8. How to choose a STRUCTURAL TYPE for my home?

How to choose a good structure for your home?
What to keep in mind when expanding an existing house?

This toolkit shares easy -to-follow tips to choose a good structural type for your home.

LOKAL Habitat Labs

Durable Homes Toolkits

How to choose a good structure for your home?

A. CHOOSING A STRUCTURAL SYSTEM

What is a Structural System?
The structural system of a house carries the load of the building & transfers it through its members to the ground.

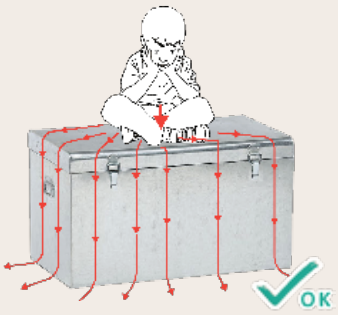
Why is it important?
A well constructed structure ensures safety and durability. A faulty structure may cause irreparable or very expensive damages in the future, and may result in the loss of life.

How to ensure safety of the Structure?
Ensure that there is no compromise in the quality of materials and construction of the structure. Keep in mind the soil conditions, building load, protection from water & good construction practices.

There are two main types of structural systems-

What is a 'Load Bearing Structure'?

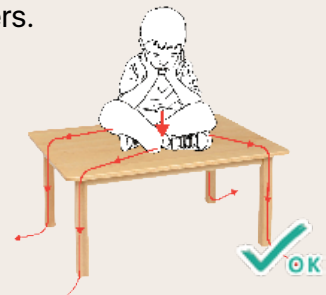
In a load bearing structure, the load is transferred via walls to the foundation. Walls are the structural members.



It can be thought of as a box, where all the sides of the box support the load that falls on the box.

What is an 'RCC Structure'?

In an RCC structure, the load is transferred from beams to columns and then to the foundation. The structural members are made of Reinforced Cement Concrete (RCC). Walls are not the structural members.



It can be thought of as a table, where only the 4 corners of the table support the load that falls on the table.

How can you choose the most suitable structural system?

B. COMPARISON OF STRUCTURAL SYSTEMS

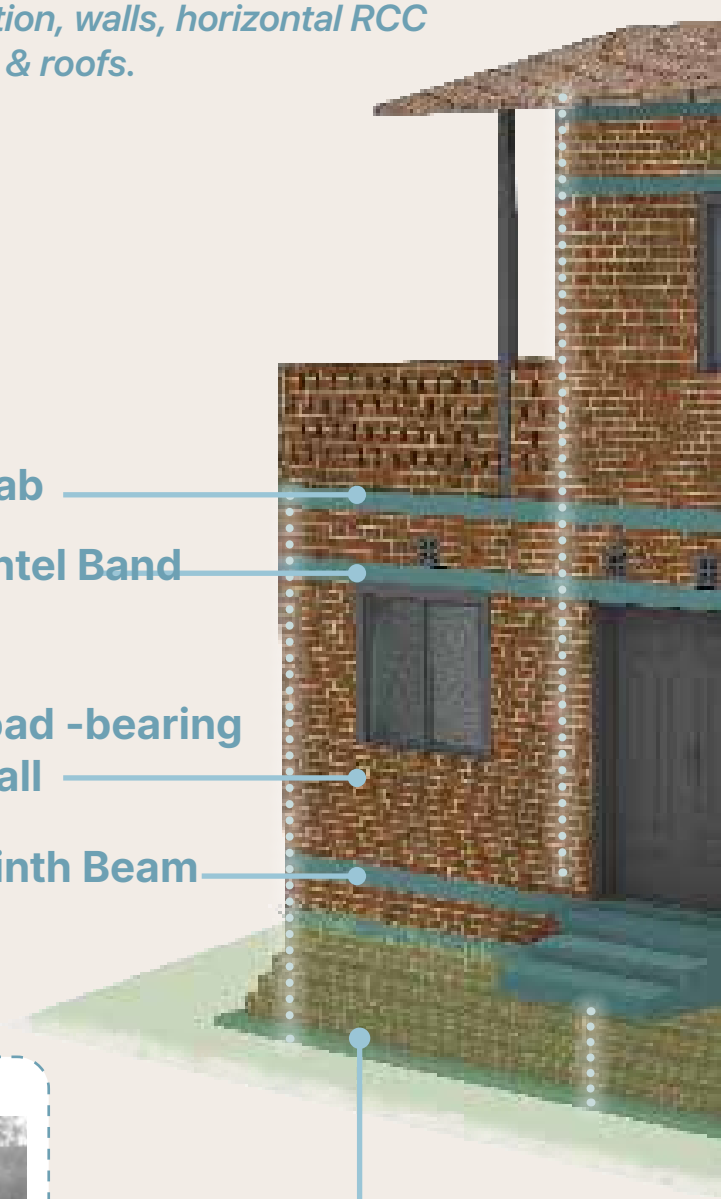
Choosing among the 2 structural systems according to your needs & budget, based on the criteria below.

