

# A DESCRIPTIVE STUDY ON CONSTRUCTION PROGRESS INVOLVED IN APARTMENT BUILDING

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**Abstract** - An apartment or flat is a self-contained housing unit that occupies only part of a building, generally on a single level. Such a building may be called an apartment building or flat complex, especially if it consists of many apartments for rent. Due to rapid development within the city land acquisition has become tougher for residential construction. As a result of this concrete jungles are being constructed at every nook and corner of the city. In economic point of view if the building is constructed at a far distance from the city it will be cheaper and residents can preferred peaceful life without any external polluted sources in today's lifestyle.

**Key Words:** Construction, Apartment Building.

## 1. INTRODUCTION

### 1.1 General

The basic needs of human existences are food, clothing's & shelter. The point of his efforts has been to provide an economic and efficient shelter for every human being. The possession of shelter besides being basic, used, gives a feeling of security and also shown the social status of man. Every people need a peaceful environment for his pleasant living, this is achieved by having a place of living situated at the safe and convenient location, such a place for comfortable and pleasant living requires considered and kept in view.

- A Peaceful environment.
- Safety from all natural source & climate conditions
- General facilities for community of his residential area.

### 1.2 Selection of Plot and Study

Plot selection is very important for building a house. Site should be in good atmosphere for better standard of living instead of inconvenience or noisy. Transportation, shopping, facilities are the basic amenities needed before selecting any plot. One should consider the road condition for future development or not in case of undeveloped area. These are the basics before selection of any plot.

The factor to be considered while selecting the building site is as follows:-

- Access to park & playground.
- Agriculture polytonality of the land.
- Availability of public utility services, especially water, electricity & sewage disposal.
- Contour of land in relation the building cost. Cost of land.
- Distance from places of work.
- Location with respect to school, collage & public buildings.
- Nature of use of adjacent area.
- Transport facilities.
- Wind velocity and direction.

### 1.3 Building by Laws & Regulations

- Line of building frontage and minimum plot sizes.
- Minimum standard dimensions of building elements.
- Provisions for lighting and ventilation.
- Provisions for safety from explosion.
- Provisions for means of access.
- Provisions for drainage and sanitation.
- Provisions for safety of works against hazards.
- Requirements for off-street parking spaces.
- Requirements for landscaping.
- Special requirements for low income housing.
- Size of structural elements.

### 1.4 Arrangement of Rooms

- Living Room
- Kitchen
- Bedroom
- Bath & W C

**Living Room:** This is the area is for general use. Hence the living & drawing room should be planned near the entrance south east aspects. During colder day the sun is towards the south & will receive sunshine which is a welcoming feature. During summer sunshine in the northern side & entry of sunrays from southern or south – east aspects do not arise.

**Kitchen:** Eastern aspects to admit morning sun to refresh & purity the air.

**Bedroom:** Bedroom may also be provided with attached toilets, their size depends upon the number of beds, they should be located so as to give privacy & should accommodate beds, chair, cupboard, etc., and they should have north or – west south – west aspect.

**Bath & W.C:** Bath and W.C are usually combined in one room & attached to the bed room and should be well finished. This should be filled with bath tub, shower, wash-hand basin, W.C, shelves, towels, racks brackets, etc., all of white glazed tiles. Floor should be mosaic or white glazed files. Instead of providing all bed room with attached bath and W.C separated baths & latrines may also be provided.

## 2. BUILDING ORIENTATION

After site selection, the next step is to considering the orientation of building. It is useful for proper arrangement of rooms in the effective manner for to getting direct sources from sun, wind, rain, topography .The factors that affect orientation most are as follows.

- Solar heat
- Wind direction
- Humidity
- Rain fall
- Intensity of wind site condition
- Lightings and ventilation

**Solar Heat:** Solar heat means sun’s heat; the building should receive maximum solar radiation in winter and minimum in summer. For evaluation of solar radiation, it is essential to know the duration of sunshine and hourly solar intensity on exposed surfaces.

**Wind Direction:** The winds in winter are avoided and are in summer, they are accepted in the house to the maximum extent.

**Humidity:** Humidity is very high which is especially in coastal areas, causes perspiration, which is very uncomfortable condition from the human body and causes more discomfort.

**Rainfall:** Direction and intensity of rainfall affects the drainage of the site and building and hence, it is very important from orientation point of view.

**Intensity of Wind:** Wind force in hilly area is comparatively higher than other regions. So the window openings are generally preferred in smaller size compared to other regions.

**Site Conditions:** Location of site in rural areas, suburban areas or urban areas also effects orientation, sometimes to achieve maximum benefits, the building has to be oriented in a particular direction.

**Lighting:** Lighting is required for all building types and they are three primary objectives. The first is to promote the work or other activities carried on within the building. The second is to promote the safety of people using the buildings. The third is to create, in conjunction to interest and of well beings.

