ashlar masonry. Since this is type of masonry is very expensive, it is not commonly used throughout the whole thickness of the wall except in works of great imp & strength.

Joints In Stone Masonry :

Following are the common types of joints provided in stone masonry.

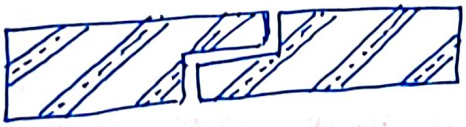
1) Butt joint
2) Rebated joint
3) Tonged & grooved joint
4) Bed joint @ tabled joint
5) Cramp joint
6) Plugged joint
7) Dowel joint
8) Rusticated joint
9) Saddled @ water joint.

1. Butt joint

This is the most commonly used joint in stone masonry. The dressed edges of 2 stones are placed side by side

2. Rebated joint

This type of joints are provided in arches, gables, coopings etc to prevent the possible movement of the stones. The length of the rebate @ lap depends upon the nature of the work. It should not be less than 70mm.

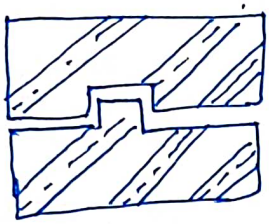


3. Tongue & grooved joint :

This type of joint is provided to prevent sliding along the side joints. The joint is made by providing projection @ tongue in one stone & a corresponding groove @ sinking on the adjacent stone,

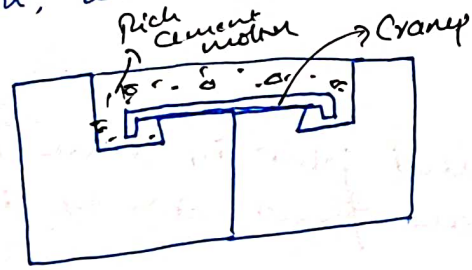
4. Tabled @ bed joint

This joint is used to prevent lateral movement of stone such in sea walls where the lateral pressure is heavy. The joint is made by forming a groove in the bed of stone



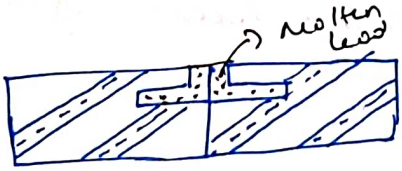
5. Cramped joint:

This joint is used metal cramp instead of dowels. Holes made in the adjacent stones should be of dovetail shape. The cramps are usually of non-corrosive metal such as gunmetal, copper etc. with their end turned down to a depth of 4-5cm length, width & thickness of cramps varies from 20-30 cm



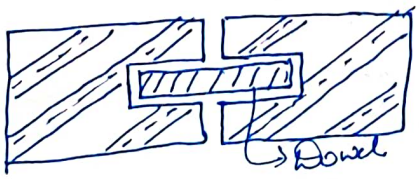
6) & Plugged joint:

It is alternative for cramped joint. It consist of making plug holes of dovetail shape in the sides of adjacent stones. After placing the adjacent stones, a common space for plug is formed which is filled with molten lead.



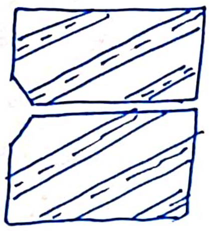
7. Dowelled joint:

This is a simple type of joint used for the stability of the adjacent stones against displacement @ sliding. The joint is formed by cutting rectangular holes in each stone & inserting dowels of hard stone, flat gunmetal, bars, bronze @ copper. The dowels are set in cement mortar.

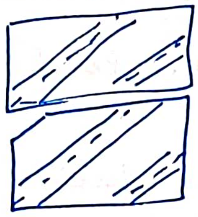


8: Rusticated joint :-

This joint is used in those stones whose edges are sunks below the general level such as plinth quoin quarted walls of lower storys etc such a joint gives massive appearence to the structure various forms of rusticated joint.



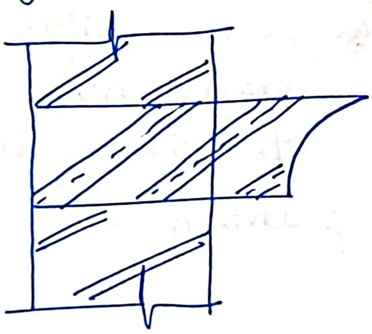
Vee - joint



Channeled joint.

9. Saddled @ water joint :-

This type of joints are used in cornice & such other weathered surfaces, to divert the water moving on the weathered surface away from the joint the saddle is bevelled backwards from the stone edges.



Introduction to Load bearing wall :-

wall is one of the most essential component of building. The primary function of a wall is to enclose @ divide space of the building to make it more functional & useful wall should be therefore be so desined to have provision of adequate

(i) Strength & stability
(ii) Weather resistance
(iii) Durability
(iv) Fire resistance
(v) Thermal insulation
(vi) Sound insulation

Wall may be defined as, a vertical load-bearing member, the width of which exceeds four times of the thickness. In contrast to ~~this~~ a column is an isolated load bearing member, the width of which does not exceeds four times of the thickness.

Wall may be basically divided into 2 types.

1) Load bearing 2) Non-load bearing

Load bearing walls are those which are designed to carry super imposed loads in addition to their own weight.

Non-load bearing walls carry their own load only they generally serves as divide walls @ partition walls the external non-load bearing wall commonly related to framed structure is termed as panel wall.

Partition walls:

A partition wall is a their internal wall which is constructed to divide the space with in the building rooms @ area. A partition wall may be either non-load bearing @ load bearing. Generally, partition walls are non-load bearing. A load bearing partition wall is called as internal wall.

Requirements of partition walls:

1) The partition wall should be strong enough to carry its own weight
2) The partition wall should be strong enough to resist imposed loads.
3) The partition wall should have the capacity to support suitable decorative surface
4) It should be light as possible
5) It should be thin as possible
6) A partition wall should acts as a sound barrier, specially when it divides 2 rooms.
7) A partition wall should be fire resistant.

CAVITY WALLS:

A cavity wall @ hollow wall is the one which consists of two separate walls called leaves @ skins. with a cavity @ gap in b/w the two leaves of cavity wall may be of equal thickness if it is non-load bearing wall @ the internal leaf may be thicker than the external-leaf to meet the structural requirements.

Advantages:

1. There is no direct contact b/w inner & outer leaves of the wall.
2. The cavity b/w the 2 leaves is full of air which is bad condition of heat-
3. Cavity walls also offers good insulation against sound
4. The efflorescence is also very much reduced..
5. They are cheaper & economical
6. Loads on foundations are reduced because of lesser solid thickness.

Requirements of Good building stones

1) Crushing Strength :- Good stones have a crushing strength, $> 100 \, N/mm^2$.

2) Appearance :- Stones must be good in appearance & should be uniform in colour

3) Density :- It should be dense & its specific gravity > 2.7

4) Durability :- This property is very important especially when used in external @ exposed condition.

5) Easiness of dressing :- Should have easiness of get dressed to a required texture.

6) Fire resistance :- Should withstand high temp for a long time. It is recommended that the temp above 500 - 600 °C can be applied on stone upto 8 hrs & stone should not disintegrated

7) Fracture :- Should be well cemented & sharp. If used examine a fractured surface.

8) Impact resistance :- It is a measure of toughness of stone
Reccomended - 19 - Good impact value
< 13 - Poor quality

9) Hardness :- It should give good resistance against wear
Rec., values → 17 is good, < 14 - Poor quality.

10) Seasoning :- The stone should be well seasoned meaning of seasoning is drying of stone after quarrying.

11) Texture :- It should have a pleasing texture & should be free from cracks & cavities.

12) Water absorption :- Should be less than 0.6 %.

13) Weathering :- Good resistance to wear & tear.

14) Workability :- Easily attain the required shape.

Dressing Stones:

The stone obtained from nature is very rough, undulated & random in shape. The construction of masonry requires a good rectangle @ cubical shaped stones. The process of shaping the stone to the required degree is known as Dressing of Stone.

Dressing of stones is generally done by handtools. Modern construction industry has diff machines for dressing of stone The dressing of stones can be done as per the requirements.

Detoriation of Stones:

Eventhough the stone is strong & durable it is suspectible for detorioation due to natural agencies. The amount of det-oriation of stone must be small at a time but the cumulative after several years can affect the stone.

Agencies causing detoriation of Stones:-

1) Rain:- Rainwater can affect physically & chemically. The rainwater which strikes the stones with high forces can erode the surface. This is more evident in stones which are under flowing water. Chemical decomposition, oxidation & hydration of mineral takes place. Chemicals dissolved in rainwater due to industrial pollution detoriate stone for long extent..

2) Frost:- Frost detoriate the stone when it comes into contact with stones. The differential temp causes disintegration

3) Wind:- If wind carries dust particles can cause abbrasive force on structures made of stones & detoriate the surfaces but comparitively very less to other agencies.

4) Temp. Change:- Frequent change in temp from high to low & low to high can cause undue expansion & contraction which made detoriate stones

5) Vegitative growth: Growth of plants in the cracks of rocks leads to deterioration.

6) Decay of stones:- Continue- application of water & chemicals on stones can deteriorate the stone easily.

7) Chemical agents:

8) Alternate freezing & thawing

9) Nature of mortal

Preservation of Stones:

The structure built with stone is susceptible for decay & damage when it is exposed to the atmosphere for several yrs. This can be prevented by proper precautions before & during the construction of stonework & after stonework has been completed.

1) Precautions during construction
2) Preservation of completed stone work
   (i) Coating of stone
   (ii) Frequent washing with water & steam
   (iii) Epoxies over the surface of stones.
3) Conservation of Granite.

:- LINTELS & ARCHES :-

Lintel :-

Openings in a wall either external wall @ internal wall are required as essential element to provide doors & windows. The wall is generally brick @ stone masonry which can't stand on its own above the opening.

"Lintel is defined as, the horizontal structural membel which is placed across the openings to support the portion of the structure above".

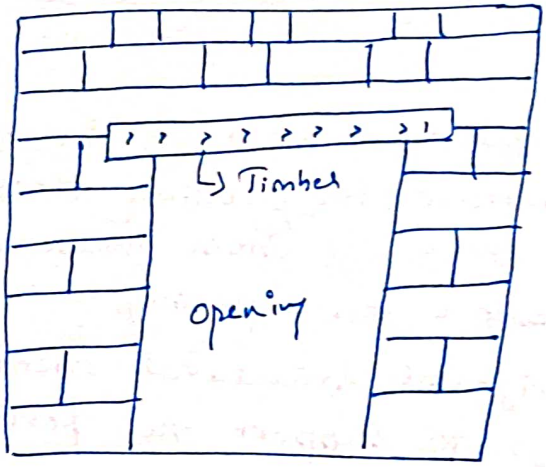
Classification of Lintel :-

Acc., to the materials of their construction.

1) Timber lintel
2) Stone lintel
3) Brick lintel
4) Reinforced brick lintel
5) Steel lintel
6) Reinforced cement concrete lintels.

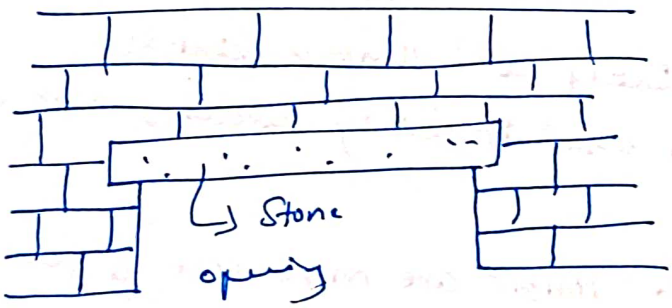
1) Timber lintel :

*) One of the early form of lintels are timber lintels.
*) Timber lintels are probably used in hilly areas, also used in old cities
*) The main disadvantages with timber are more cost & less durable & vulnerable to fire.
*) If the length of the opening is more than it is provided by joining multiple no. of wooden piece with the help of steel both which is shown in fig.
*) In case of wider walls, it is composed of two wooden piece kept at a distance with the help of packing piece & strengthened by providing mild steel plates.



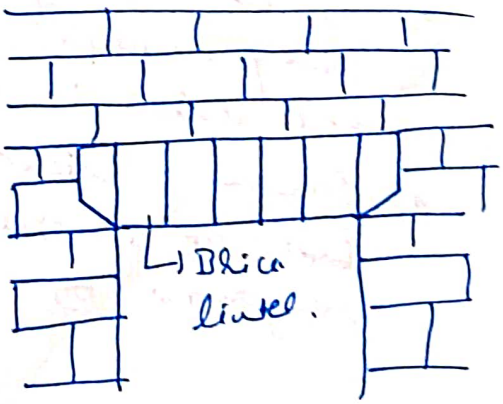
2) Stone lintel:

*) These are common type specially where stones are abundantly available there it is used.
*) The thickness of these are most imp factor of its design.
*) The lintel may be a single piece @ more than one piece
*) The depth is kept equal to 10 cm/metre span, min. 15 cm
*) They are used up to span of 2 metre.



3) Brick lintel:

*) These are used when opening is less than 1m & less loads are acting.
*) Depth varies from 10 - 20cm
*) It will get fail
*) Bricks with joggs are provided bcz. joggs when filled with mortar gives more shear resistance of end joints which is known as jogged brick lintel.

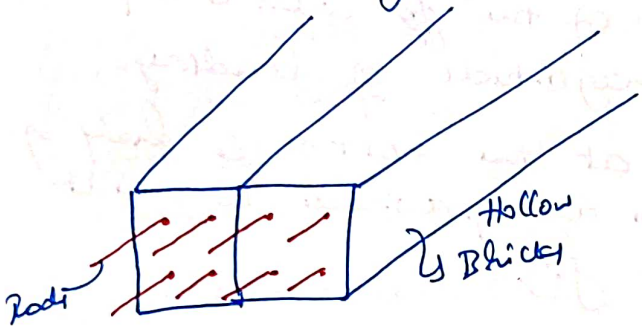


4) Reinforced brick masonry!

i) For large spans & heavy loads brick lintels are reinforced with mild steel bars.

ii) This type of lintels are common due to durability, strength & fire resisting properties

iii) Joints are filled with cement concrete.

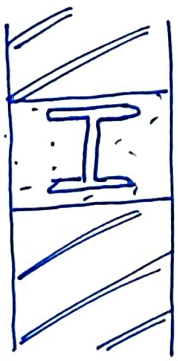


5) Steel lintels:

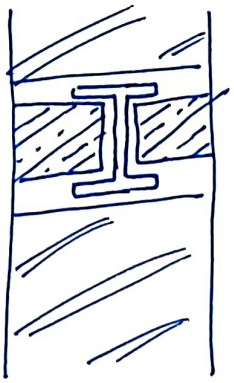
i) These are used when the superimposed loads are heavy & openings are large.

ii) These consist of channel sections @ rolled steel joists. we can use on single section @ in combinations depending upon requirement

iii) when used singly, the steel joist is either embedded in concrete @ cladded with stone facing to keep the width same as width of wall.



(i) Concrete Embedment.



(ii) Stone facing.