LOAD BEARING STRUCTURE		RCC STRUCTURE	
			
LESS	Financially feasible for buildings up to 3 storeys (Ground + 2 floors)	Expensive for 1, 2 and 3 storeys. Financially feasible for buildings more than 3 storeys	MORE
LESS	Quick construction for up to 2 storeys	Time consuming for buildings up to 2 storeys. For higher structures, this works faster	MORE
LESS	No requirement of specialised skills	Requirement of skilled & experienced masons	MORE
LESS	Engineer expertise not needed	Engineer expertise needed	NEEDED
LESS	Low environmental impact due to limited use of cement, steel	High environmental impact due to higher use of cement, steel	MORE
	Advisable to add necessary structural elements for better strength and performance during earthquakes	Good quality construction and design required for better strength and performance during earthquakes	
	Up to 3 storeys recommended with this structure	Tall structures possible, with engineering expertise	
	Horizontal & vertical expansion is possible, but requires structural guidance	Horizontal & vertical expansion is possible, but requires structural guidance	

What are the components of a load bearing structure?

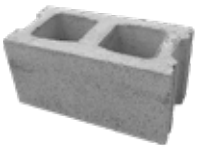
C. COMPONENTS OF A LOAD BEARING STRUCTURE

This structural system consists of foundation, walls, horizontal RCC bands, & roofs.



Materials

Load bearing walls are constructed by using locally available stone, burnt clay bricks, stabilized earth blocks or cement blocks. Mortar is used as the binding material.