**Ventilation:** Ventilation may be defined as the system of supplying or removing air by natural or mechanical mean or from any enclosed space to create and maintain comfortable conditions. Operation of building and location to windows helps in providing proper ventilation. Sensations of comfort, reduction in humidity, removal of heat, supply of oxygen are the basic requirements in ventilation apart from reduction of dust.

## 3. CONSTRUCTION SEQUENCE

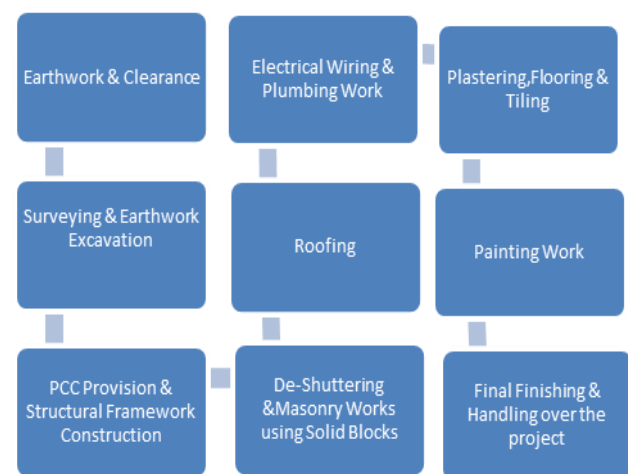


Fig -1: Construction Sequence Structure

## 4. CONSTRUCTION MATERIALS

**4.1 Cement:** IS 456:2000 standard is recommended. Cement should be stored properly in stacks not more than 10 bags, clear from the walls by 1 meter with tonnage and protected at all time from moisture. Identify each lot/consignment of cement and follow a first in first out method of issue of bags. Cement should be consumed within 1 month from their manufacturing date.

**4.2 Fine Aggregate:** Fine aggregate shall be gritty sand with FM range between 2.6 to 3.2, silt content should not be more than 5% and there should be no traces of salt. If dirt, wash sand before use. Sand should be clear of organic material. For mud mat below structural concrete, maximum size up to 40mm shall be used. Aggregate with specific gravity below 2.6 should not be used.

**4.3 Coarse Aggregate:** Coarse aggregates conforming to IS 383 and IS 2386 having maximum size of 20mm and down. It should be obtained from crushed granite. Trap, basalt quarry.

It should be in the shape of round or angular and free from dust, foreign matter and not thin porous laminated or flaky.

**4.4 Water:** Water should be clean, fresh and free from oil, acid, alkali and organic matters. Potable water is considered good for concreting and curing.

**4.5 Admixture:** Use of admixture/additive should be done only after obtaining technical clearances. Dosage point of application, the desired results should be clearly understood. Accelerators, retarders, plasticizers, integral-waterproofing compound are the additional commonly used.

**4.6 Brick Masonry:** A strong brick, that its composition provides excellent resistance for wear. IS: 3495 - P (1)-1992-Methods of tests of burnt clay building bricks and the bricks should be tested before placing. Five numbers of bricks should be tested and the average value is reported. Bricks should be soaked well before made into use. Any lumps formation and dust should be cleaned.

**4.7 Tiles:** The most important thing before fixing tiles is to arrange the edge tiles at the bottom and sides. You can check that the tiles are "centered" on the most prominent part of the wall and do not fall awkwardly at edges and, corners and also in relation to cupboards and electric sockets in kitchen. Fix to batten at right angles. The main body if whole tiles - known as the "field" - is fixed first and the adhesive is allowed to dry. Then the border or edge tiles are fitted. Before fixing, the tiles must be soaked in water for about an hour. The mortar bed or surface in which tiles are to be fixed should be fine, smooth and free from dirt/dirt particles to avoid contamination.

**4.8 Reinforcement:** Mild steel bar should comply IS 432. Cold worked steel high strength deformed bars should comply IS 1786. Steel weightiest should be done at site by the store keeper by taking it to the nearest weigh bridge before Unloading. Stack steel at 150mm clear of ground on tonnage. Stack steel grade wise, consignment wise, dia wise and length wise. Protect stored steel from rusting, oil, grease & distortion. Ensure Mill Certificate is delivered with each load. Binding wire shall be 18 gauge soft annealed iron wire or 18-gauge GI annealed wire. Collect the rings used for bundling rods in bags and store them. Cut pieces as scrap should be stored separately in a enclosed area with tonnage. If steel is going to be exposed to weather for a long time to come give cement wash to protect it from corrosion.

## 5. DESCRIPTION OF WORK

**5.1 Earthwork & Clearance:** Initial the site should be cleared and cleaned for basic work. Leveling of ground should be done initially using machineries and equipment's.