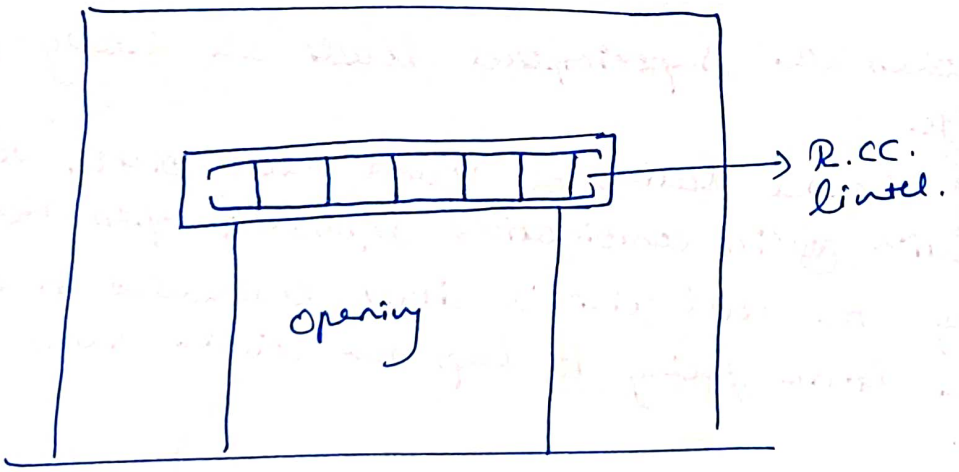
6) Reinforced cement concrete lintel:

*) At present, the lintel made of reinforced concrete are widely used to span the opening for doors, windows etc, in a structure because of their strength rigidity, fire resistance economy, etc,

1) They are suitable for all the loads & for any span.

2) The width is equal to width of the wall & depth depends on length of span & magnitude of loading.

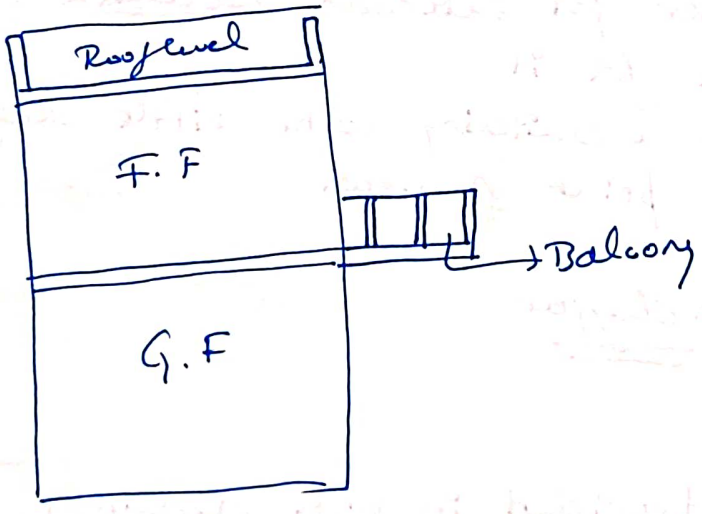
3) Main reinforcement is provided at the bottom & half of the bars are cranked. Stirrups are provided to resist transverse shear as shown in fig.



Balcony!

A balcony is the extended portion of slab in the first floor @ subsequent floors creating extra space for inmates. A balcony provides a space for standing & standing to get the street view. Balconies are designed as cantilevered structural members similar to chajja. It platform enclosed by a low @ wall @ a railing built out from the side of building. Most commonly balconies are called along RCC slab but they can be added as an external member by a metal @ wooden structure

1) Balcony acts as a external place beside from usable carpet area.
2) It acts as an door to environment.
3) It helps in maintaining proper circulation in building.



CHEJJA:

Component of building which is placed over the opening to prevent adverse effect of weather on a room.

Purpose of chejja:

1) The purpose of chejja @ sunshade is to prevent direct entry of sunlight into the room to a certain extent.
2) Also, it acts as a barrier to direct entry of rainwater into the room through opening.
3) It also adds to the aesthetic appeal of openings.
4) Usually it is provided at a ht. of 7ft. from floor level
5) It is made of concrete & casted along with lintel monolithically.
6) It acts as a barrier for external weather conditions & leaves as shade for it.
7) It a aesthetics to a building with little design on it from architectural point of view.

Classification of ~~Sunshade~~ chejjas:

1) Rcc chejja:

Reinforcement is provided in both direction. This type of chejja is casted along with lintel monolithically of min., thickness 50mm. Length of Rcc chejja will be equal to length of lintel. Top surface of chejja shall be compulsorily waterproofed. This type of chejja is most commonly used.

2) Stone chejja:

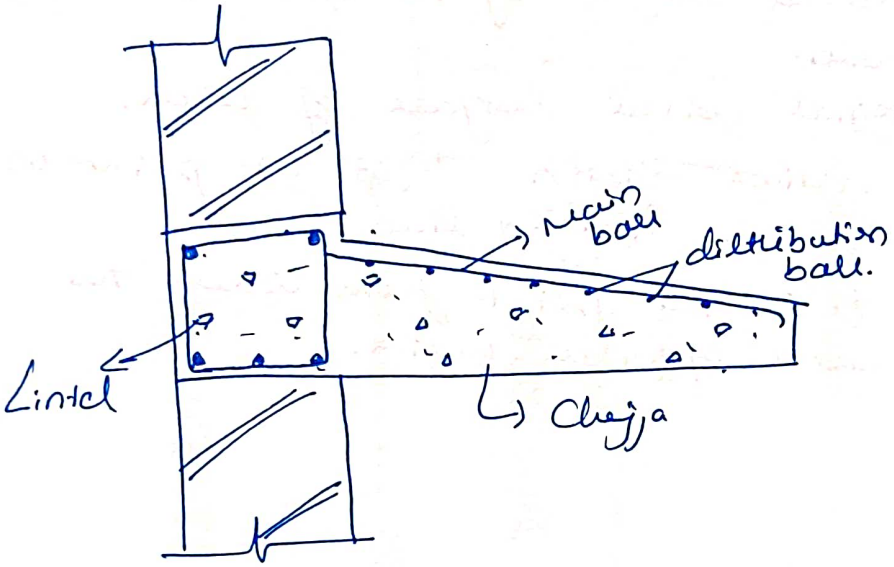
20mm thick stone slabs can be used. This chejja is usually above the lintel level. & can be incorporated into wall during construction as well as after construction also.

3) Tile chajja:

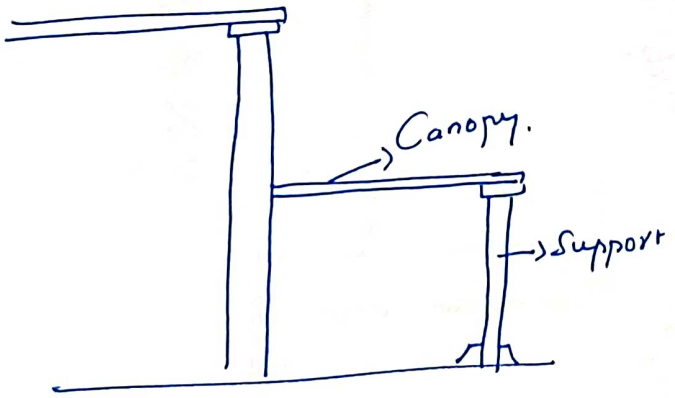
It consist of metal frames & tiles. Initially 'L' shaped frame is fixed to the wall & are connected in b/w by secondary members. Space b/w secondary members are covered with tiles & they are aesthetically good.

4) Ferrocement chajja: Layer of metal meshes.

5) Sheet & wooden chajja: Respective materials are used



CANOPY: "A canopy is the extended portion of lintel @ chajja with @ without the probed support".



A extended portion of slab either provided at lintel level @ roof level. Canopy looks like chajja but- Mutter for vehicles. The most- common position of canopy is in front of windoors @ on the side of building if sufficient space is available.

Purpose: It provides an elegance beauty to structure. It may be temporary offered- @ structure provided in the building for special reason.

ARCHES:

"An arch is a structure which is constructed to span across openings such as doors, windows".

Elements of Arches / Technical terms used in arches:

1) Abutment: This is the end support of an arch.
2) Pier: The intermidiate support of arch
3) Intrados:- Inner curved surface of the arch is known as intrados.
4) Extrados: The external curved surface of arch.
5) Rise: It is the vertical distance b/w ist point on the intrados & the springing line
6) Springing point: It is the point from where the curve of arch begins.

ELEMENTS OF THE ARCH

7) Voussoirs:- Wedge shaped blocks used in construction of arch.

8) Crown:- It is the highest point of extrados.

9) Key:- wedge shaped blocks used at the crown sometimes it is larger than the normal voussoirs.

10) Span:- Clear horizontal distance b/w the supports.

11) Haunch:- The lower half portion of the arch b/w crown & skewback.

12) Skewback:- Inclined surface of abutment which is prepared to recieve the arch.

13) Springer:- Lowest voussoirs immediately adjust to the skewback.

FLOORS:

It is the level surface inside the house @ building which is smooth, levelled @ & easy to clean.

"Floor is to provide a level surface capable of supporting the occupancies of building, furniture, equipment & inside partition walls".

Requirements of Good floor:

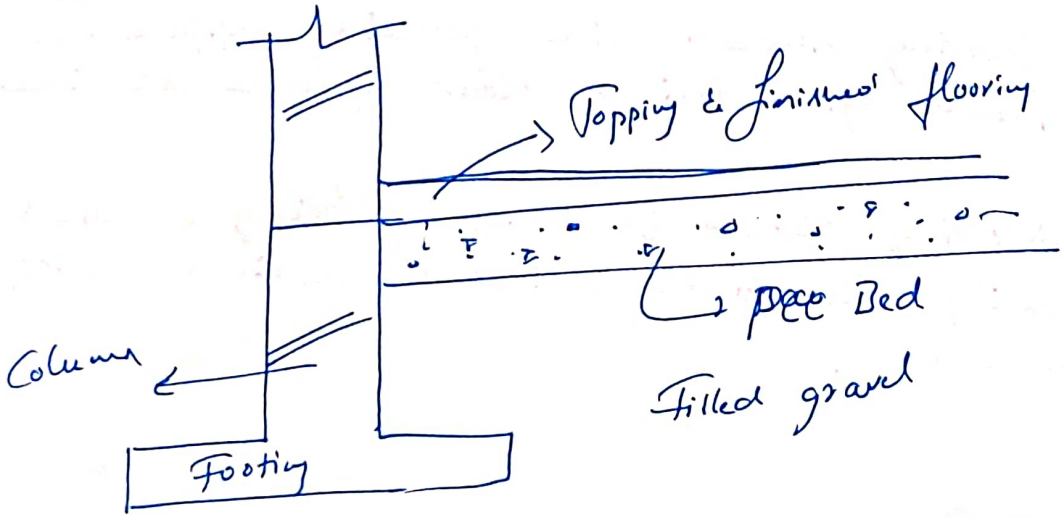
1) It should have adequate strength & stability.
2) Should have adequate resistance to weather & ground moisture.
3) Should have good durability & free from maintanance.
4) Should have adequate fire resistance.
5) Should have sound insulation.
6) Should have damp resistance.
7) Should have resistance to proper passage of heat.

Components of Ground floor:

Floor consists of 2 components

1) Base concrete : 2) Topping / wearing coarse

The two components of the floor can be constructed either monolithically (i.e., @ non-monolithically.



1) Base flooring:-

↳ Base concrete gives strength & levelled surface to the topping course

↳ Base concrete @ floor base is a structural component that supports the floor covering.

↳ Base concrete has 2 types

- PCC - Plain cement concrete
- Grade slab (with reinforcement)

2) Topping:

↳ This is top surface of flooring, it should be well levelled, easy to maintain & have resistance to take off the load.

↳ Materials used for the floor finish.

- Mud & Muram
- Bricks
- Marbles
- Asphalt
- Flag stone
- Concrete
- Granite
- Rubber
- Mosaic
- Tiles
- wood @ timber
- Cork

Selection of flooring material:

1) Initial cost: Cost of material should be in confirmity with building type.

2) Appearance: Covering should give pleasing appearence, should give desired colour effect & architectural beauty.

3) Cleanliness:- Flooring should be capable of being cleaned easily, should be resistant against absorption of oil, grease, etc.,

*) Lay base coat of 100 mm thick in the ratio of cement-concrete 1:3:6 @ 1:4:8. on a compacted earth under the floor.

*) Divide the floor area in suitable panels with the help of strips. The depth of strips should be equal to the thickness of floor.

*) Keep the length of panels not more than 2 mtrs. The panels should be uniform in size.

*) Place cement concrete in the panels & level it with the help of straight edge.

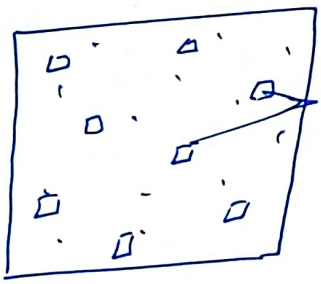
*) Float the toping with wooden float to render even & compacted surface.

*) Lay cement slurry / floating coat on compacted surface. The top surface then is finished with wooden float.

*) Test evenness of the surface with straight edges & make it true to required slopes.

*) Curing is done for 28 days.

2) MOSAIC :



*) Lime surkhi mortar is spread over the concrete base & levelled Thickness of the mortar will be 5 to 8 cm.

*) Before drying the lime-surkhi mortar a layer of cementing material of about 3mm thick will be placed over it. This layer is consisting 2:1:1 ratio of lime, marble & pozzolana material.

*) After sometime about 4 hrs later, marble pieces @ tiles laying is started.

*) A stone roller is pulled over the surface gently & water being sprinkled over now & then to work up the cement-b/n the marble

*) The surface is allowed to dry for drying & is rubbed with a punice stone to polish the surface & make it smooth & level

4) Durability:- Should have sufficient resistant to wear, temperature changes, etc.,

5) Damp resistance:- Should have sufficient resistance against dampness. Concrete & mosaic flooring is the best flooring than brick flooring.

6) Thermal insulation:- Should provide good thermal insulation providing good comfort to residence.

7) Sound insulation:- Should provide good insulation from noise, cork, rubber, timber flooring.

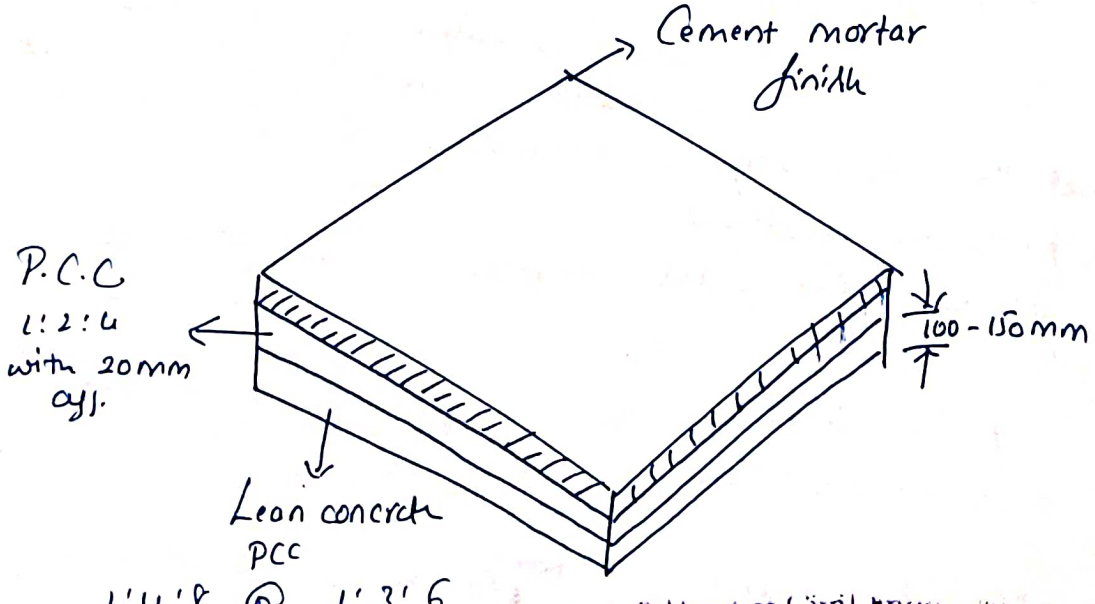
8) Hardness:- Should be sufficiently hard so as to have resistance to indentation marks, imprints likely to be caused on slipping of instruments.

