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G. PULLAIAH COLLEGE OF ENGINEERING AND TECHNOLOGY
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Department of Civil Engineering

Bridge Course
On
Cost Effective Housing Techniques

Background:

- The important need and everyone's dream to have their own home with individual needs.
- Since India is a developing country, the economy haves importance. The housing is so impacted with the cost based construction.
- So, there are various cost effective techniques of construction. Lots of them are also energy efficient and easily adoptable.

Introduction:

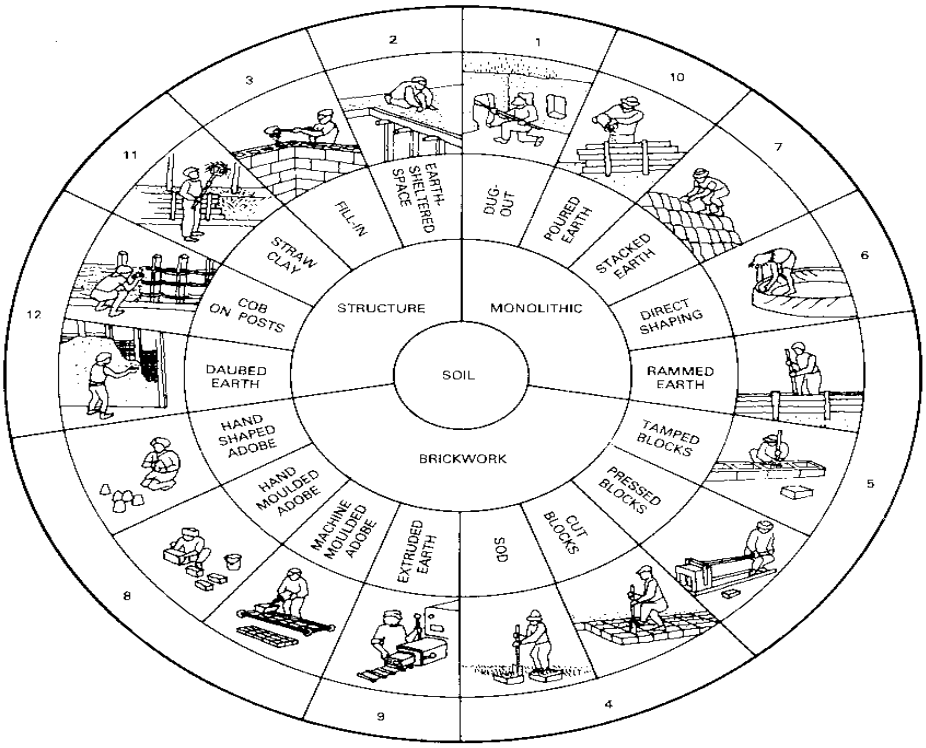
- Ar. Laurie baker is one who worked on cost effective construction techniques as its best.
- Baker showed, in fact, that sustainable technologies when adopted with care and creativity, could lead to a unique architectural expression, one that moved the expert and the layman alike.
- Proper materials are the basic need to develop any construction technique.
- Brick, wood, stone are three major materials which can be used in India for any type of construction.
- Major causes of high building costs have been identified as use of expensive materials, lack of necessary building skills and lack of guidelines in selection of appropriate building packages (designs, materials, methods, Equipment).
- Fatty (1973) contends that the basic philosophy on housing in developing countries should be to Provide people with appropriate and attractive architectural designs that make use of native materials.
- This apart from promoting the use of locally available skills would provide housing that also serves “indigenous needs while being at the same time socially and aesthetically satisfying”. Lack of consolidated and ready-to-use information is also a major contributing factor; several alternative building materials are continually researched and developed – several model housing units have been put up to demonstrate new designs, materials and techniques; A lot of work has been carried out on the use of compressed earth blocks, interlocking blocks, alternative stabilizers (research on the use of admixtures and fly ash currently being undertaken by RIIC), roofing tiles, equipment (canvas ram, tile making machines) etc.
- To a larger extent these never pass beyond this stage, findings are normally documented but usually only to serve as references for academic and intellectual purposes. Some of the many technologies and designs are discussed in this paper and recommendations are proposed on how to make effective use of this information

Building technologies:

This section looks at building materials, skills requirement and equipment in the context of cost effective Systems

Building materials:

Building materials may be classified as traditional, conventional or adapted traditional materials mainly consist of earth construction



Earth construction methods (Earth Construction, 1994)

- Conventional materials refer mainly to cement and concrete based building methodsCorrugated sheets roofing.
- Adapted materials: these are the several new methods comprising mainly of combinations of the other two methods.
- Examples include Ferro cement, fired clay bricks, timber panels, rice husk and lime stabilizer, sisal fiber reinforced roofing sheets, etc.
- In a recent study carried out in the North West Province in South Africa [Housing in Southern Africa April [1999] the following were some of the findings regarding the use of upgraded construction technologies