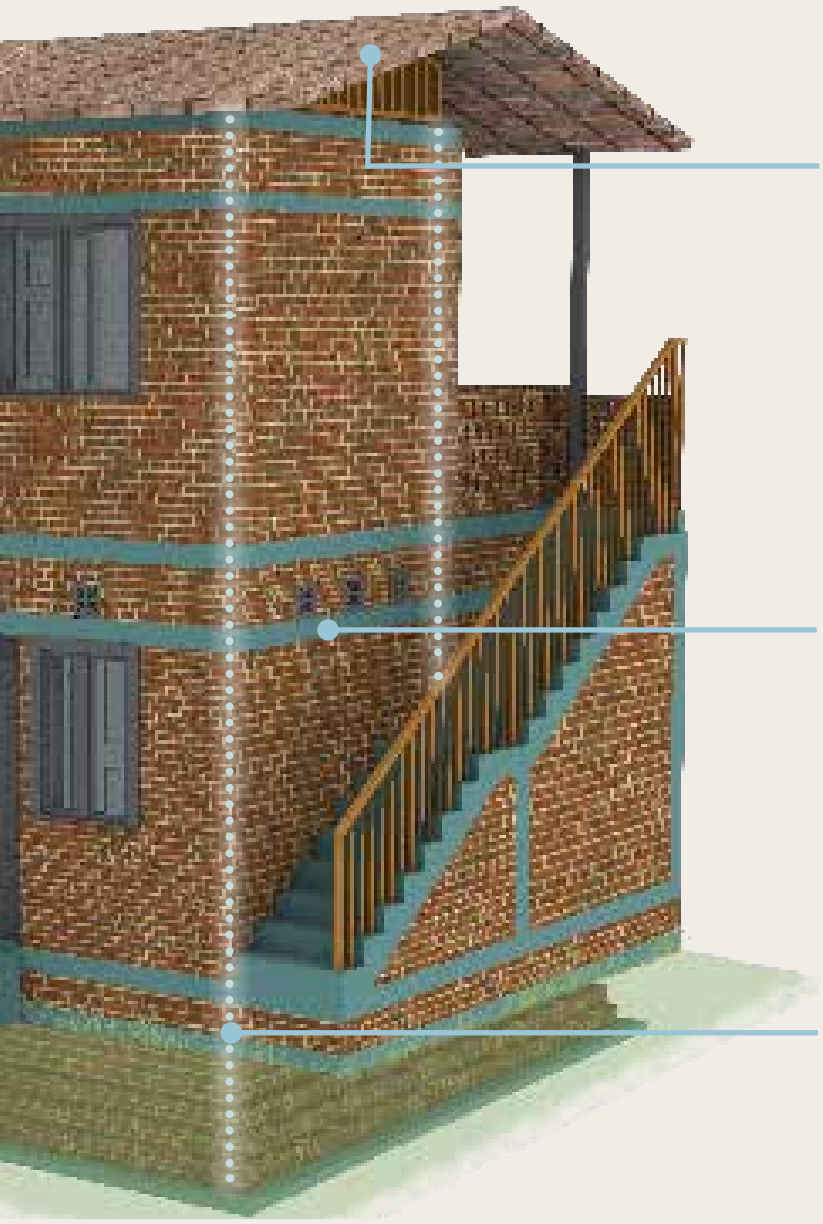


Foundation

Load bearing structures are supported by 'Strip foundations', running centrally throughout the length of wall, without any breaks.

Material Options **-** local stone, brick masonry

Depth & Width **-** depends on design, size of house and soil condition of site



Roofing

The type of roof should be decided based on local climatic conditions, material and skill availability, cost and purpose.

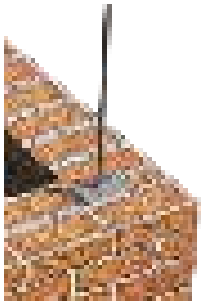
Material Options **-** Common roofing options include sloping roof with slay tiles or sheets, OR RCC flat slab.

Horizontal RC Bands

To increase the structural strength, add continuous horizontal reinforced concrete (RC) bands at plinth, lintel and roof level.

Vertical Steel Reinforcement

To make the structure strong, we should add single steel bars at wall junctions, within the brickwork.



Load Bearing Walls

All walls in this type of structure bear the load of the building. The thickness of the wall should be-

Brick Masonry - Min. width 9 inches thick, maximum height of wall is 10 ft.

Stone Masonry - Min. 1 ft 2 inches width

What are the components of a RCC structure?

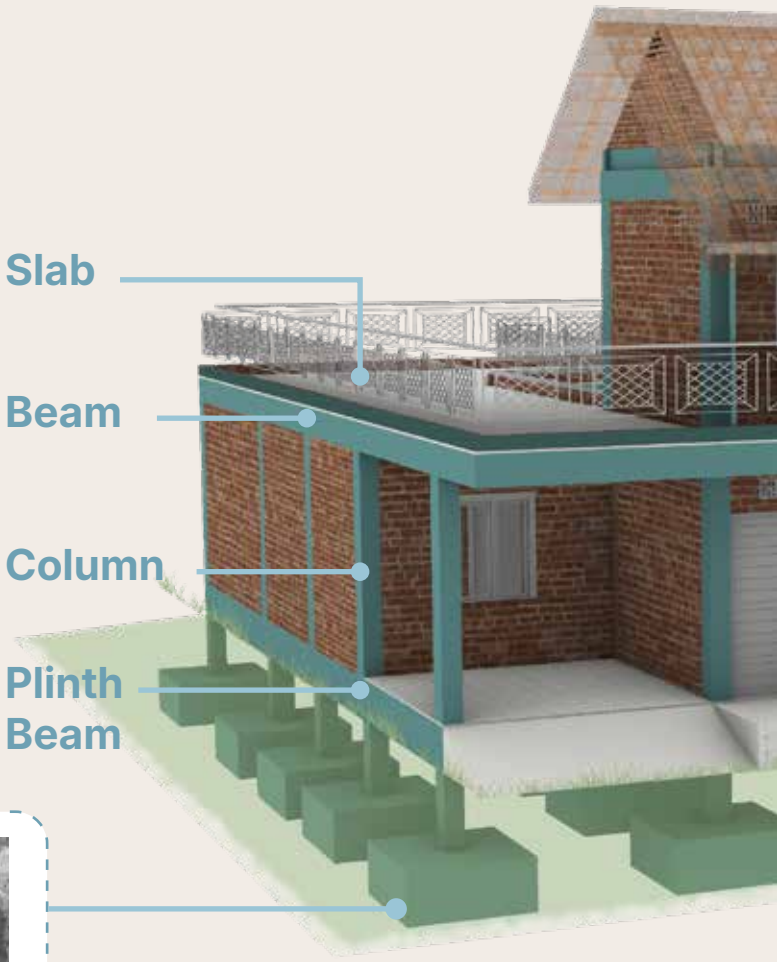
D. COMPONENTS OF A RCC STRUCTURE

This Structural system consists of RCC slabs, beams, columns & foundations.