9) Fire resistance:- Flooring material should offer fire resistance.

10) Smoothness:- Flooring surface should be smooth & should have even surface but not slippery.

11) Maintanance:- The flooring material should require least maintanance. whenever repairs are required, it should be such that repairs can done easily with least possible expenditure.

Laying of concrete flooring:



Prof. & Head of Civil Engg. Dept.
S. I. E. T. Dharmavaram

3) Marble Flooring:

This type of flooring is used in temples, residential building, hospitals etc., when the extra cleanliness is essential.

Procedure for marble flooring:

+) Base concrete is prepared as that of cement concrete flooring, over this 20 mm thick mortar in 1:4 ratio is spread under the area of each individual slab.
+) Marble slab is then laid over it gently pressed with wooden mallet & is levelled.
+) Marble slab is lifted up & fresh mortar is added to hollow space left in blw.
+) Mortar is allowed to harden slightly.
+) Cement slurry is spread over it & then marble is fixed in position.

4) Granite Flooring:

+) It is similar to marble flooring but the granite slabs are pre-polished slabs.
+) Pre-polished slabs are cut into required sizes & layered with the help of mortar & joints are filled with grout.
+) The grouts filled is similar colour to the granites.
+) This is costlier type of flooring but less than marble flooring.

5) Tile Flooring:

+) Before tile flooring make a floor free from impurities & dirts & plan for greater accuracy of floor plan.
+) And also make sure subfloor can support the tails, mortar & grout applied over it after compilation of projec-

(5) Asbestos cement sheets

→ Cement is mixed with about 15% of asbestos fibres & pulp so formed is pressed under rolled with grooves @ teeth. These sheets are commonly known as A.C sheets with a series of waves @ corrugations formed.

→ Used for factories, workshops, garages, bijhall.

→ Corrugations help to increase strength & rigidity & permit easy flow of rain water.

(6) Tiles:

→ Tiles are named acc., to their shape & pattern & manufacture w.r.t their std. shapes as like bricks.

→ The commonly used tiles are

(a) Plain tiles
(b) Ridge tiles
(c) Curved @ pan tile
(d) Interlocking tile/ Mangalore tile

Roofing materials / Roof covering types:

1) Thatch covering:

↳ This is a very light wt but it is combustible absorbs moisture rapidly & easily liable to decay.

↳ Frame work to support the thatch consist of round bamboo rafters spaced at 80 cm apart & tied with split bamboos laid at right angles to the rafters

↳ Used in rural areas because of its cheap & simple in construction.

2) Wood Shingles:

→ Use of shingles is generally restricted to hilly areas where wood is easily available at low cost.

→ wooden shingles are cut from well-seasoned timber & they are laid in similar manner as slates & tiles.

→ Shingles length varies from 30-38 cm & width varies from 6-25 cm.

3) Galvanised iron sheets & G.I Sheets:

→ G.I sheets are prepared by passing slat rough wrought iron plates b/w rollers with grooves @ teeth & then galvanised with a coat of Zinc

→ Available at length 1.2-3.6 mtr & 0.6-0.9 mtr width.

→ They are costly & do not offer resistance to fire & sound.

4) Slates:

→ These are fire resisting light & cool materials

→ Not easily affected by weather

→ About 8 slates are required for covering $1\ m^2$ of roof area.

→ Generally available in Grey, black & red colour.

Flat roof:

- Flat roof is one which is either horizontal (or) practically horizontal with slope less than 10° so that rain water can be drained off easily & rapidly.
- The construction is same as that of floors except that the top surface is made slightly sloping. It may be of RCC reinforced brick work, precast concrete units, etc.,
- Flat roofs are considered as suitable for buildings in plains (or) in hot regions, where rainfall is moderate & where rainfall is not there.
- Efficient water proofing & road drainage is an imp requirement of flat roof.
- In addition with this insulating material is provided for thermal insulation which is known as terracing (or) grading.
- Usually 1 in 60 slopes are provided

Roof :

Roof is defined as the upper most part of a building, provided as a structural covering to protect the building from weather.

Requirement of Good roofs :

1) The roofing system should be strong enough to carry its own weight & superimposed load on it.
2) It should protect the building against environmental agencies like rain, sun, wind, etc.,
3) It should have efficient water proofing arrangement.
4) It should grant the desirable insulation against sound & heat.
5) It should be fire resistant
6) It should be well drained.

Types of Roofs / Classification of Roofs :

1) Flat roof @ terraced roof
2) Pitched @ sloping roof
3) Curved roof.

The choice of the type of roof will depends on the climatic conditions, shape of building, availability of materials & imp of building.

Flat roof:

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Pitched roofs

A roof with sloping surface is known as a pitched @ sloped roof.

→ Building with limited width & simple shape can generally be covered by pitched roofs.

→ In pitched roof a slope of less than 1 in 3 is generally considered from drainage pt. of view.

→ In areas of heavy snowfall steeper slopes of say 1:1.5 & 1:1 are provided to reduce the snow load on roof.

→ The slope varies acc. to span, climatic conditions & nature of covering materials.

Types of pitched roof:

1) Single roof
   - Lean to roof
   - Couple roof
   - Couple - close roof
   - Collar beam roof / Collar tie roof

2) Double @ purlin roof

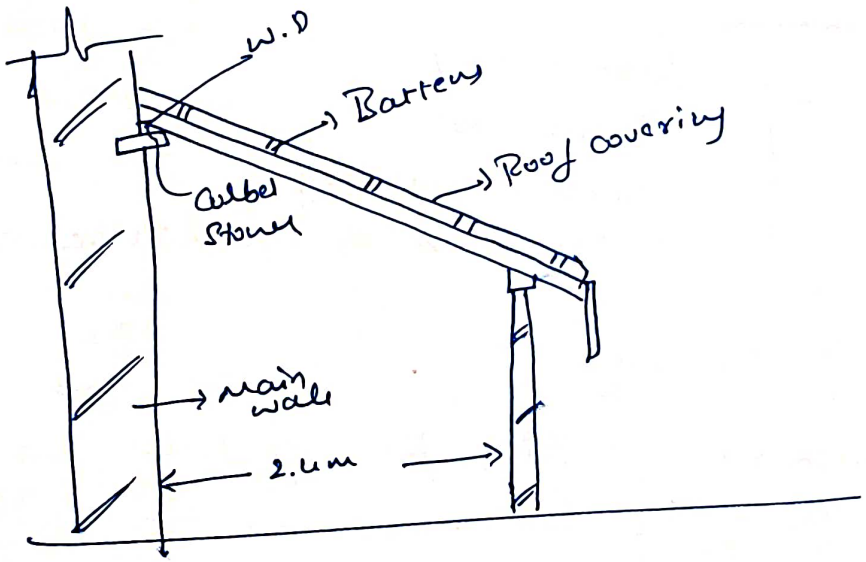
3) Triple membered @ framed @ trussed roof
   - King post roof truss
   - Queen post ——
   - Combination of king & queen post
   - Mansard roof truss
   - Truncated roof truss
   - Composite ——
   - Steel sloping roof trusses.

Single roof:

In single roof common rafters are provided to each slope without any intermediate support.

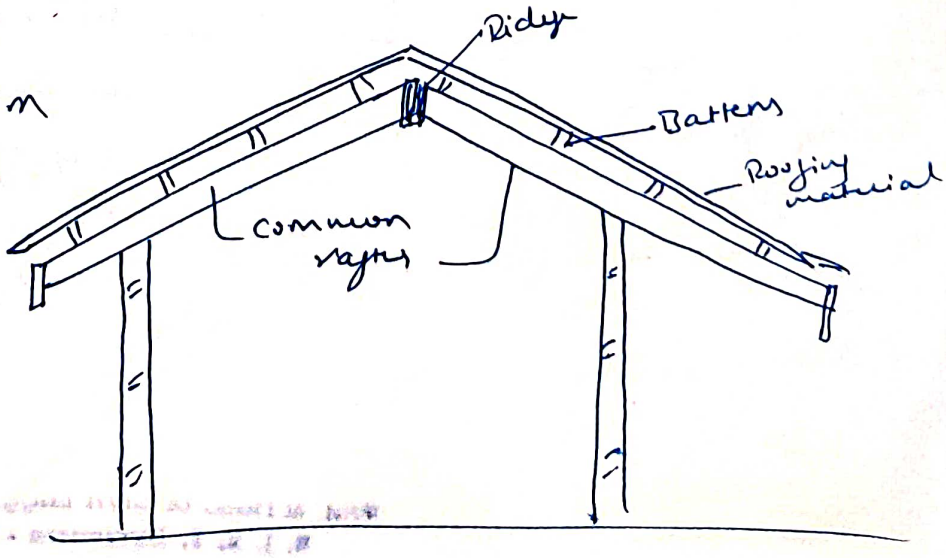
a) Lean to roof:-

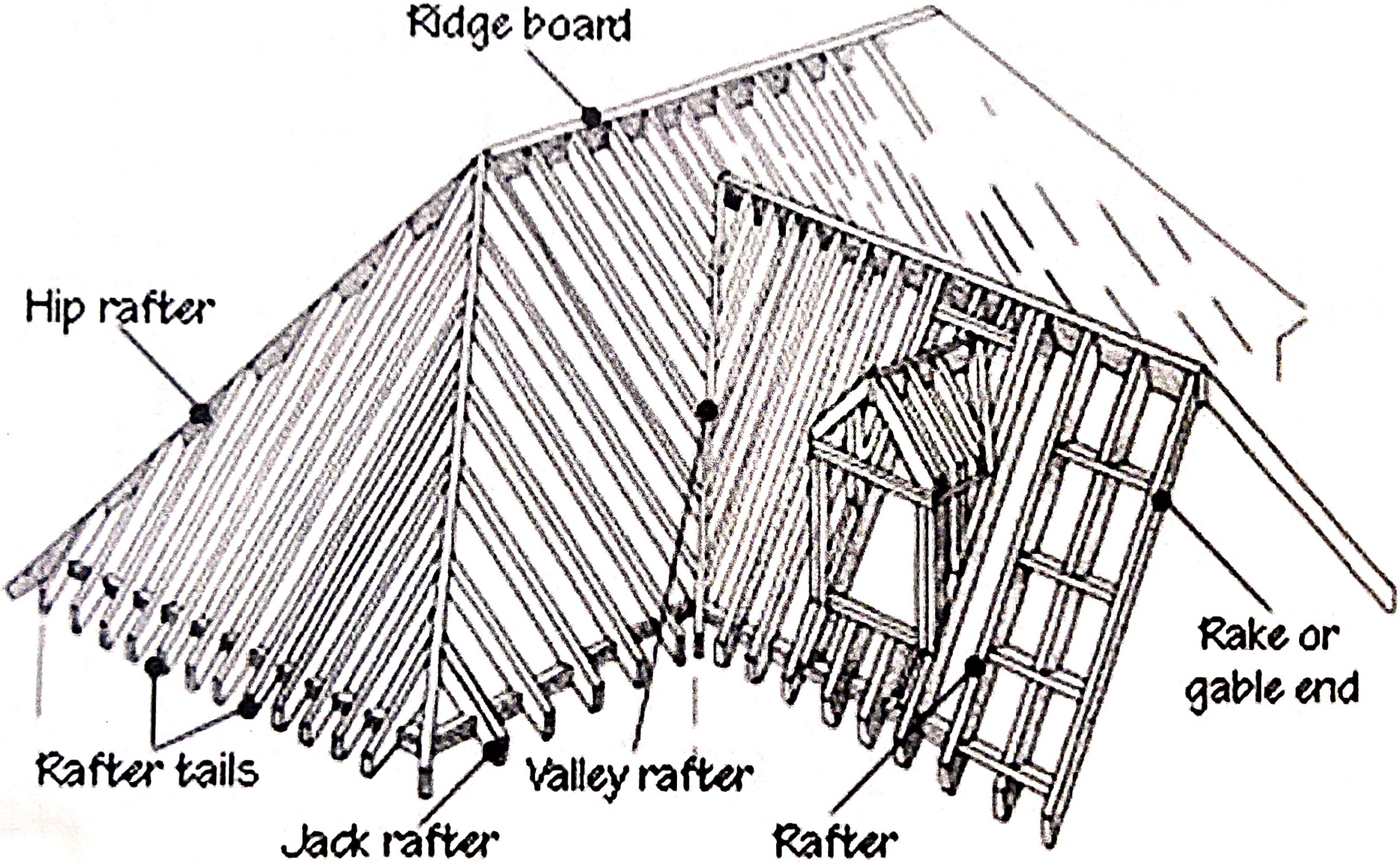
- It is simplest form of pitched roof & it is known as pent @ aisle roof.
- In this, one wall is constructed to a greater ht to give a good slope.
- It is generally used for sheds, outhouse attached to main buildings, verandah, etc.,
- Suitable for a span of 2.4 mtr.



b) Couple roof:-

- In this type of roof the common rafters slope upwards from the opposite walls & they meet on ridge in the middle.
- Suitable for 3.6m




Ridge board
Hip rafter
Rafter tails
Jack rafter
Valley rafter
Rafter
Rake or
gable end

Trussed roofs:

*) Trussed roof when span of roof exceeds 4.8m & where there are no inside supporting walls @ partitions for the purlins, framed structures & provided at suitable interval along the length of the room.

*) The spacing of trusses depends upon the load on the roof positions of cross walls, span & material of the truss.

a) The trusses carry the ridge piece & purlins on which the common rafter rest. The trusses span in the same direction in which the common rafter run.

The trussed roof consist of the following components.

1) Rafters to support the roofing material
2) Purlins to provide intermediate support to the rafters
3) Trusses to grant support to the ends of purlins.

a) King post truss:

*) It is the simplest form of truss; it consist of 2 principal rafters, a tie beam, & a central vertical post & 2 angled struts & requires sophisticated joints b/w tie beam & principal rafter

Joints in this truss are:

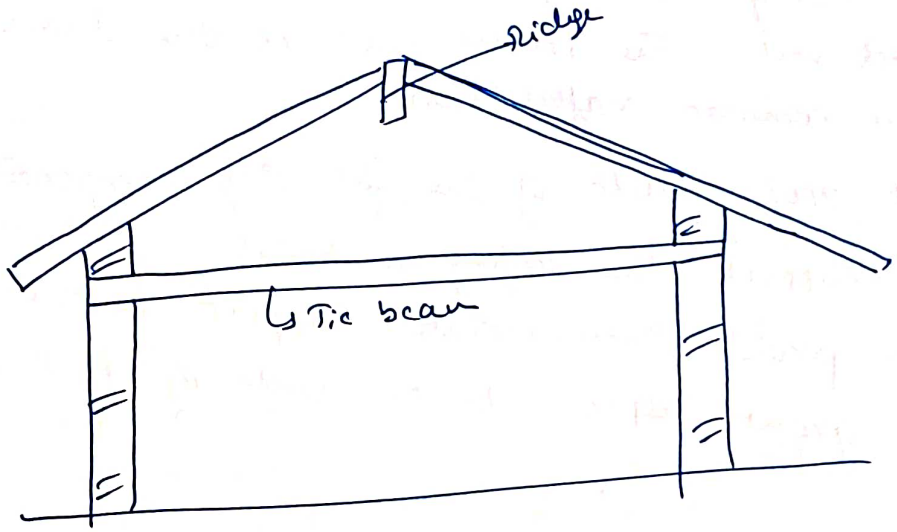
a) Joint b/w the principal rafter & tie beam
b) Joint b/w the king post & tie beam
c) Joint at the head & feet of struts
d) Joint b/w the principal rafter & the king post.