- Although conventional methods appeared more acceptable, communities were generally willing to consider using upgraded traditional construction technologies.
- Traditional construction methods were more cost-effective than conventional methods in rural areas.
- The most prevalent building method use in one area known as Lekgopung is earth blocks with an earth and dung plaster and a corrugated iron roof

Factors affecting construction cost estimation:

- **Building Cost**-The building construction cost can be divided into two parts namely: Building material cost : 65 to 70 %,Labor cost : 65 to 70 %
- **Size**-The smaller the project in terms of scope or the number of square feet, the more it will cost per square foot.
- **Type**-Different types of project have different levels of complexity and detail
- **Special Construction -** Complexity can greatly increase the cost of the project. For exp-Renovation, especially if it requires altering or moving structural components, can be costly because it necessitates demolition as well as building.
- Special construction may also be necessary to shield surrounding spaces from noise, fire and other hazards.
- Project accessibility
- Labor Rates
- Material Costs
- General Economic Pressures
- Time of Year

Cost effective appropriate technologies:

Foundation:

- Random rubble masonry in mud/cement mortar placed in excavation over thick sand bed. Rubble pointing above ground level in stabilized cement mortar.
- Use of lean cement concrete mix 1:8:16 for base with brick masonry in 1:6 cement mortar footings.
- Use of lean cement concrete mix as above for base and over burned bricks masonry in cement lime mortar (1:2:12) footings.
- Arch foundations in place of spread foundations.

Foundation costs:

- Normally the foundation cost comes to about 10 to 15% of the total building.
- It is recommended to adopt a foundation depth of 2 ft. (0.6m) for normal soil like gravely soil, red soils etc.
- It is suggested to adopt arch foundation in ordinary soils.
- In case of black cotton and other soft soils, it is recommend to use under ream pile foundation which saves about 20 to 25% in cost over the conventional method of construction
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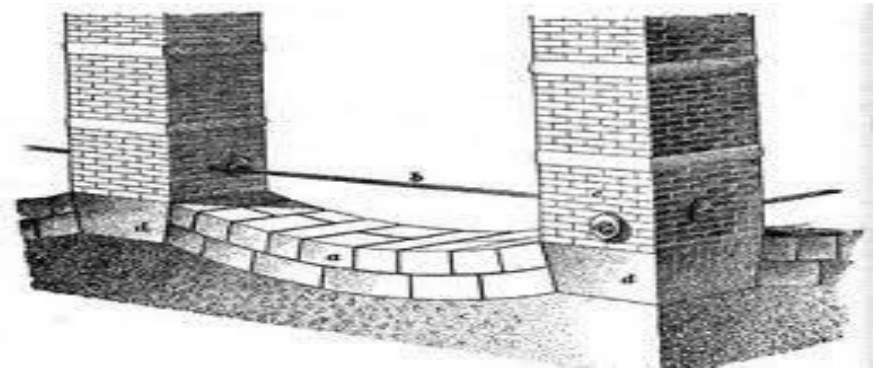


Arch Foundation

Masonry:

The art of building a structure in stone with any suitable masonry is called stone masonry.

Stone masonry may be broadly classified into the following two types:

- Rubble Masonry
- Ashlar Masonry

Rubble Masonry:

The stone masonry in which either undressed or roughly dressed stone are laid in a suitable mortar is called rubble masonry. In this masonry the joints are not of uniform thickness. Rubble masonry is further sub-divided into the following three types.

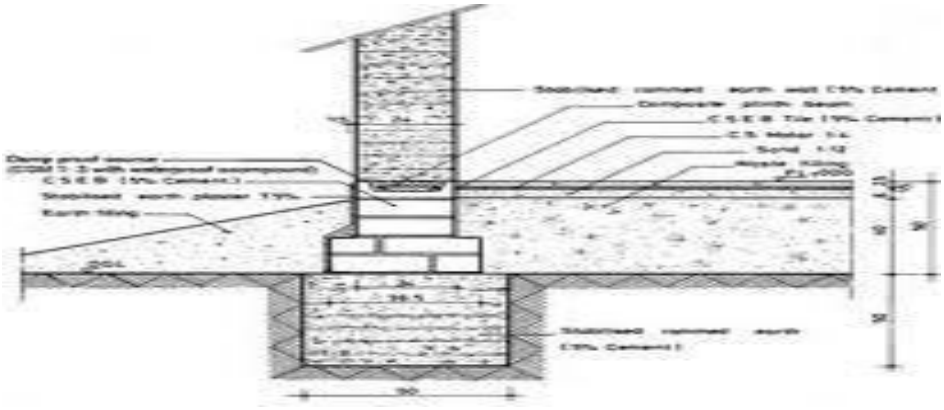
- Random rubble masonry
- Squared rubble masonry
- Dry rubble masonry