Materials

RCC Structures are made of cement, sand, aggregate & ISI approved steel bars.

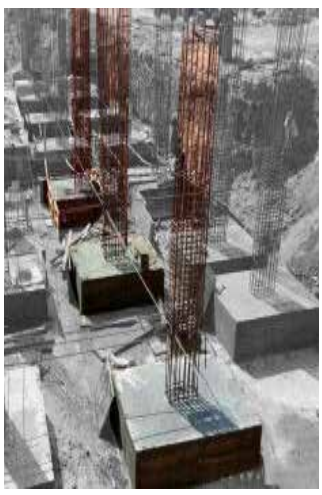
Composition -
Standard 'M20 grade' proportions - 1:2:4
i.e. (Cement: Sand: Aggregate)

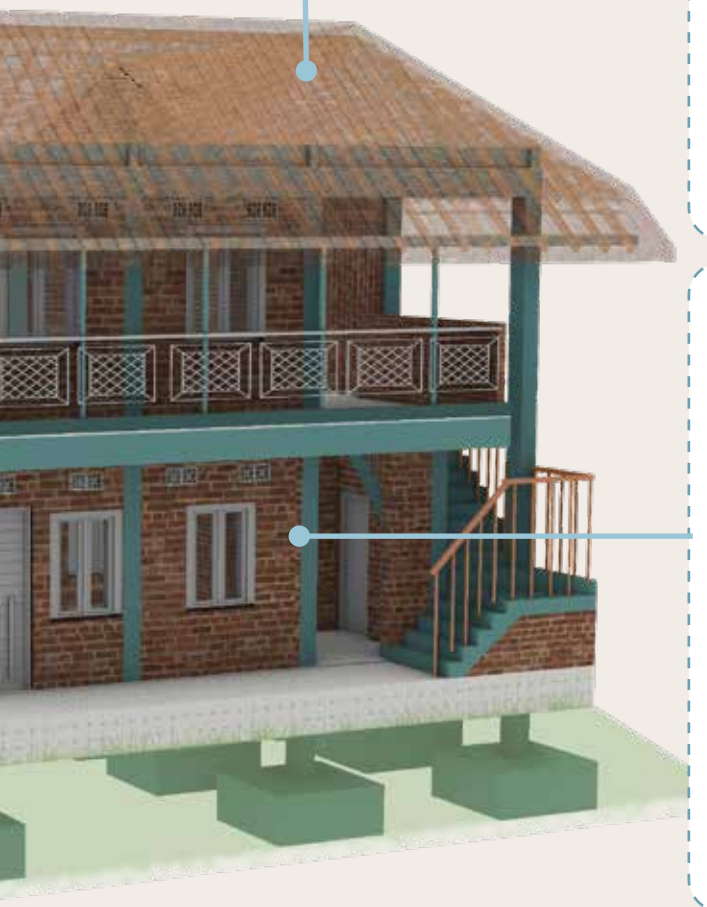


Foundation

RCC structures are supported by isolated footings, one for each column

Materials **-** RCC
Sizes **-** Depends on design, size of house, and soil condition of the site. This should be decided by engineer.





Roofing

The type of roof should be decided based on local climatic conditions, material and skill availability, use purpose, and cost.

Material Options -
Common roofing options include sloping roof with slay tiles or sheets, OR RCC flat slab.

Infill Walls

The internal & external walls are built after the structural frame of the floor is complete.

Material Options - Bricks, concrete blocks, Fly ash bricks, CSEB blocks.
Minimum Thickness -
Interior walls - 4" or 115 mm width
Exterior walls - 9" or 230 mm width

Structural Frame

The Beams and Columns together make the RCC frame. The frame is built first, then the walls are built.

Materials - Reinforced Cement Concrete (RCC)
Sizes - Depends on the structural load. This should be decided by the structural engineer.