Couple closed roof:

a) This is just limited to couple roof except that the legs of the common rafters & which are connected by a tie beam.

b) Tie beam prevents the tendency of rafters to spread out. thus danger of overturning of the walls is avoided.

c) It is economical when adopted for a span upto 4.2m

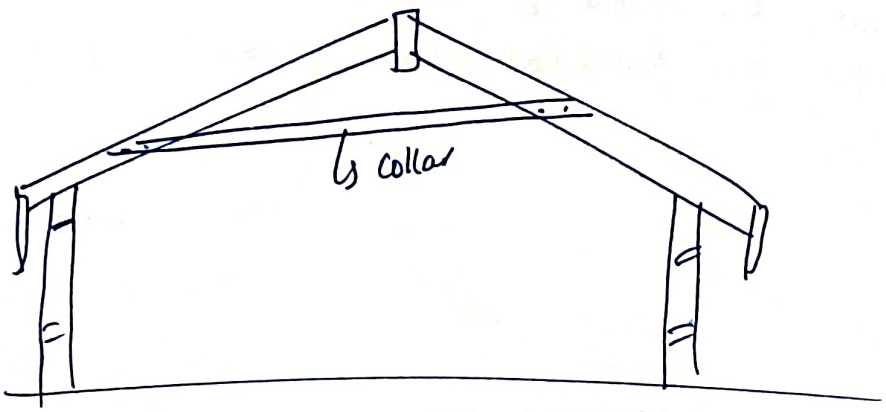


Collar beam roof:

a) The tie beam is raised & placed at higher level as shown in fig.

b) It is adopted to economize the space & to increase the ht. of room.

c) Adopted for max span of 4.8m



Queen post truss:

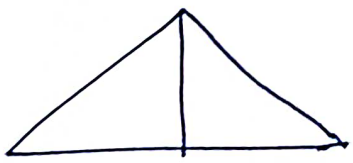
- A queen post truss differs from a king post truss in having 2 vertical ~~joists~~ posts rather than one.
- Two vertical posts are known as queen-posts, the top of which are connected by a horizontal piece known as straining beam
- Two struts are provided to join the feet of each queen post to the principal rafter.
- These are provided for span b/w 8 – 12 mtrs

Steel truss:

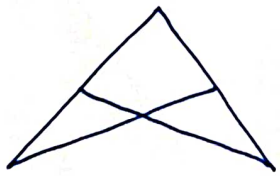
- When the span exceeds 10 mtrs. timber trusses becomes heavy & uneconomical.
- Steel trusses are more economical for larger spans.
- However steel trusses are more commonly used these days for all spans small @ large since they are more economical, easy to construct, more rigid, fire proof & permanent.
- Steel trusses are fabricated from rolled steel structural members such as channels, angles, T-sections & plates.

Types of steel trusses:

1. Open trusses



King post truss.



Scissor truss

2. North light trusses
3. Bow string trusses
4. Arched trusses.

Advantages of Steel roof trusses over timber roof trusses

1) Steel trusses are stronger & are more rigid
2) Fire proof & termite proof.
3) Can be used for any span length where as timber trusses are suitable for span length upto 15mtr
4) Light in wt & can be fabricated to any desired shape depending on its requirements.
5) Sections comprising of steel truss are readily available in required dimensions resulting in min., wastage of materials.
6) More resistant to other environmental agencies like temp.; wind, moisture, etc.,.
7) Fabrication of steel roof truss is easier & quicker.

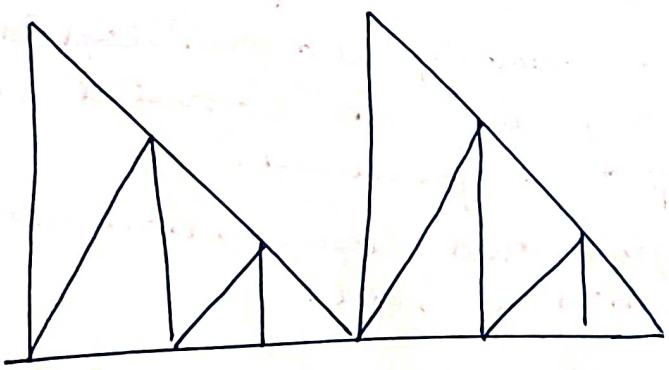


Fig: North light truss

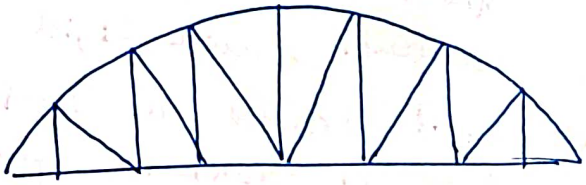
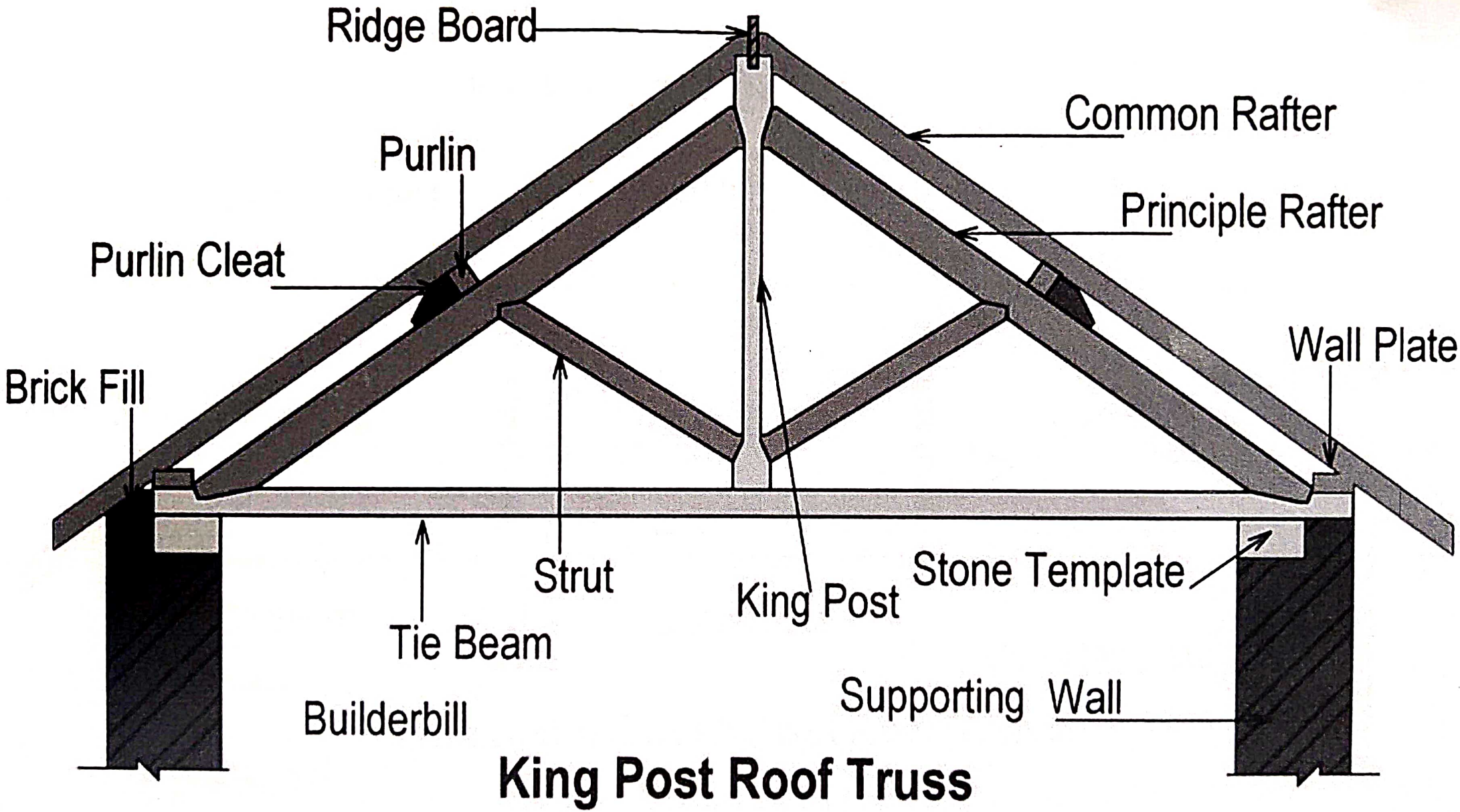
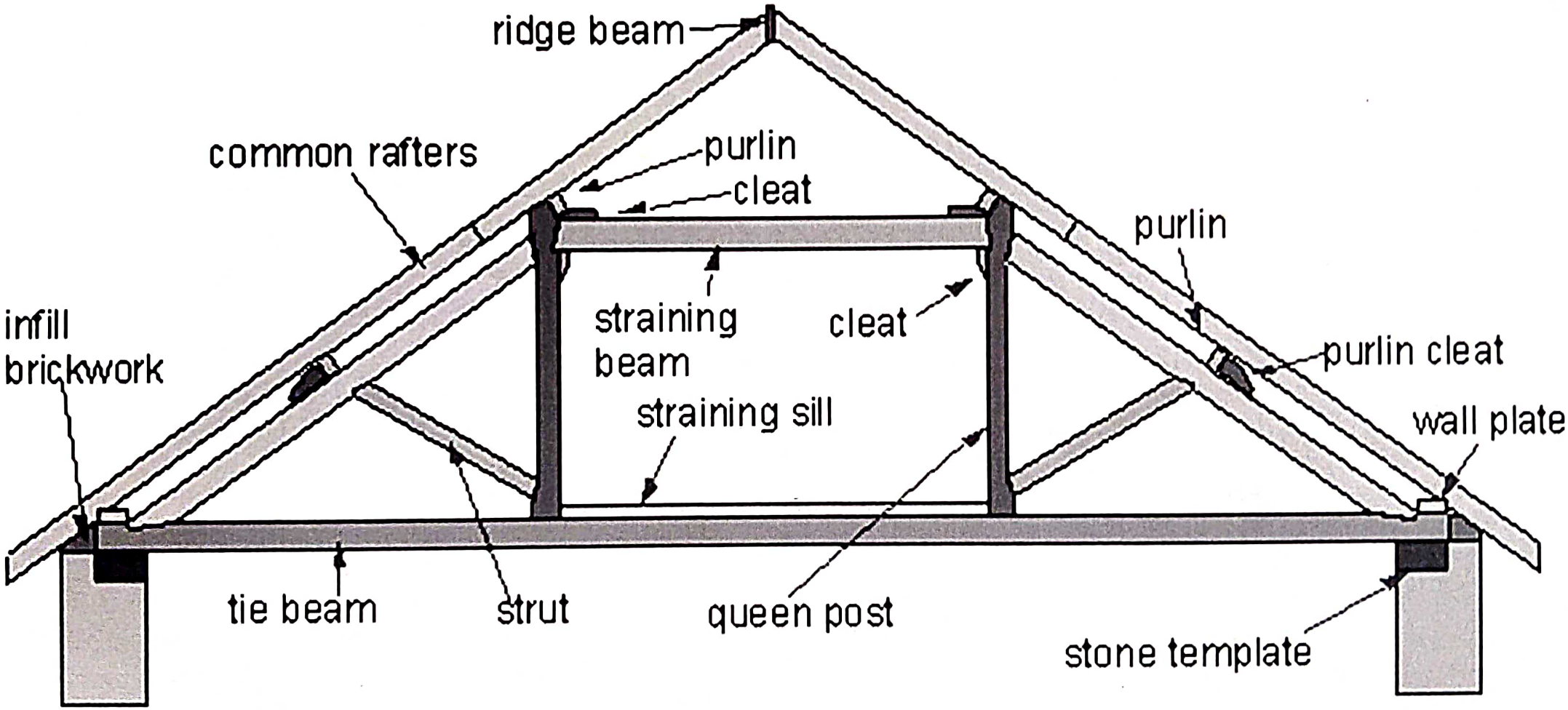


Fig: Bow string truss



King Post Roof Truss



Traditional Queen Post Roof Truss

DOORS and WINDOWS:

Location of doors & windows:

1) Number of doors in a room should be kept minimum since large no. of doors causes obstruction, & consume more area in circulation
2) The location of door should meet the fun. requirements of room. It should not be located at the centre of the length of the wall.
   Preferably it should locate at the corner.
3) If there are 2 doors in a room, the doors should preferably be located in opposite walls, facing each other so as to provide good ventilation & free air circulation in the rooms.
4) The size & no. of windows should be decided based on imp factors such as distribution of light, control of ventilation & privacy of occupants.
5) A window should be located in opposite wall, facing door (or) another window, so that cross ventilation is achieved
6) From the point of view of fresh air, a window should be located on the northern side of a room.
7) The sill of window should be located about 70-80 cm about floor level of the room.

Technical Terms:

1) **Frame:** It is an assembly of horizontal & vertical members forming an enclosure, to which the shutters are fixed.
2) **Shutters:** These are the openable parts of a door @ window. It is an assembly of styles, panels & rails

3) Head: This is the top @ uppermost horizontal part of a frame.

4) Sill: This is the lowermost @ bottom horizontal part of a window frame. Sills are normally not provided in door frames.

5) Horns: These are the horizontal projects of the head & sill of a frame to facilitate the fixing of the frame on the wall opening.

6) Style: Style is the vertical outside member of the shutter of a door @ window

7) Hold fast: These are mild steel flats generally bent into Z-shape, to fix @ hold the frame to the opening.

8) Top rail: This is the topmost horizontal member of a shutter

9) Lock rail: This is the middle horizontal member of a shutter, to which locking arrangements are done

10) Bottom rail: This is the lowermost horizontal member of a shutter.

Size of doors:

1) Doors for residential buildings

a) External doors:
(1.0 x 2) m to (1.1 x 2) m

b) Internal doors
(0.9 x 2) m to (1 x 2) m

c) Doors for bathroom & w/c
(0.7 x 2) m to (0.8 x 2) m

d) Garages for cars
(2.25 x 2.25) m to (2.25 x 2.40) m
Ht x width

2) For public buildings:

i) 1.2 x 2.0 m
ii) 1.2 x 2.1 m
iii) 1.2 x 2.25 m

STAIRS:-

A stair may be defined as series of steps suitably arranged for the purpose of connecting different floors of building.

The room @ enclosure of the building in which the stair is located is known as staircase.

The opening @ space occupied by the stair is known as a stairway.

In a domestic building the stairs should be centrally located to provide easy access to all the rooms. In public buildings stairs should be located near the entrance

Terms used in staircase:-

1) **Tread:** The horizontal upper surface of a step on which foot is placed in ascending @ descending stairway.
2) **Riser:** Vertical portion of step.
3) **Rise:** It is the vertical distance b/w the successive tread
4) **Landing:** A flat-form @ resting place provided b/w two flights
5) **Flight:** A series of steps without any flatform break @ landing in their direction
6) **Going:** It is the horizontal distance b/w 2 successive riser face
7) **Nosing:** The outer projecting edge of a tread is termed as a nosing
8) **Newel post:** It is a post supporting the handrail

Requirements of good stair:

1) The width of the stair should be minimum 90 to 100 cm.
2) The tread should not be less than 250 mm.
3) The riser should be maximum 200 mm
4) The no. of steps should not exceed 12 in a flight
5) The pitch of the stair should not be limited to 30 - 45.
6) The width of landing should not be less than width of the stair.
7) Stair should be so located that sufficient light & ventilation is ensured in the stair way
8) The materials used for the construction of stairs should be such that it has to provide sufficient strength & also for resistance.