Ashlar Masonry:

- The stone masonry in which finely dressed stones are laid in cement or lime mortar is known as ashlars masonry.
- In this masonry are the courses are of uniform height, all the joints are regular, thin and have uniform thickness.
- This type of masonry is much costly as it requires dressing of stones
- This masonry is used for heavy structures, architectural buildings, high piers and abutments of bridges

Plinth:

- It is recommended to adopt 1 ft. height above ground level for the plinth and may be constructed with a cement mortar of 1:6.
- The plinth slab of 4 to 6" which is normally adopted can be avoided and in its place brick on edge can be used for reducing the cost.
- By adopting this procedure the cost of plinth foundation can be reduced by about 35 to 50%.



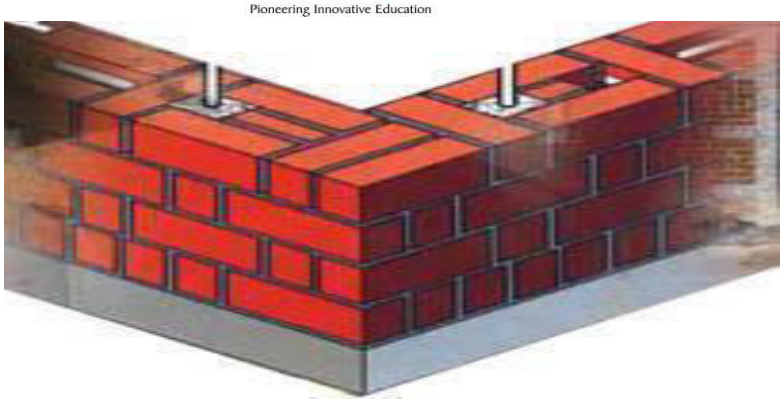
Columns:

- A column or pillar in architecture and structural engineering is a structural element that transmits, through compression, the weight of the structure above to other structural elements below.
- In other words, a column is a compression member. The term column applies especially to a large round support (the shaft of the column) with a capital and a base or pedestal and made of stone or appearing to be so. A small wooden or metal support is typically called a post, and supports with a rectangular or other non-round section are usually called piers.
- For the purpose of wind or earthquake engineering, columns may be designed to resist lateral forces.
- Other compression members are often termed "columns" because of the similar stress conditions.

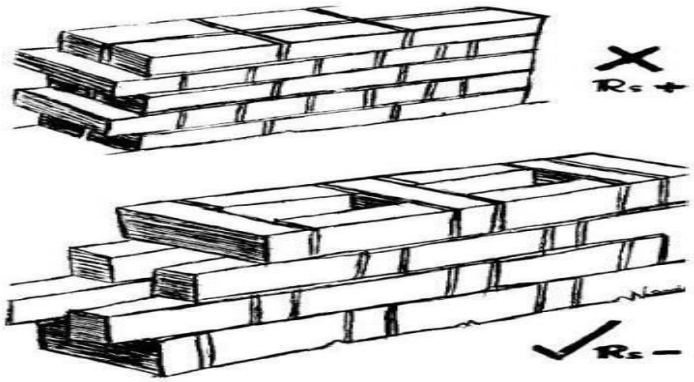
- Columns are frequently used to support beams or arches on which the upper parts of walls or ceilings rest. In architecture, "column" refers to such a structural element that also has certain proportional and decorative features.
- A column might also be a decorative element not needed for structural purposes; many columns are "engaged", that is to say form part of a wall

Walls:

- Brick work in 1:6 cement mortar using bricks from black cotton and inferior soil stabilized with fly-ash.
- Rat-trap bond brick work in 1:2:12 cement lime mortar/1:1.5:3 cement sand mortar.
- Hollow concrete block masonry in cement mortar.
- Compressed mud blocks masonry in mud mortar.
- Stabilized mud blocks masonry (4% cement or lime) in stabilized mud mortar.
- Sand lime brick walls in 1:6 cement mortars.
- FAL-G sand block with 1:6 cement mortar
- While laying bricks, the manner in which they overlap is called the bond.
- The rat-trap bond is laid by placing the bricks on their sides having a cavity of 4” (100 mm), with alternate course of stretchers and headers
- The headers and stretchers are staggered in subsequent layers to give more strength to the walls