What are the advantages of building a house in stages?

E. BUILDING IN STAGES

Planning first phase of the house

As your family and needs grow, your house will grow with you. This can take months or years. It is important to plan the space and finances for the different stages, to minimize any demolition in the future.

1.

Prioritize elements of your design into what is necessary (to be constructed in stage 1) & what is desirable (for stage 2 of construction.) The following criteria can be followed -

1. **Stage 1:** Kitchen, Bathroom, Bedroom with Attached Bathroom, Washing Area.
2. **Stage 2:** More Common Rooms And Bedrooms

2.

Build all services like water supply tanks, septic tanks, etc. in full capacity in Stage 1, accommodating for future use as well.

3.

1. With the help of contractors & masons, get estimates of both the full design & of Stage 1
2. If the difference is minimal, try to build everything in one go
3. Future expansion can prove costlier because of increasing costs of material and labor

What to keep in mind when expanding an existing house?

F. EXPANDING EXISTING HOUSES

Expanding existing houses has higher risks of structural stresses & damages, in both vertical as well as horizontal expansion. Thus, proper assessment & surveillance is necessary.

Assess the Structure

With the help of contractor & masons, make an assessment of your existing house for the following aspects -

1. Condition of existing structure
2. Impact of new construction on old structure

Appoint structural engineer for high earthquake zones.

Estimate Cost of New Structure

Get detailed estimate of new expansion as expansion can cost more than building anew.

Ensure Quality of New Construction

Carefully monitor all expansion work, with a special focus on joints, gaps and structural connection work.

Ensure that the new construction does not damage the existing house

Points to note!

- *For future extension, do not keep steel bars exposed and extending out from column/slab/beams. They rust and lose strength over time.*
- *Add cement cover to exposed steel bars from columns and slabs to avoid corrosion. This cement can be broken when future expansion is taking place.*
- *Make sure existing structural grid is followed. For vertical expansion, columns should be made above existing columns only, and walls should be made above beams.*

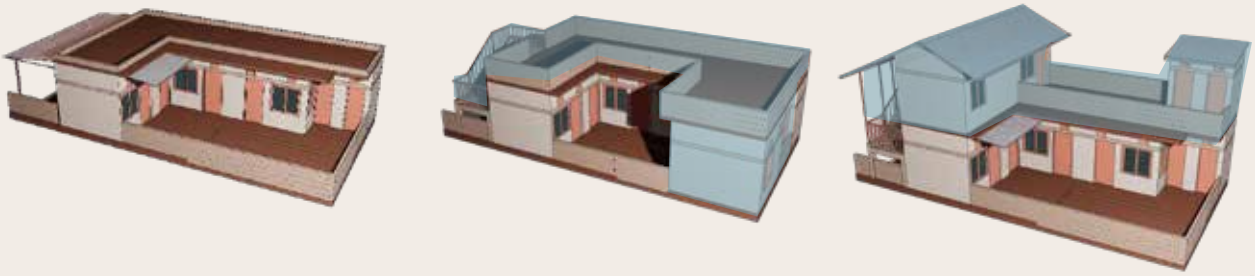
What should you keep in mind when expanding a load-bearing house?

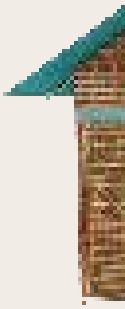
G. EXPANDING A LOAD BEARING HOUSE

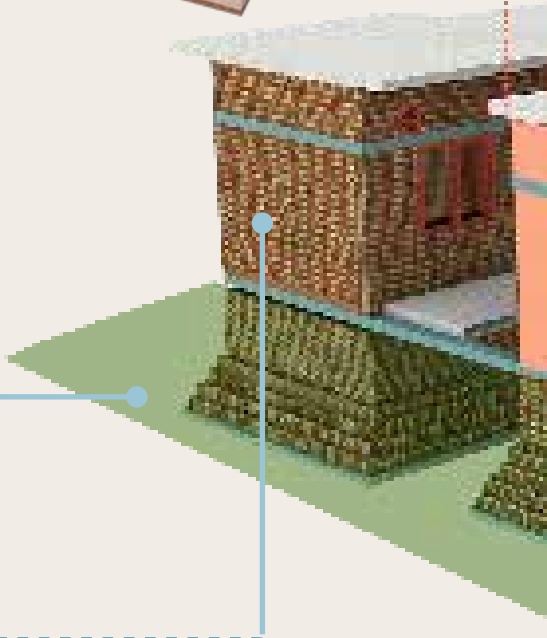
Criteria for House Expansion

1. Vertical or horizontal expansion depends upon the current size of the house & its load bearing capacity.
2. Type of materials used in the old & new structures should be the same.
3. Follow all the guidelines for Load Bearing construction on pg - 39, 51.