Classification of Stairs:

1) Straight stairs.
2) Turning stair [Dog legged & Open well]
   a) Quarter turn b) Half turn stair
   c) Three quarter turn stair
   d) Bifurcated turn stair
   e) Continous stair
3) Geometrical stair

Geometrical Design of open-newel & dog legged Stairs

1) Plan a dog-legged stair for a building in which the vertical distance b/w the floor is 3.6mtr. The stair hall measures 2.5m x 4.5m

⇒ Let the Rise be 15 cm & tread = 25 cm

width of flight = width of stair = 1.2m

Ht. of each flight = $\frac{3.6}{2}$ = 1.8 mtr = 180 cm

No. of Risers = $\frac{\text{Ht. of flight}}{\text{Riser}}$ = $\frac{180}{15}$ = 12 in each flight

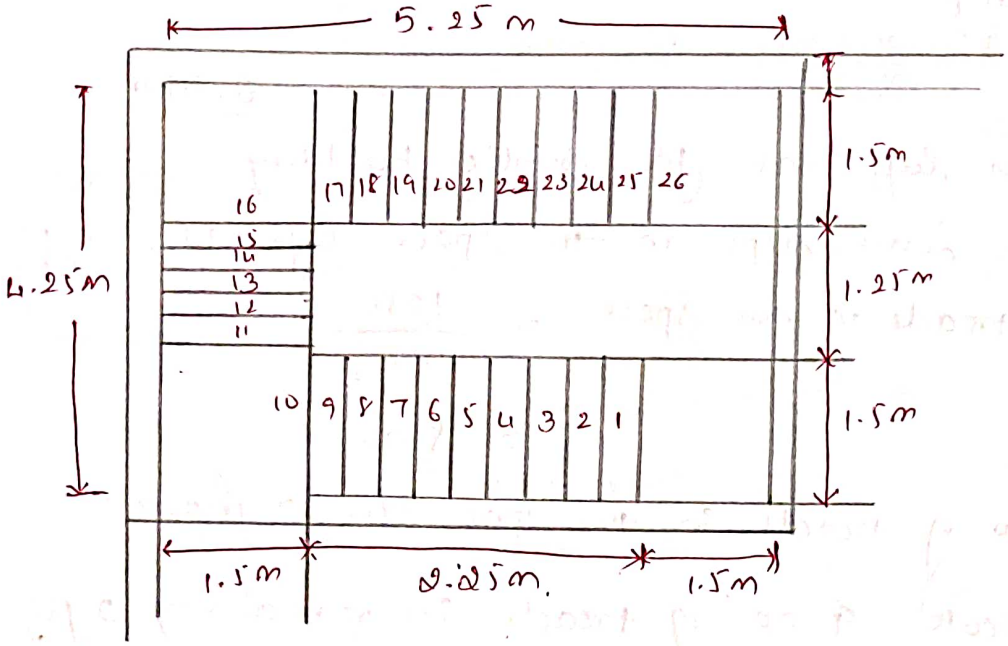
No. of treads = No. of Risers - 1

= 12 - 1 = 11 no.

Spaced occupied by treads in each flight = 11 x 25

= 275 cm

Fig. shows the plan of Stair hall of a public building which measures 4.25 m x 5.25 m. The vertical distance b/w the floor is 3.9 mts. Design a suitable stair for building.



For public building,

width of Stair = width of landing = 1.5m

width of Room = 4.25m

Space left b/w 2 flights = 4.25 - 2(1.5)

= 1.25m

Assume Rise of Riser = 150mm

Rise of tread = 250mm

No. of risers in each flight = $\frac{3900}{2 \times 0.15}$

= 13.

∴ No. of treads = 13 - 1

= 12 no.

Horizontal distance required to accommodate 13 risers & 12 treads

= (0.25 x 12) + 1.5 (width of landing)

= 4.5m

But length of stair hall = 5.25m

Space remained after locating 12 treads & 1 landing = 5.25 − 4.5

= 0.75m

0.75 m is not sufficient for public building

Let us provide some steps in the space left b/w 2 flights

∴ No. of treads in the space = $\frac{1250}{250}$

= 5 no

∴ Allocate 5 no. of treads in the space b/w 2 flights

∴ we can allocate 9 no. of treads in remaining 2 flights

Horizontal distance = 1.5 m + (9 × 250) + passage (1.5)

= 1500 mm + 2250 + 1500

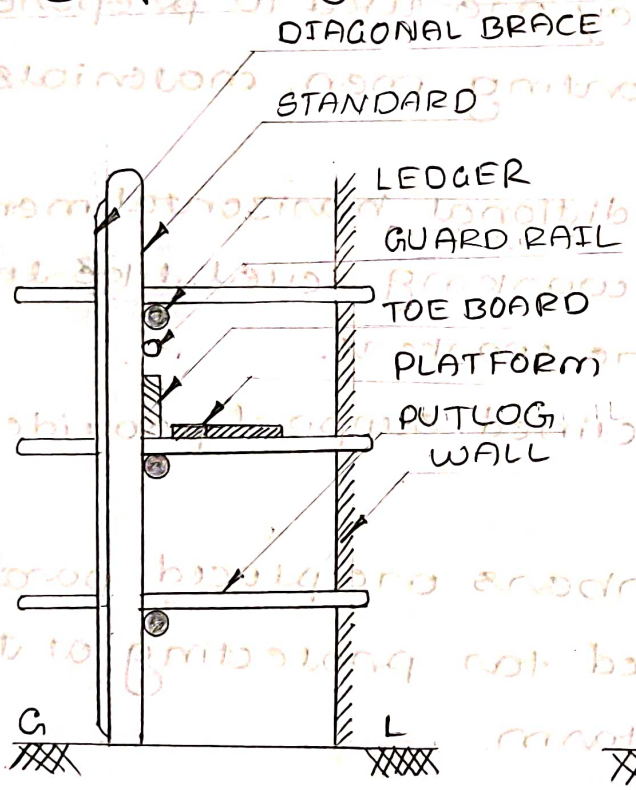
= 5250 mm ≅ 5.25 m

SCAFFOLDING

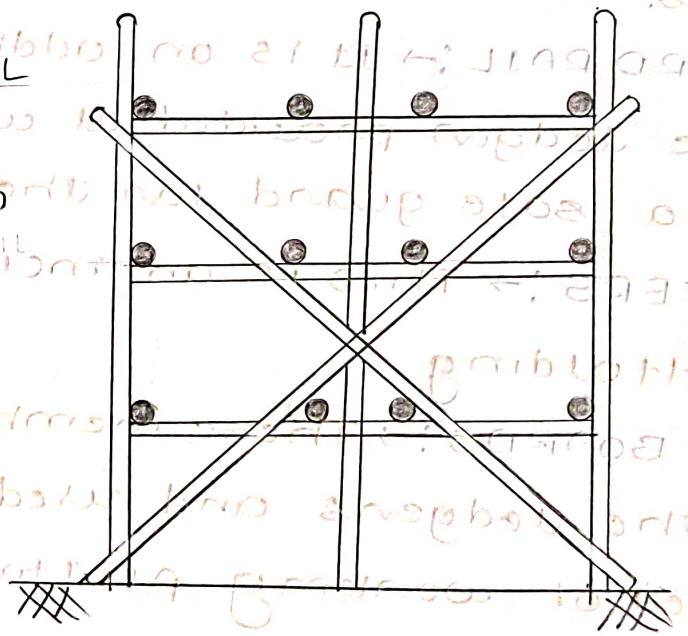
DEFINITION OF SCAFFOLDING :-

when the height of wall @ other structural member of wall building exceeds 1.5m, certain tem-porary from work of timber @ steel are platform over which a work man can sit @ stand @ to carry construction is called as scaffolding.

They are useful in demolishing, repairs of work @ painting @ construction of wall.



SECTION



ELEVATION

COMPONENTS PARTS OF SCAFFOLDING :-

STANDARD :- These are vertical members, erected at one meter to two meter from the wall of the structure. All the loads are born by of standards. Hence they should be strong durable, rigid. They are barried into

-The ground.

LEDGERS :→ They are laid horizontally parallel to wall, They are rigid and connected to standards by rope @ other connective at heights where temporary platform -m have to be built.

PUTLOGS :→ They are placed on ledgers on the right angles to the walls, one end of which held into the way

BRACES :→ These are diagonal members fixed parallel to the ledgers and used in the standards to provide steatness to the scaffolding.

PLANKS OR BOARDING :→ They are used to prepare horiz ontal platform for supporting men, materials and tools.

GUARD RAIL :→ It is an additional horizontal member like ledger as a safe guard for the workers.

RAKERS :→ This is an inclined support provided for scaffolding

TOE BOARDS :→ These members are placed parallel to to the ledgers and used for protecting at the level of working platform.

ESSENTIAL REQUIREMENTS OF GOOD SCAFFOLDING.

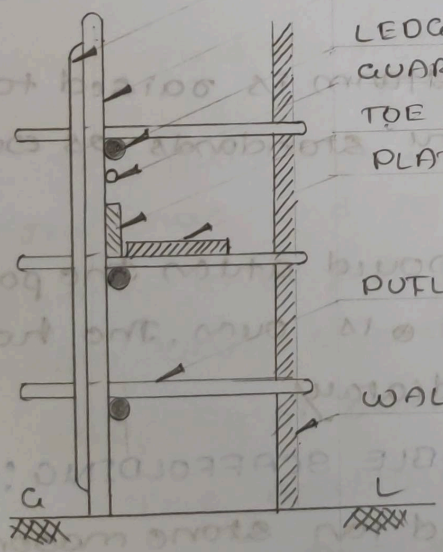
* The materials used for scaffolding should be hard, rigid and durable.

TYPES OF SCAFFOLDING

The following various types of scaffolding

1. Single scaffolding @ B. layers scaffolding
2. Double scaffolding @ S. mason's scaffolding.
3. steel scaffolding.
4. Needle @ continuus scaffolding
5. Trestle scaffolding.
6. pendented @ laden scaffolding.
7. suspended scaffolding

①. BRICK LAYERS OR SINGLE SCAFFOLDING :→



CONSTRUCTION PROCEDURE

* It consist of a single row of standards which are firmly embaded in ground @ in a barrel filled with sand @ earth at a distance of 1.5m to 2m and about 2m away from the wall.
* The standards are connected to each other by ledgers-

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⑦. suspended scaffolding

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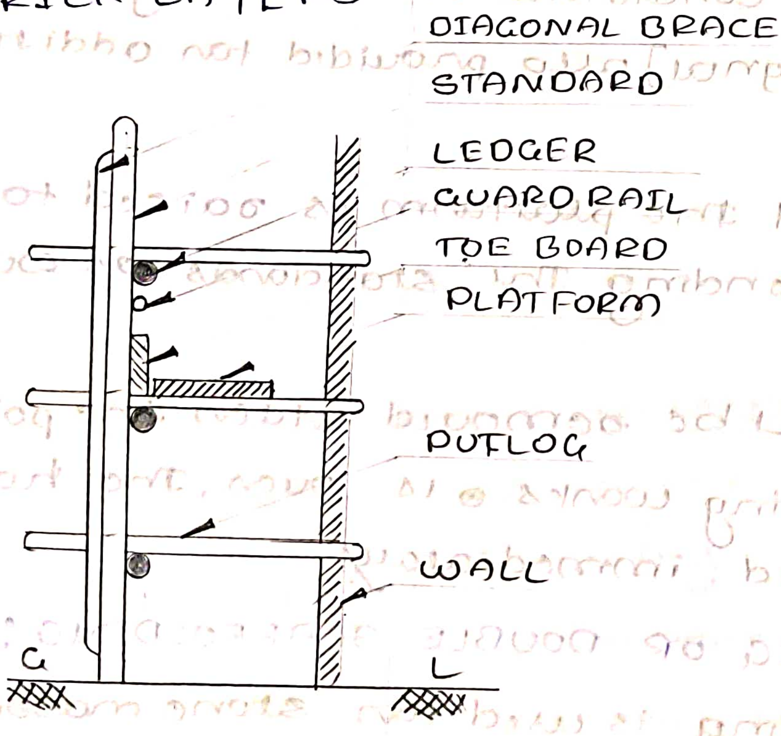


CONSTRUCTION PROCEDURE

* It consist of a single row of standards which are firmly embeded in ground ⓐ in a barrel filled with sand ⓐ earth at a distance of 1.5m to 2m and about 2m away from the wall.

* The standards are connected to each other by ledgers-

(horizontal members) placed at right angle and spaced at a vertical distance of about 1.2 to 1.5m They are secured in position by rope lashings.

* The putlogs, are placed at a spacing of about 1.2m-1.5m, such that one end is supported on the ledgers and the other end is held in the holes is provided in wall. The putlogs are tightened by ropes.

* For keeping materials and to use a platform at different elevation are fixed using timber boards on the putlogs.

* Guard rails, toe boards are also fixed at appropriate places to have safety conditions at working platform. Also cross braces [diagnal] also provided for additional strength.

* As the work proceed the platform is raised to higher levels by extending the standards as extra members.

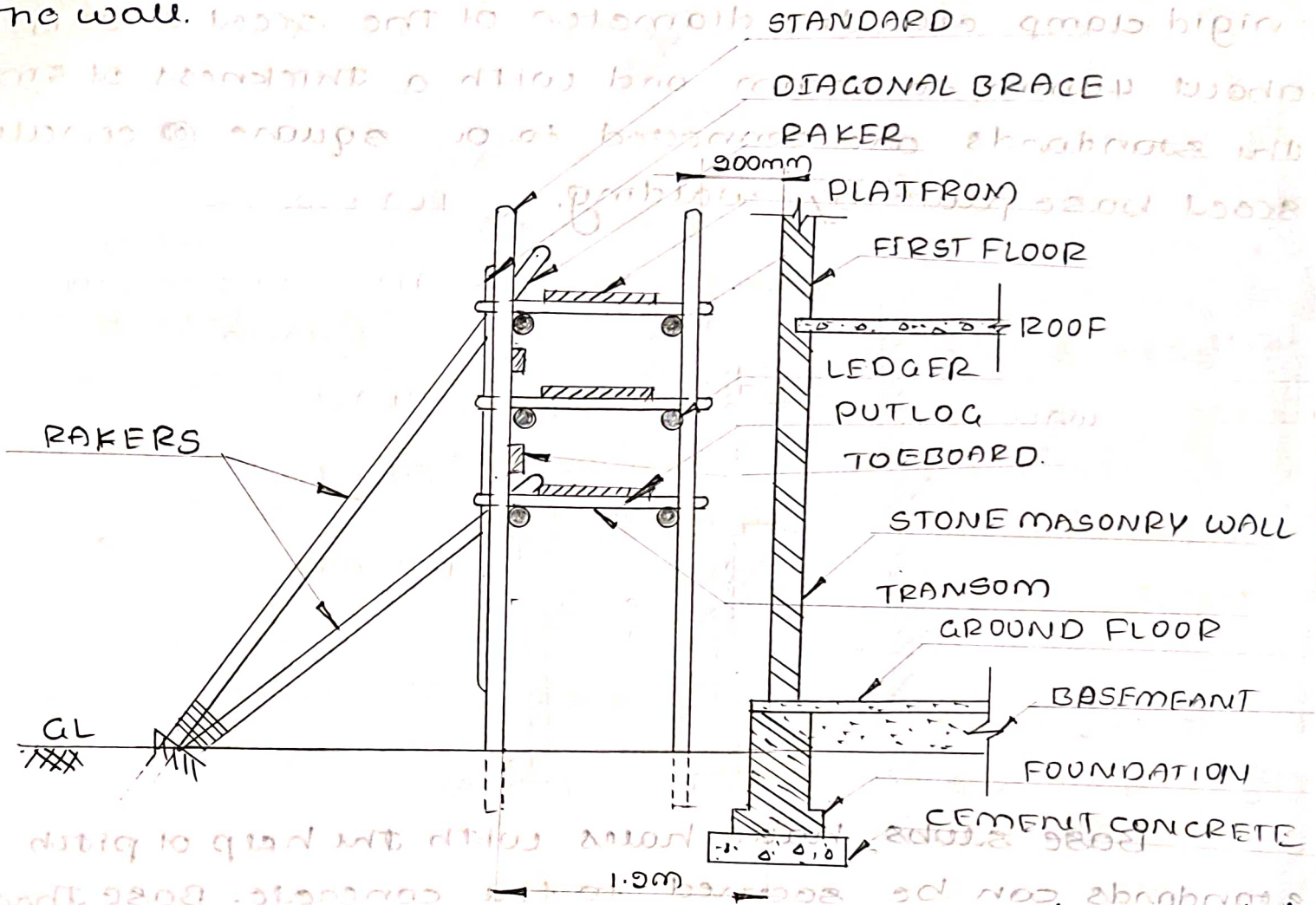
* The scaffolding will be removed after the pointing plastering, white washing works is over. The holes in the walls to be filled immediately.