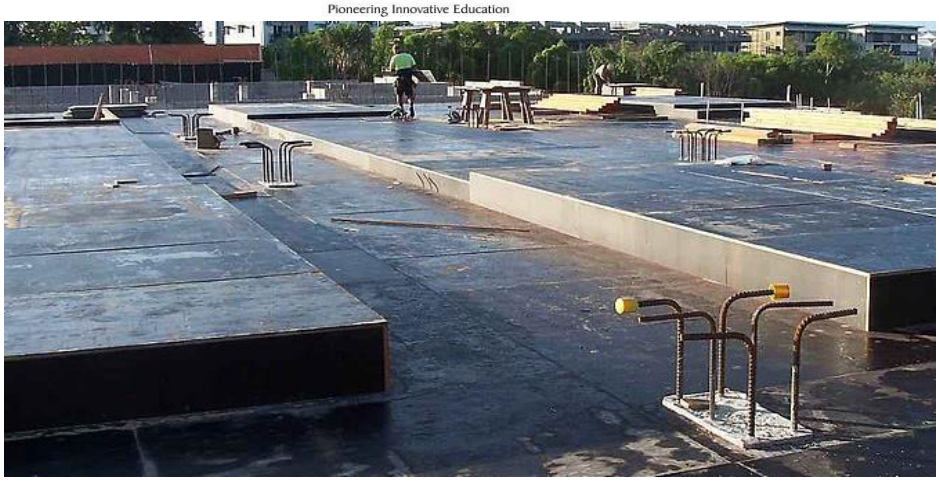


- This technology has about 25% overall-saving on cost of a building of traditional 9" construction.
- The structure has proven its strength to go up to three floors with the support of brick columns With this technique there is reduction in cost of the wall by 25% as with conventional English bond (9''thk wall) 350 bricks are required per cu. m whereas in Rat-trap bond only 280 bricks are required and also the reduced number of joints reduces the mortar consumption

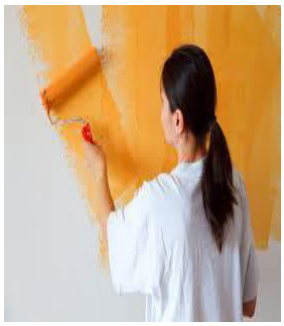


Slabs:

- A concrete slab is a common structural element of modern buildings. Horizontal slabs of steel reinforced concrete, typically between 4 and 20 inches (100 and 500 millimeters) thick, are most often used to construct floors and ceilings, while thinner slabs are also used for exterior paving.
- Sometimes these thinner slabs, ranging from 2 inches (51 mm) to 6 inches (150 mm) thick, are called mud slabs, particularly when used under the main floor slabs or in crawl spaces.
- In many domestic and industrial buildings a thick concrete slab, supported on foundations or directly on the subsoil, is used to construct the ground floor of a building.
- These can either be "ground-bearing" or "suspended" slabs. In high rise buildings and skyscrapers, thinner, pre-cast concrete slabs are slung between the steel frames to form the floors and ceilings on each level.



Finishing Work: The cost of finishing items like sanitary, electricity, painting etc., varies depending upon the type and quality of products used in the building and its cost reduction is left to the individual choice and liking.



Types of precast components in a building:

The numbers of different types of components in these structures over the years have become very large and the major types of precast components in a building.

Precast Beams:

There are two main categories of beams:

1. Internal beams – where floor loading is approximately symmetrical
2. External beams – where floor loading is predominantly non-symmetrical.

Precast Columns:

For structures of five storeys or less, each column will normally be continuous to the full height of the building. For structures greater than five storeys two or more columns are spliced together.

The main types of precast columns are:

- **Edge columns** – symmetrical in one direction
- **Internal columns –** symmetrical in all directions.
- **Corner columns** – not symmetrical at all.

Precast floor slabs:

The main types of slabs are used in the precast frames are:

Precast walls:

Precast concrete walls serve two functions:

- Stability
- As walls or boxes surrounding staircases and lift shafts.

Walls may be classified as infill or cantilever

- Infill walls rely on contiguous composite action with the beam and column frame.
- Cantilever walls or boxes act as deep beams to which the frame is attached.

Precast staircases:

Three options are available for precast staircases

- A single precast unit containing all the flights and landings
- Separate precast flights and landings
- Parts of the flights and landings are made in one piece.

Cost-effective building materials and construction technologies Research and development bodies in India are:

- Central Building Research Institute (CBRI)
- Structural Engineering Research Centre (SERC)
- Centre for Application of Science and Technology to Rural Areas (CASTRA)
- Regional Research Laboratories (RRL)
- National Environmental Engineering Research Institute (NEERI)

State level organization for housing: The following are the organization acting at state level for housing program.

- Andhra Pradesh Housing Board [APHB]
- Andhra Pradesh Police Housing Corporation [APPHC]
- Co-Operative housing societies
- Land development bank
- Adidravidar housing development scheme [AAHDCO]
- Building Centre [Located at collect orate of each districts]
- Private housing finance

Factors affecting Choice of Materials and Technologies:

- Availability/suitability of raw materials
- Availability of skilled labor
- Scale of construction
- Cost variation with conventional materials
- Availability of adequate power for production of components
- Typology based on geo-climatic conditions
- Disaster-resistant requirements
- Environmental aspects
- Acceptability by people