1. Existing Structure **2. Horizontal Expansion** **3. Vertical Expansion**







Horizontal Expansion

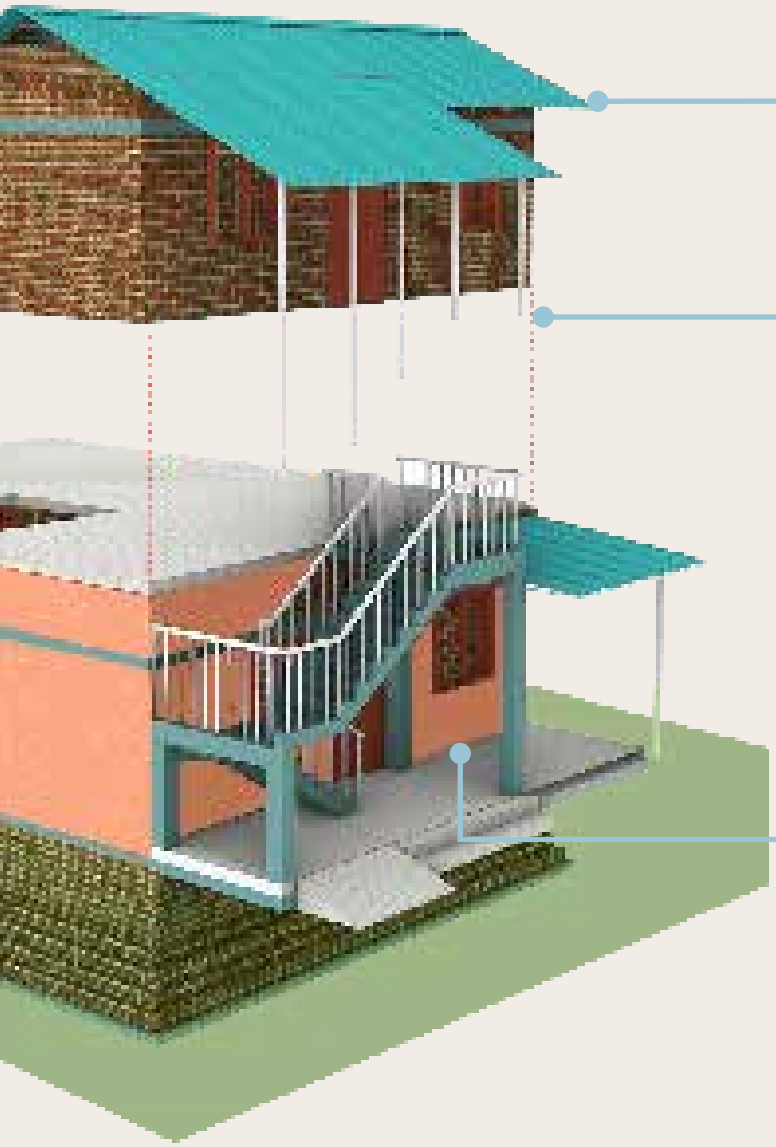
Foundations

- Create a foundation under the new structure, by following the same rules of site preparation, foundation and building construction.
- Connect to or extend existing strip footing.

New Walls

- Ensure proper brick-bonding is carried out between old & new structures
- Add vertical reinforcement in the new walls as recommended.
- Connect and continue all horizontal bands.
- If possible, provide a 4-9" gap between old and new structures above ground.

Vertical Expansion



Lightweight Structure

- Preferably, construct a sloping roof on new floor.

Structural Grid

- On higher floors, follow the same structural grid pattern as the ground floor.
- Build walls on top of existing walls with same or lesser thickness and same material.
- Avoid projections on the new structure.
- Vertical expansion of more than one floor is not advisable for structural safety.

Walls

- Redo plaster on existing wall then continue the same coat on new walls.
- Add chicken mesh on new and old connection for better plaster work.

Adding more than one floor above original design needs assessment done by structural engineer.