②. MASON'S SCAFFOLDING OR DOUBLE SCAFFOLDING :→

This scaffolding is used for stone masonry works as holes are not made in the stone masonry wall for inserting the putlogs This scaffolding is stronger than single scaffolding.

In this scaffolding two rows of standards are used one row is about 200mm from face of wall and other row is about 1.2-1.5m away from face of

- the wall.



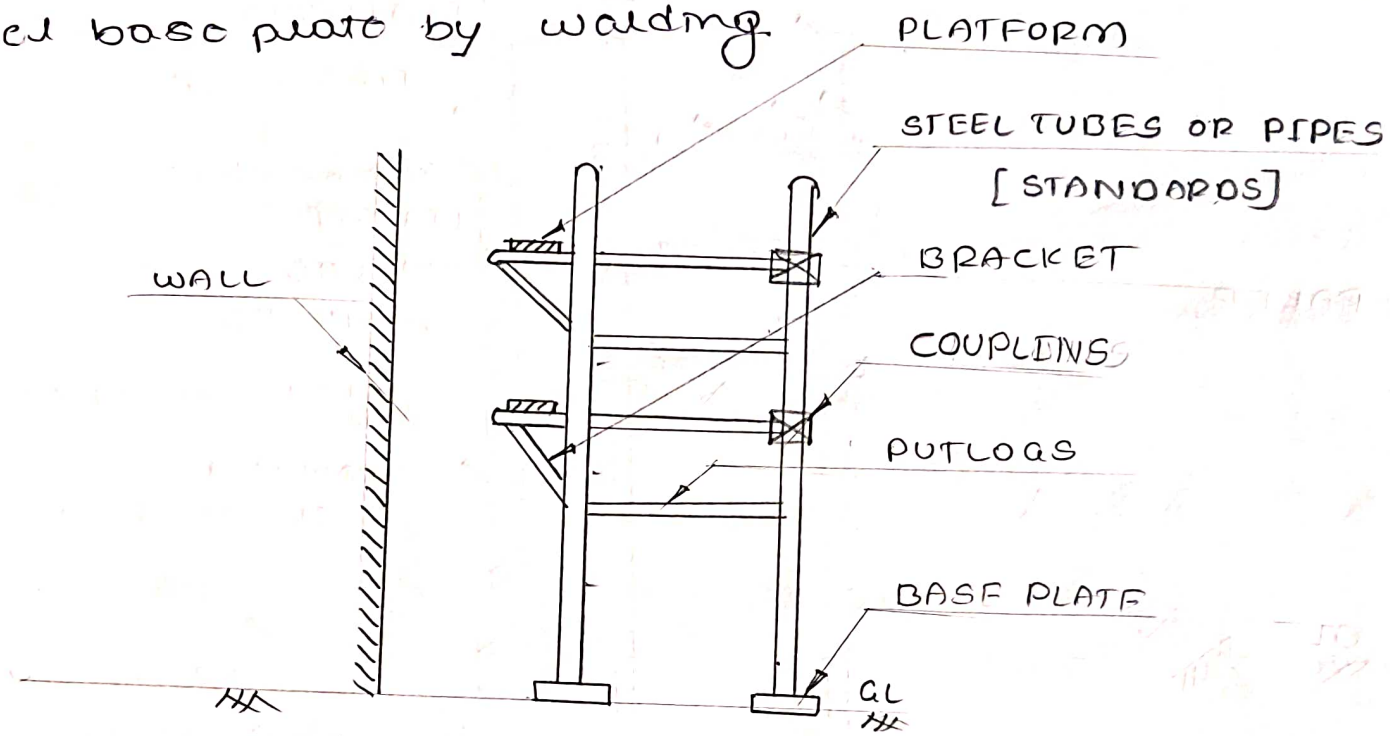
The putlogs are supported on the ledgers and at both the ends and tightened using rope lashing in addition to this some additional members like transom. braces and rakers are provided to prevent the slipping of scaffolding.

The scaffolding are buried into the ground on in the bonral filled with sand.

③. STEEL SCAFFOLDING :→

Now a days steel @ tubular scaffolding are more popular than timber scaff in this type steel tubes are used for standard, putlogs which are joined by nuts and bolts or couplers like wedge clamp.

rigid clamp etc. the diameter of the steel tube is about 40mm to 60mm and with a thickness of 5mm the standards are connected to a square @ circular steel base plate by welding.



Base slabs have holes with the help of pitch standards can be secured to the concrete. Base through the spike @ bolts standards are spaced about 2.5m apart and connected with the help of steel tube loggons at a vertical distance of about 1.8m purlogs are kept projecting on the side of the wall and working platforms are forms on the purlogs which are supported by angle iron brackets as shown in figure

Advantages of steel scaffolding over timber scaffolding

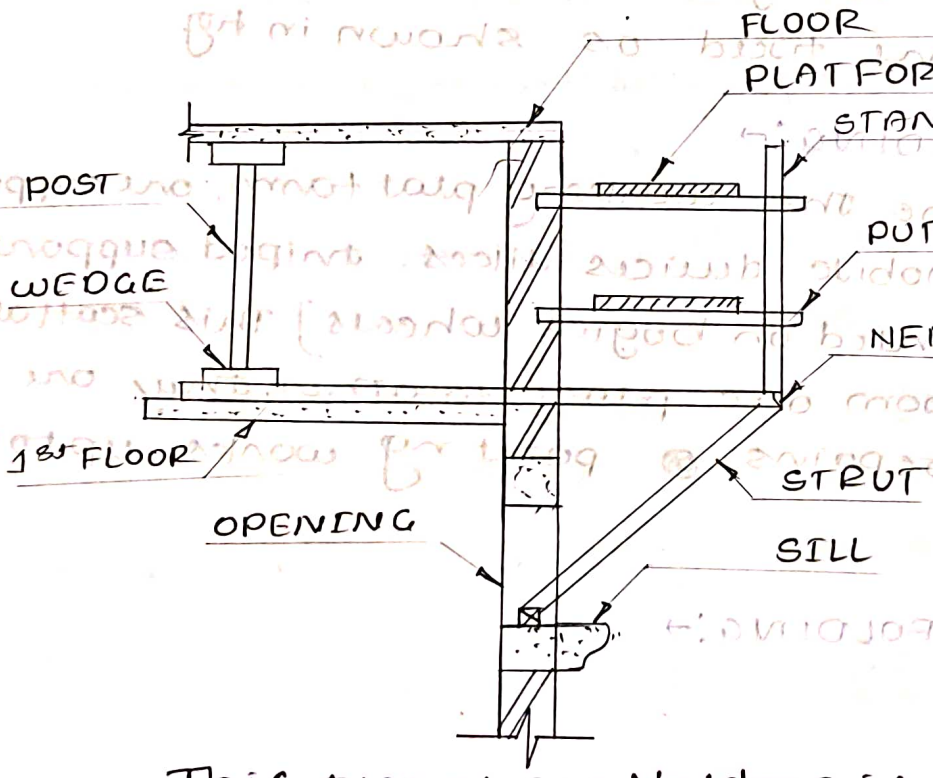
* They are more and durable.
* They can be used for any height
* They can be easily assembled and dissambled.
* They are fire resistant.
* They do not suffer any damage during assembling & dis

* They possos highon scrap and salvage valuo.
* They can be usod numbon of timos.

Disaduantages:→

* They have high initial cost
* They nequined skilled labours
* They nequined peniodically painting to avoid the corrosion.

④. NEEDLE OR CONTILEUER SCAFFOLDING:→



This type of scaffolding is generally adopted for repairing purposes and for adding further storyin -g in existing building, when it is difficult to provide other type of scaffolding from GL due to busy road area.

This type of scaffolding in adopted in the following circumstances.

* when the ground is weak to support the standard.
* when construction is to be carried out on the busy road

* when the upper storyies is added in existing building
* when the repairing works is to be done on the to stories.

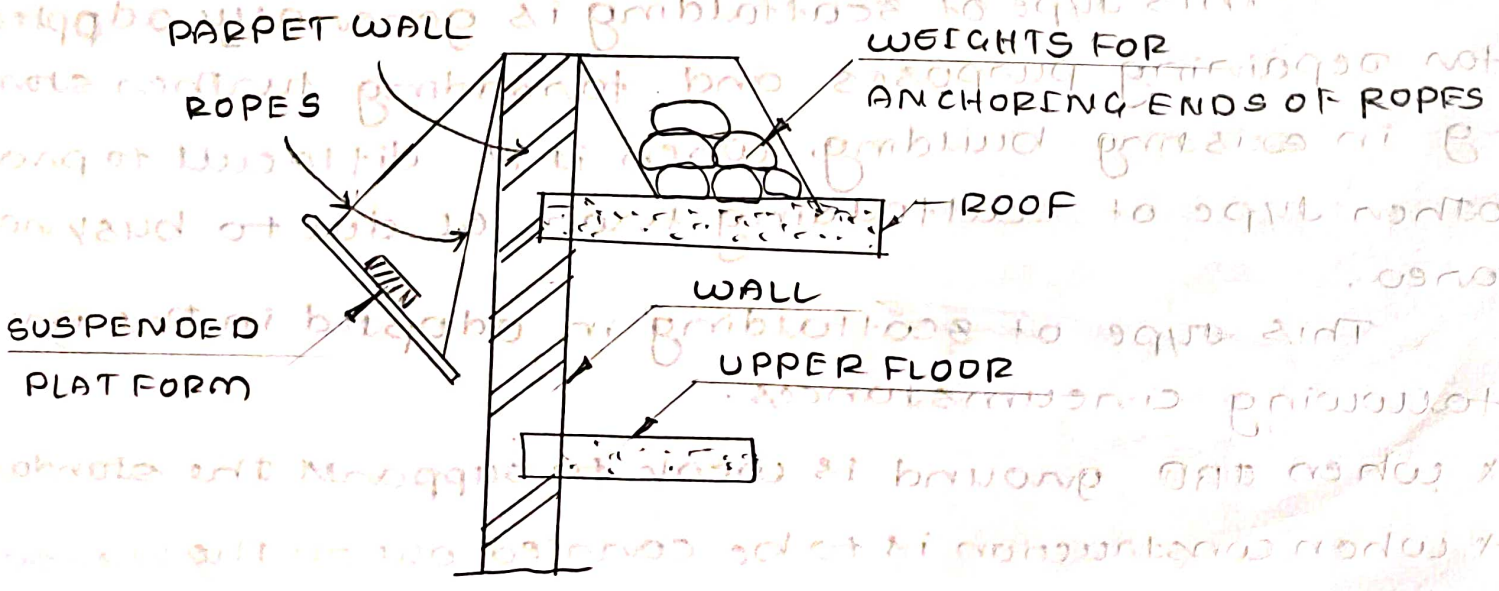
fig shows on the cross section of needle scaffolding which consists of series of needle beams passing through the holes in the walls.

outside above the needles suitable standard purlogs are provided as shown in the fig. Inside the building above the needle vertical posts are provided over the wedges and for more stability inclined struts are fixed as shown in fig

⑤. TRUSTLE SCAFFOLDING :→

In this type, the working platform, are supported on the top of mobile devices likes, tripod supported on [laddons, mounted on bogics wheels] This scaffolding can be shifted from one place to other. they are used for minor repairs @ painting works upto 5m height.

⑥. SUSPENDED SCAFFOLDING :→



This scaffolding is mostly used for maintance work, painting cleaning etc.. the working platform is suspended from the roofs by means of wire ropes or chains the platform may be raised or lowered by manually or mechonical arrangement it is as show in figure.

They may be of

1. fixed type suspended scaffolding
2. suspended scaffolding operated by pully
3. suspended scaffolding operated by winches.

⑦. LADDER SCOFFOLDING :→

The scaffolding is available, in markets with different size and width, height. In this type the working platform supported by brackets it can adjust any heights. The various component of scaffolding are fastened to each other by bolts and nuts.

-: PLASTERING :-

Plaster is a building material used for coating walls & ceilings. Plaster starts as a dry powder similar to mortar @ cement & like those materials it is mixed with water to form a paste which liberates heat & then hardens.

Purpose of plastering:

1) Resistance to impacts expected in use.
2) Free of irregularities.
3) Consistent in texture & finish
4) Firmly bonded to substrates for the expected life of the application.
5) As a suitable substrate for the nominated final finish.

Types of plaster based on the material used:-

1) **Cement mortar:-**
   - (+) Cement is used as binding material in this type of mortar sand is employed as aggregate.
   - (+) The proportion of cement & sand is based on the specified durability & working conditions
   - (+) Cement mortar gives high durability against water.
   - (+) The amount of cement to sand may varied from 1:2 - 1:6

2) **Lime mortar:-**
   - (+) In this case lime is used as a Binding material
   - (+) Generally 2 types of lime are available.
     - (i) Hydraulic lime (ii) Fat lime
   - (+) It has high plasticity so it can be placed easily.

3) Gypsum mortar:

(+) Gypsum mortar consists of plaster & soft sand as binding material & fine agg..

(+) It has low durability in damp conditions.

4) Surkhi mortar:

(+) In surkhi mortar, lime is used as a binder material & surkhi used as a fine agg.

(+) The surkhi is finely-powdered burnt clay which provides more strength than sand & easily available in market

5) Aerated Cement mortar:

(+) It is a cement mortar contain Air entraining agent

(+) Air entraining agents are used for increase the plasticity & workability.

Defects in plastering:

1) Cracks: Appears on the plastered surface in the form of thin lines (or) wider. It causes because of shrinkage of thick plaster (or) due to poor workmanship. It can be prevented by proper curing & keeping thickness of plaster as uniform

2) Efflorescence: Due to soluble salts present in the brick (or) material. It can be avoided by washing the surface with Zinc sulphate salts & water

3) Falling out of plaster:

Due to inadequate bondage of materials, water adsorption by the dry wall

PAINTING :-

1) New building:

Painting is done in 4 steps.

(a) Surface preparation :-

a) Surface should be minimum 15 days old, well cured & completely dry.

b) If there is any defect repair first with cement, sand mortar mixt is called patch work. And cure it.

c) Apply a coat of lime-wash then allow it to completely dry.

d) Then remove loose mortar, dirt @ any other foreign material by applying sand paper on the surface.

(b) Applying primer :-

a) The main job of primer is to provide adhesion b/w the surface & the paint film.

b) It also make the surface smooth, less absorbent & increases the spreading ability of paint.

c) Normally primer is applied by brush @ roller

d) Before applying primer it is thinned with water

e) The coverage area of primer 125 sqm / gallon.

c) Applying putty :-

a) Putty is applied to repair cracks & to make smooth & level the surface.

b) After applying putty the surface should be allowed to dry for 4 day

c) And then scrap off the surplus putty with sand paper

Preparation of putty:

Putty is prepared by mixing 1 gallon of plastic paint, 1 ltr. enamel paint & 25 kg of chalk powder with water.

Applying paints:

a) Paint is applied two @ three coat on the surface.
b) After completely drying up the putty the first coat of paint is applied by roller.
c) The water should be max., 20% for 1st coat & max 15% for subsequent coat
d) After applying 1st coat surface should be allowed to dry for minimum 7 days before applying 2nd coat.
e) Then 2nd coat of paint is applied on the surface in this stage if the surface is not smooth, luster, good quality.
f) Before starting painting work some precaution should be taken

Precaution:

Don't paint during damp, hot & dry weather. Relative humidity should be above 20% & below 50%. also avoid painting on surface having direct sun contact.

Painting for New wood work :-

The painting on new wood work on the following steps For good work 4 coats of paints are required while for interior work, only 2-3 coats are applied.

1) Surface preparation of wood works:

(i) The surface should be well cleaned without any dust, spots, greasy matter etc.,.

(ii) The nail used in the wood work should be punched upto 3mm below the surface.

(iii) The wood in the work should be well seasoned & should not contain > 15% of moisture content.

2) Knotting:

Knot present in the wood may eject resin from wood So, Knots are killed @ covered in this knotting procell.

(a) In the first method, 2 coats of solutions are applied on surface. First coat consist of 15g of red lead, 12th of water & 225g of glue. The mixture of above ingredients are heated & applied & kept for 10min. Later 2nd coat is applied consist of red lead ground in boiled linseed oil & thinned with turpentine oil.

(b) In the second method, hot lime coat is applied on the surface & kept it for 24hrs. After this the layer is scrapped off from the surface.

3) Priming:

a) Surface is smoothened with abrasive paper & then first coat of paint is applied to fill all the pores in the surface

4) Stopping:

a) After filling all the pores of wooden surface in priming, it is time to fill up nail holes, dents, cracks etc. Putty is used as the fill material.

b) When putty is dried, then the whole surface is rubbed with glass paper @ pumice stone.

5) Under coating of new wooden surface:

In general, for good quality works 4 coats of paints are applied. For inferior quality works 2-3 coats can be used. So undercoats are nothing but second & third coats of good quality works which provides same look @ sheen as finishing coat.

6) Finishing:

a) Final coat is applied generally over undercoatings. It should be applied in smooth, uniform manner.

Painting

3) Painting of New iron & Steel surfaces:

Painting of iron & steel surfaces will resist the rust formation due to weathering.

Before painting the surface must be cleaned. If rust is any rust @ scales, should be wiped off using steel brush, etc.,. Stains on surface can be washed with benzene @ lime water.

Before applying prime coat, the surface should be treated with phosphoric acid to get better adhesive nature. Now prime coat is applied which contains 3kg of red lead in 1ltr of boiled linseed oil. This should be applied using brush

After that, two @ more under coats are applied which contain 3kg of red lead in 5ltrs of boiled linseed oil. After drying up, smooth finishing coat of desired paint applied.

DAMP PROOFING :-

The damp proof course (DPC) is generally applied at basement levels, which restricts the movement of moisture through walls & floors. The selection of materials for the damp proof course & its various methods applications are as below.

Properties of materials for DPC :-

1) It should be impervious.
2) It should be strong & durable & should be capable of withstanding both dead as well as live loads without damage
3) It should be dimensionally stable.
4) It should be free from deliquescent salts like sulphates, chlorides & nitrates.

Causes of dampness :-

1) Moisture rising up the walls from ground.
2) Rain travels from wall drops.
3) Rain beating against external walls.
4) Poor drainage at the building site.
5) Defective construction.

Effects of dampness :-

1) Moisture causes unsightly patches, softening of plaster.
2) May cause efflorescence : disintegration of stones, bricks.
3) Cause rusting & corrosion of metal fittings.
4) Floor coverings are damaged.

Methods of Damp proofing:

There are various methods of damp-proofing & depending upon the nature of surface, situation of the structure & amount of dampness.

Following are the methods of damp proofing.

1) Membrane damp-proofing:

This consists in providing layer of membrane of water repellent material b/w the source of dampness & the part of the structure adjacent to it. It may comprise of materials like bituminous felts mastic asphalt, epoxy, polymers, plastic or polythene sheets etc., General principles to be observed while laying DPC are as under

i) The D.P.C should cover full thickness of walls
ii) The mortar bed which is prepared to recieve the horizontal damp-proofing course should be even & leveled & free from projections so that the damp-proofing course is not damaged
iii) At junction the corner of walls, the horizontal D.P.C should be laid continuous.

2) Integral Damp proofing:

i) This consists in adding certain water-proofing compounds with the concrete mix, so that it becomes impermeable. These water proofing compounds may be in 3 forms.
a) Compounds made from chalk, talc, fuller's earth which may fill the voids of concrete under the mechanical action principle.
3) Compounds like alkaline silicon, aluminium, sulphate & $CaCO_3$ etc, which react chemically with concrete to produce WDPC.
4) Compounds like soap, petroleum oils, fatty acids compounds such as stearates of calcium, sodium, ammonia, etc. work on water repulsion principle.

~~XXXXXX~~

3) Surface treatment:

This consists in filling up the pores of the surfaces subjected to dampness. The use of water repellent metalic soaps such as calcium & stearates is much effective in protecting the building against the ravages of heavy rain.

The walls plalted with cement, lime & sand mixed in proportions of 1:1:6 as found to have the purpose of preventing dampness in wall due to rain effectively.

4) Guniting:

This consists in depositing an impervious layer of rich cement mortar over the surface to be water proofed. The operation is carried out by use of machine known as cement gun. The surface to be treated is first thoroughly cleaned of dirt, dust, grease & loose particles & wetted properly. Cement & sand usually taken in proportion of 1:3 to 1:4 are then fed into the machine. This mixture is finally shot in the prepared surface under a pressure of 2-3 kg/cm². The nozzle of the machine is kept at a distance about 75-90cm from the surface to be guinited. The mortar mix of desired consistency & thickness can be deposited to get an impervious layer.

15CV36

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Building Materials and Construction

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What are the qualities a good building stone should posses when it is used for construction purpose. **(04 Marks)**

b. Describe the construction and working of Bull's trench kiln. **(06 Marks)**

c. What is bulking of sand? Mention its practical importance. Explain the size of sand grain on bulking of sand. **(06 Marks)**

OR

2 a. Describe the constituents of good brick earth along with their importance. **(04 Marks)**

b. Explain the factors causing deterioration of stone work and preservation of stone work. **(06 Marks)**

c. Briefly explain the importance of shape, size and texture of coarse aggregates in concrete work. **(06 Marks)**

Module-2

3 a. What is foundation and what are its functions? **(04 Marks)**

b. Differentiate between strip footing and strap footing with sketches. **(06 Marks)**

c. Describe salient features of English bond with an elevation sketch of burnt brick masonry wall. **(06 Marks)**

OR

4 a. Explain the importance of load bearing wall and partition wall in construction of buildings. **(04 Marks)**

b. Describe the types of Ashlar type of stone masonry with sketches. **(06 Marks)**

c. Explain the construction and importance of Grillage foundation with its plan view. **(06 Marks)**

Module-3

5 a. Differentiate between stone lintel and RCC lintel with sketches. **(04 Marks)**

b. Explain the construction of marble flooring in ground floor of building with sketch. **(06 Marks)**

c. Differentiate between lean-to-roof and couple roof with sketches. **(06 Marks)**

OR

6 a. Sketch king post roof truss label its parts (half portion). **(04 Marks)**

b. Mention the requirements of good floor. What are the factors affecting selection of flooring material. **(06 Marks)**

c. Explain the factors affecting stability of arches. **(06 Marks)**

Module-4

7 a. Mention the requirements of good stair. **(04 Marks)**
b. Explain raking shore with a neat sketch. **(06 Marks)**
c. Differentiate between flush door and louvered door with sketches. **(06 Marks)**

OR

8 a. Briefly explain types of stairs. **(04 Marks)**
b. Explain with neat sketches : **(06 Marks)**
(i) Bay window (ii) Corner window
c. Differentiate between brick layers scaffolding and Mason's scaffolding. **(06 Marks)**

Module-5

9 a. Explain the procedure of painting of newly plastered wall surface. **(04 Marks)**
b. Write the objectives of plastering and requirements of good plaster. **(06 Marks)**
c. Briefly explain the methods of damp proofing. **(06 Marks)**

OR

10 a. Explain the procedure adopted in stucco plastering. **(04 Marks)**
b. Explain the importance of constituents of a paint. **(06 Marks)**
c. Describe the defects in plastering. **(06 Marks)**

18CV34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Building Materials and Construction

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Mention the importance of stones Bricks and Timber as construction materials. **(06 Marks)**
b. Explain the manufacture process of Brick with necessary flow chart. **(08 Marks)**
c. What is Bulking of Sand? Explain its importance in construction field. **(06 Marks)**

OR

2 a. What are the requirements of good building stones? **(06 Marks)**
b. What are the constituents of good brick earth? Explain. **(06 Marks)**
c. Which are the methods of seasoning of Timber? Describe them brief. **(08 Marks)**

Module-2

3 a. Which are the functions of foundation? Explain them briefly. **(06 Marks)**
b. Sketch the plan of alternate courses 1 brick thick wall in English bond. Mention its essential features. **(08 Marks)**
c. What are the General principles to be observed in stone masonry? **(06 Marks)**

OR

4 a. Differentiate between strip footing and strap footing with sketches. **(06 Marks)**
b. Sketch the elevation of Flemish bond and mention its special features. **(08 Marks)**
c. Differentiate between uncoursed rubble masonry and Random rubble masonry with a sketch. **(06 Marks)**

Module-3

5 a. Draw a neat sketch of an arch and Label its parts. **(06 Marks)**
b. Explain the procedure for laying Marble flooring in Grand floor with a sketch. **(06 Marks)**
c. Mention the requirements of good roof. Draw the sketch of wooden king post truss (half part). **(08 Marks)**

OR

6 a. Discuss various modes of failure of an arch. What are the remedies? **(06 Marks)**
b. Explain the procedure for laying Mosaic flooring in ground floor with a sketch. **(06 Marks)**
c. Draw the sketch of wooden Queen post truss (half part) and label its parts. **(08 Marks)**

Module-4

7 a. Draw a sketch of a wooden door frame with shutter and label its parts. **(06 Marks)**
b. What are the requirements of good stair? **(06 Marks)**
c. What is meant by shoring? Explain Raking shore with a neat sketch. **(08 Marks)**

OR

8 a. Write a note on Bay window with a sketch. **(06 Marks)**

b. Plan a dog legged stair for a building in which the vertical distance between the floors is 3.6m. The stair hall measure 2.5m × 5m. **(08 Marks)**

c. Write a note on Revolving Door with a neat sketch. **(06 Marks)**

Module-5

9 a. What are the requirements of plastering? **(06 Marks)**

b. Explain various causes of Dampness in building. **(06 Marks)**

c. Describe the constituents of a paint, mentioning the specific functions of each. **(08 Marks)**

OR

10 a. Write a note on various defects in plastering. **(06 Marks)**

b. What are the ill effects of dampness in building? Explain them briefly. **(06 Marks)**

c. Describe the procedure of painting: i) Newly plastered surfaces ii) Iron and steel surfaces. **(08 Marks)**

Third Semester B.E. Degree Examination, Aug./Sept.2020
Building Materials and Construction

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Write the requirements of good building stones. Explain the factors causing deterioration of stone work and preservation of stone work. **(10 Marks)**

b. Explain briefly the tests conducted on bricks. **(10 Marks)**

OR

2 a. Explain the importance of size, shape and texture of coarse aggregates. **(10 Marks)**

b. Explain bulking with reference to fine aggregates with its importance and how the test for bulking is done. **(10 Marks)**

Module-2

3 a. Explain briefly the essential requirement of good foundation. **(10 Marks)**

b. Explain with sketches the following types of foundation :
(i) Combined footing
(ii) Strap beam footing. **(10 Marks)**

OR

4 a. Explain with sketches the features of English bond and Flemish bond in brick masonry, with their merits and demerits. **(10 Marks)**

b. Explain briefly following types of walls:
(i) Load bearing wall
(ii) Partition wall
(iii) Cavity wall. **(10 Marks)**

Module-3

5 a. Explain various modes failures of an arch. **(10 Marks)**

b. Define Lintel. Draw a neat sketch of an R.C.C. lintel with chejja indicating the positions of reinforcements. **(10 Marks)**

OR

6 a. Explain the factors which contribute in selection of flooring materials. **(10 Marks)**

b. Draw a neat sketch of a kind post truss indicating various elements. **(10 Marks)**

Module-4

7 a. Explain briefly the guidelines to be followed while locating doors and windows. **(10 Marks)**

b. Explain with neat sketches the following :
(i) Corner window
(ii) Bay window **(10 Marks)**

OR

8 a. Plan a doglegged stair for a building in which vertical distance between the floors is 3.6m. The stair room measures 3m × 5m (internal dimensions). **(10 Marks)**

b. Write short notes on :
(i) Shoring
(ii) Under pinning **(10 Marks)**

Module-5

9 a. Mention the objectives of plastering? Explain the requirements of good plaster and defects in plastering. **(10 Marks)**

b. What are the causes of dampness? Explain any one method of damp proofing. **(10 Marks)**

OR

10 a. Mention the objectives of painting and point out the characteristics of an ideal paint. **(10 Marks)**

b. Explain the procedure for :
(i) Painting on new wood work
(ii) Painting on new iron work and steel work. **(10 Marks)**

(65)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Course/Subject Title	Building Materials And Construction	Course/Subject Code	18CV34
Semester	3rd B Sec	Scheme	CBCS – 18
Date	12.09.2019	CIE No.	01
Time	3:00 – 4.00 PM	Max. Marks	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	To gain knowledge on various building materials such as stone, bricks, aggregates and CC blocks
CO2	To decide a suitable type of foundation based on soil and loading conditions
CO3	To know the characteristics of brick masonry, stone masonry and walls.
CO4	To gain the knowledge on lintels, arches, floors and roofs
CO5	To gain knowledge on various types of openings in buildings, staircase and formwork for construction
CO6	To gain the knowledge on building finishes such as plastering, painting and damp proofing

Note : Answer any one full question from each part				
Q. No.	Question	Marks	RBT Level	CO
	Part A			
1 a)	Write the requirements of a good building stones.	05	L1	1
1 b)	**Explain** briefly the manufacturing process of Autoclaved Aerated Concrete Blocks	10	L2	1
	OR			
2 a)	**List** the tests which are conducted on fine aggregates and **explain** any two tests briefly.	05	L1,L2	1
2 b)	**Explain** the classification of bricks based on their properties.	10	L1	1
	Part B			
3 a)	**List** the tests which are conducted on fine aggregates and **explain** Impact test briefly with neat figure.	07	L1,L2	1
3 b)	Briefly **explain** the importance of size and shape and texture on coarse aggregates.	08	L2	2
	OR			
4 a)	**Define** foundation. **What** are the purpose & functional requirements of foundation?	07	L1, L2	2
4 b)	With a neat sketch **explain**: i) isolated foundation, ii) Combined foundation	08	L2	2

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain					
L1 : Remembering	L2 : Understanding	L3 : Applying	L4 : Analysing	L5 : Evaluating	L6 : Creating

9/9/2019
Course Coordinator
(Faculty in charge)

9/9/19
Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Building Materials & Construction	Course/Subject Code	18CV34
Semester	3rd 'B' Sec	CIE No.	01
Date	12.09.2019	Max. Marks	30