What to keep in mind when expanding a RCC structure house?

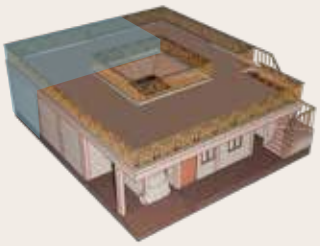
H. EXPANDING A RCC STRUCTURE HOUSE

Criteria for House Expansion

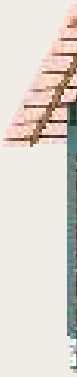
1. Type of materials used in the old & new structures should be the same
2. Follow all the guidance for RCC on pg. 40, 43
3. Structural Engineer needed

1. Existing Structure

2. Horizontal Expansion



3. Vertical Expansion



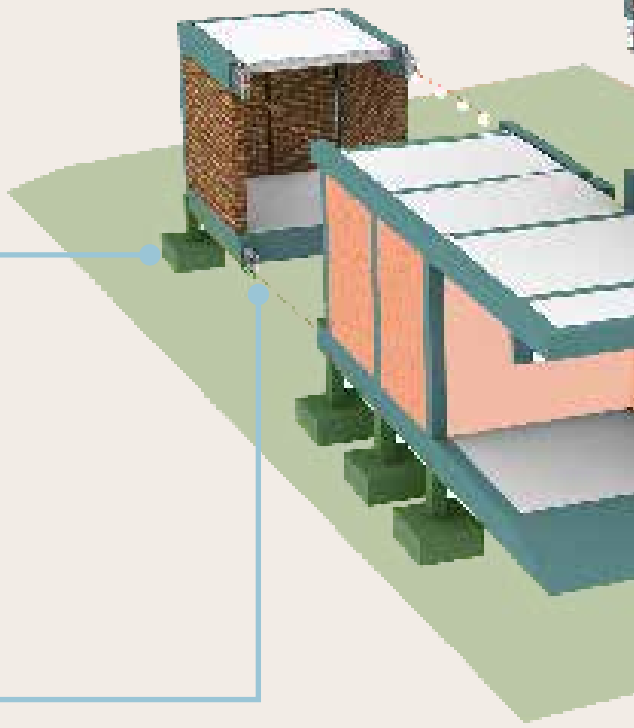
Horizontal Expansion

Foundations

- Create a foundation under the new structure, by following the same rules of site preparation, foundation and building construction.
- Extend the existing plinth beam over the new foundation.

Structural Frame

- Connection between new and old beam needs be done with same size of beam and RCC bars, and the same mixing proportion for concrete.
- If the building is becoming too long after horizontal expansion, provide a 4 to 9 inch gap between old and new structure above ground.



Vertical Expansion

Lightweight Structure

- Preferably, construct a sloping roof on new floor.

Structural Grid

- Follow existing column and beams grid for horizontal or vertical expansion.
- Avoid projections on new structures.
- Do not keep steel bars exposed as they are prone to corrosion.
- Vertical expansion of more than one floors is not advisable for structural safety.

Walls

- Redo plaster on existing wall, then continue the same coat new walls.
- Add chicken mesh on new and old connection for better plaster work.

Adding more than one floor above original design needs assessment done by structural engineer.

NOTES

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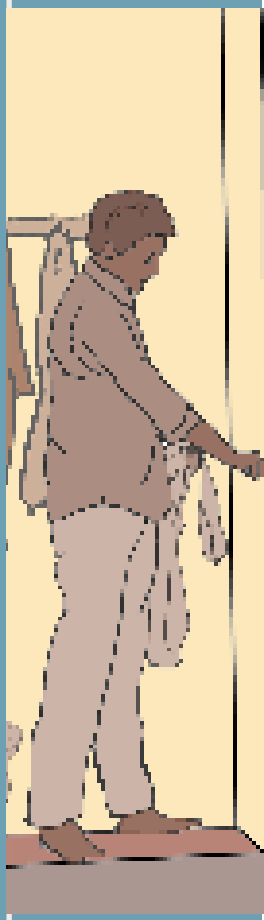

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4. How do I select the right construction team and supervise the work?
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6. How to build strong walls and design windows?
7. How to build a strong roof?
8. How to choose the structural system for your home?
9. How to build a well-serviced home?
10. What are the tips for good RCC construction?
11. How do I maintain my home after construction?
12. How do I design my home?

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