Q.	Solution	Marks
1		
a)	Requirements of a good building stones. $0.5 \times 10 = 5$	5M
b)	Manufacturing of Autoclaved Aerated concrete blocks: Materials used – 3M Effect of Al. dross – 1M Process & storage of ~~product~~ – 6M 10M	10M
2		
a)	Tests on fine aggregates: Listing the tests conducted on fine agg – 2M. Explaining any 2 tests – 1.5×2 – 3M 5M	5M
b)	Classification of bricks based on their properties Classifying the bricks — 2M Explaining class I, II, III & IV bricks – 2×4 – 8M 10M	10M

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Scheme of Valuation

Q.	Solution	Marks
3 a)	**Tests conducted on coarse aggregate:** Listing the tests on coarse aggregate – 3M Impact test → Fig. 2M Explanation – 2M – 4M 7M	7M
b)	**Importance of Size, Shape & Texture of coarse agg** Imp of size of C.A – 2M Imp of shape of C.A – 3M Imp of Texture of C.A – 3M 8M	8M
4 a)	Defining Foundation ——— 1M Purpose & functional requirement of foundation – 1×6 = 6M 7M	7M
b)	Explanation of i) **Isolated footing** NLD of footing – 1M Explanation – 3M 4M ii) **Combined footing** NLD of footing – 1M Explanation – 3M 4M	8M

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USN	4	B	D							

Course/Subject Title	Building Materials And Construction	Course/Subject Code	18CV34
Semester	3rd B Sec	Scheme	CBCS – 18
Date	22.10.2019	CIE No.	02
Time	3:00 – 4.00 PM	Max. Marks	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	To gain knowledge on various building materials such as stone, bricks, aggregates and CC blocks
CO2	To decide a suitable type of foundation based on soil and loading conditions
CO3	To know the characteristics of brick masonry, stone masonry and walls.
CO4	To gain the knowledge on lintels, arches, floors and roofs
CO5	To gain knowledge on various types of openings in buildings, staircase and formwork for construction
CO6	To gain the knowledge on building finishes such as plastering, painting and damp proofing

Note : Answer any one full question from each part

Q. No.	Question	Marks	RBT Level	CO
	Part A			
1 a)	**Define**: Header, Stretcher, Queen closer, King Closer and Plinth.	05	L1	3
1 b)	With a neat sketch **explain** English Bond, Flemish bond.	10	L2	3
	OR			
2 a)	Briefly **explain** Load bearing wall and Cavity wall	05	L2	3
2 b)	**List** the types of joints in stone masonry & **explain** any four joints.	10	L1, L2	3
	Part B			
3 a)	With a neat sketch **explain** the components of an arch.	05	L2	4
3 b)	**Define** lintel. **Explain** different types of lintels with neat sketches.	10	L1, L2	4
	OR			
4 a)	Write a **short note** on Cement flooring.	05	L1, L2	4
4 b)	**What** are the requirements of a good roof? Draw the NLD of king post truss.	10	L1, L2	4

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain					
L1 : Remembering	L2 : Understanding	L3 : Applying	L4 : Analysing	L5 : Evaluating	L6 : Creating

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

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Scheme of Valuation

Course/Subject Title	Building material construction	**Course/Subject Code**	18CV34
Semester	3rd . B.Sc.	**CIE No.**	02
Date	22-10-2019.	**Max. Marks**	30

Q.	Solution	Marks
1		
a)	Define : Header — 1M Stretcher — 1M Queen closer — 1M King closer — 1M Plinth — 1M 5M	5M
b)	English Bond → Neat labelled dig — 1M Explaining the charectoristics — 1×4 = 4M 5M Flemish Bond → Neat labelled dig — 1M Explaining the charcotoristics — 1M×4 = 4M 5M	5M 5M
		10M
2		
a)	Brig note one load bearing wall — 2M Cavity wall with fig. — 3M 5M	5M
b)	Defining lintel ———— 2M. Types i) Timber lintel ii) Brick iii) RCC iv) Steel v) Stone } with fig. — 8M 10M	10M

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USN	4	B	D							

Course/Subject Title	Building Materials And Construction	Course/Subject Code	18CV34
Semester	3rd B Sec	Scheme	CBCS – 18
Date	26.11.2019	CIE No.	03
Time	3:00 – 4.00 PM	Max. Marks	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	To gain knowledge on various building materials such as stone, bricks, aggregates and CC blocks
CO2	To decide a suitable type of foundation based on soil and loading conditions
CO3	To know the characteristics of brick masonry, stone masonry and walls.
CO4	To gain the knowledge on lintels, arches, floors and roofs
CO5	To gain knowledge on various types of openings in buildings, staircase and formwork for construction
CO6	To gain the knowledge on building finishes such as plastering, painting and damp proofing

Note : Answer any one full question from each part

Q. No.	Question	Marks	RBT Level	CO
	Part A			
1 a)	**Define** a stair. With a neat sketch explain the following terms: i) Thread and riser ii) Flight and landing	05	L1	4
1 b)	Briefly **explain** i) Revolving door ii) Paneled door with neat figures	10	L2	5
	OR			
2 a)	**State** briefly the requirements of a good stair.	05	L2	5
2 b)	**Plan** a doglegged staircase for a building in which the vertical distance between the floors is 3.0m. the stair hall measures 2.8m X 5.8m	10	L3	5
	Part B			
3 a)	**Discuss** the defects in plastering.	05	L2	6
3 b)	**List** the methods of plastering and **explain** the any two.	10	L1, L2	6
	OR			
4 a)	**Explain** the painting procedure for old wall painting and metal painting.	05	L1, L2	6
4 b)	**What** is damp proof course? **Explain** its necessity.	10	L1, L2	6

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain					
L1 : Remembering	L2 : Understanding	L3 : Applying	L4 : Analysing	L5 : Evaluating	L6 : Creating

22/11/2019

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
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Scheme of Valuation

Course/Subject Title	Building materials & Construction	Course/Subject Code	18CV34
Semester	III B. Section	CIE No.	03
Date	27.11.2019	Max. Marks	30

Q.	Solution	Marks
1. a)	Define a Stair with neat sketch & a stair case → 2M Define Tread & Riser → 1 M Flight & Landing → 1 M 5M	5M
b)	Neat sketch of Revolving door → 2M. Explanation 0.5 x 6 point → 3M [Places to use, Material, uses] Neat sketch of Panneled door → 2M Explanation 0.5 x 6 point → 3M 10M	10M
2) a)	Requirements of good stair 5 points → 5M	5M
b)	Calculation no. of flights, width of stair case, rise & tread & riser → 2M Calculating no of treads & risers → 2M Space occupied by stair case → 1M Plan showing no of treads & risers → 5M 10M	10M

Course Coordinator (Faculty in charge) | Coordinator DQAC | Program Coordinator (HOD, Civil)

(150)

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Scheme of Valuation

Q.	Solution	Marks
3) a)	Defects in plastering: Listing the defects → 1M Explaining any 2 defects 2×2 = 4M → 4M 5M	5M
b)	Listing methods of plastering → 2M Explanation of any 2 method of plastering → 8M 10M	10M
4) a)	Steps for procedure of old wall painting → 2.5 Metal painting → 2.5 5M	5M
b)	Defining damp proof course → 1M Necessity of damp proofing 1×9 = 9M → 9M 10M	10M

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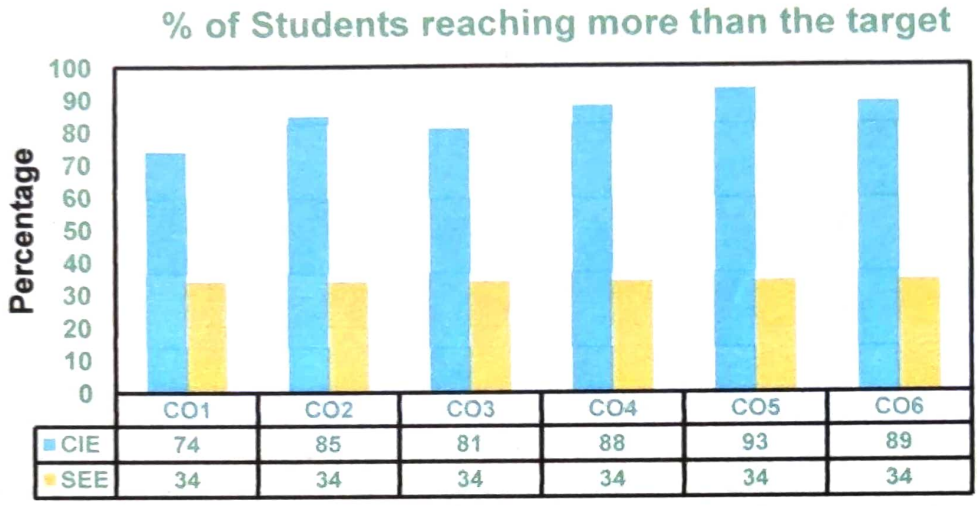
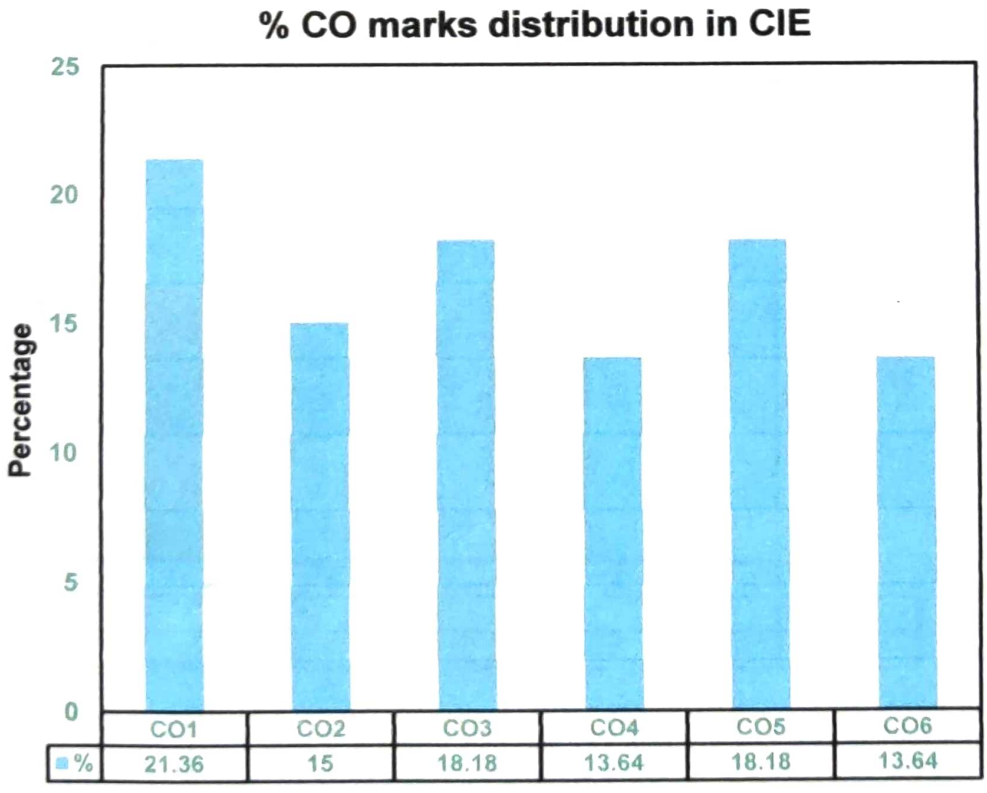
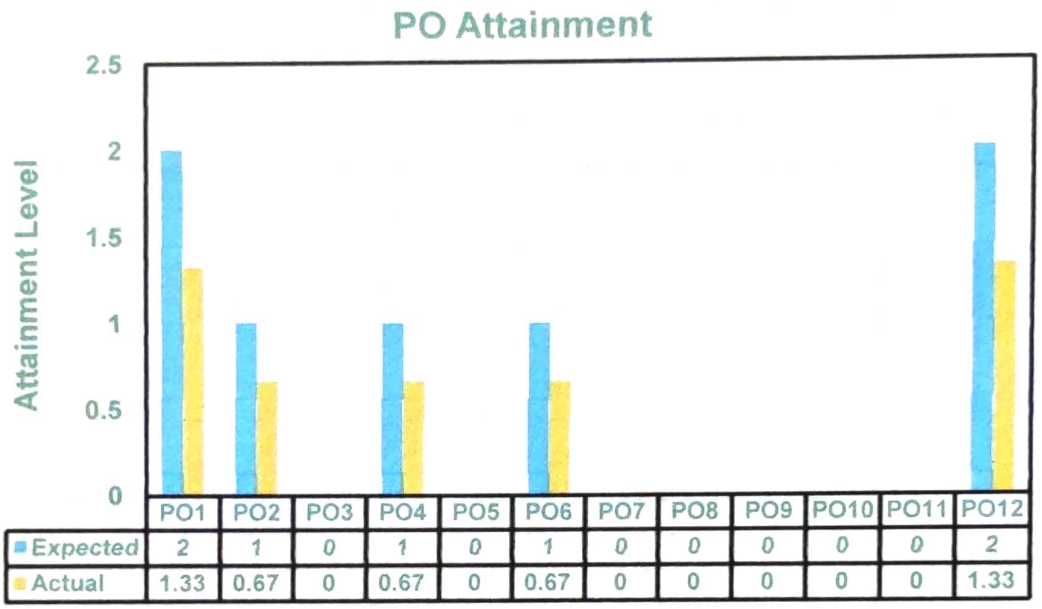
RESULT ANALYSIS

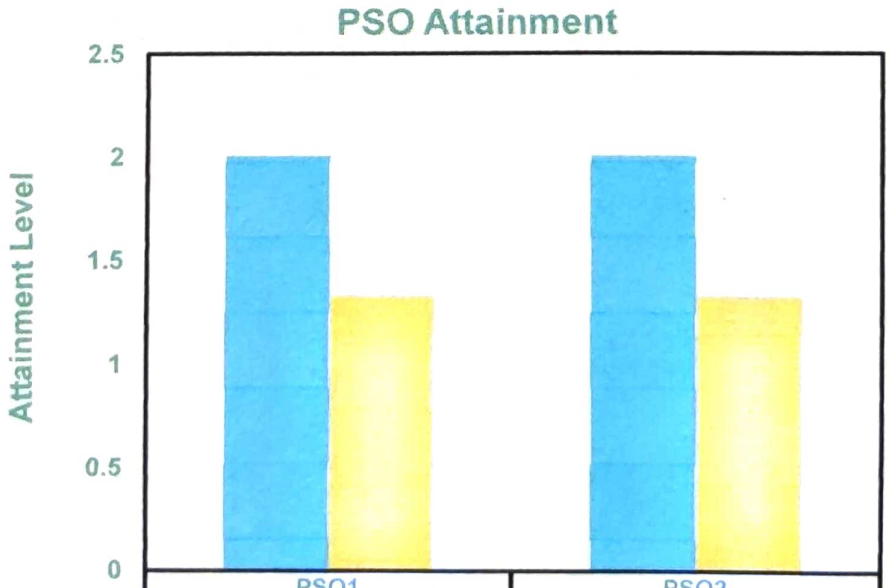
Building Materials and Construction (18CV34)







	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Expected	2	1	0	1	0	1	0	0	0	0	0	2
Actual	1.33	0.67	0	0.67	0	0.67	0	0	0	0	0	1.33



	PSO1	PSO2
Expected	2	2
Actual	1.33	1.33

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Result Analysis of Fifth Semester UG Students for the Academic Year: 2019-2020

Sl. No.	Course Code	Name of the Course Coordinator	No. of Students					%
		B Section	Total	Absent	Appeared	Passed	Failed	
01	18CV34	A R Chandrashekar	69	01	68	61	07	90