**5.2 Surveying:** Establish TBM all-round the site. Locations are decided based on visibility and permanency of TBMs. Write the

RL on the TBM. Take grid levels at 5 meters interval before the start of mass excavation.

**5.3 Earthwork Excavation:** Excavate in a phased manner after proper setting out of works. Keep dewatering pumps available and discharge point accessible. Keep necessary information regarding water table, periods of rainfall, flooding at site and so on. Shore slope or step cut sides as you excavate below 1.2 meters to ensure stability of sides. Avoid excavation after sunset. Again it is not safe to work under poor lighting conditions. Depth of excavation to be constantly monitored with leveling Instrument in relation to the TBM located around the site. Structural consultant should inspect the site after the required depth of excavation is achieved i.e., the bearing strata is exposed. Immediately after inspection, the bottom level of excavation is sealed with blinding. Hard rock removal can be done by compressed air jackhammer, wedging, chiseling etc. Do not resort to blasting as much as possible.

**5.4 Form Work:** Form work is temporarily forming given to concrete until it gains strength to withstand self-weight. Form work shall be designed to support safely the worst combined effects of all loads within acceptable dimensional tolerance and without causing bulging or deflection. Loads considered are self-weight of form work, wet concrete, reinforcement and dynamic effects of placing and compacting, construction traffic and wind load. It should be water tight, dimensionally accurate and give the desired finish to the top surface it is in contact with. Always use staging of MS tubes with timber runners. Base plates should not be placed on concrete bricks, bricks which are likely to get crushed when wet. Staging shall be true and rigid and thoroughly braced, shuttered and propped. To achieve desired rigidity ample studs, braces, bolts, spacer bricks, stay wire to be given to avoid distortion. Check the shuttering work for vertical and horizontal alignment, level surface cleanliness water tightness, and ability to withstand loads without distortion. Releasing agent should be thin evenly applied. Use sponge or mop to apply it. Releasing agent should have no adverse effect on concrete. The releasing agent should be applied within 48 hours prior to concreting. All spans in excess of 5 meters for beams and slabs should be kept within a pre camber 2mm per 1mt. For cantilever, give a camber at the end of span of 4mm per 1mtr. Form work should be stuck without injury to concrete. Use the checklist for checking the formwork done. Stability, safety, dimensional correctness, levels and alignment are the key factors. The quality of finished concrete is dependent on the quality of formwork.

**5.5 REMOVAL OF FORM WORK:** Under normal circumstances and where O.P Cement is used, forms shall be removed after expiry of the following periods:

- a) Walls, columns and vertical faces - 24 to 48 hours
- b) Slabs (props left under) -3 days
- c) Beams-soffits (props left under) -7 days
- d) Removal of props under slabs

- i) Spanning up to 4.5 m-7 days
- ii) Spanning over 4.5 m- 14 days
- e) Removal of props under beams and arches
- i) Spanning up to 6 m- 14 days
- ii) Spanning over 6 m- 21 days

For other type of cements, the stripping time shall be suitably modified in consultation with the need of Project Manager. Where the shape of elements is such that the form work has re-entrant angles, the form work might be removed as soon as possible after the concrete has set, to avoid occurrence of shrinkage or cracking that might occur due to the restraint imposed. For precast moulds, the stripping time shall be 24 hours. The mould may be lifted and stored in the yard within 24 hours to 48 hours as approved by the Project Manager. Due to weather conditions if the concrete is not sufficiently hardened, the stripping time to be extended after discussing with the project in charge. Obtain 7<sup>th</sup> day cube test result before deciding the removal of formwork.

**5.6 Mixing of Concrete:** Ensure adequate stock of all ingredients of concrete i.e., cement, aggregate, water admixture if used for the day's work. Use calibrated frame box for measurement in case of volumetric batching or calibrated weighing machine in case of weigh batching. Generally 20 to 25 liters is recommended for bag of cement. The water cement ratio is kept 0.4 to 0.5. The moisture content of aggregates has to be checked at frequent intervals. Charge the rotating drum with 25% of required water to rotate 3-4 times. Load the hopper with  $\frac{1}{2}$  the coarse aggregate followed by  $\frac{1}{2}$  the fine aggregate. At this time the entire quantity of cement should be spread. Then half the quantity of fine aggregate followed by balanced coarse aggregate should be loaded. This type of switching is done to avoid spilling of cement while discharging into the drum. Immediately after loading the drum balance quantity of water is added. The drum should be rotated for at least  $1\frac{1}{2}$  to 2 minutes. The rotation of the drum is about 15 to 20 rotation per minute. If plasticizer is used one liters of water should be held back. Add requisite Quantity if Plasticizer to the water and mix it thoroughly. This mixture is poured into the drum after the drum has rotated for about one minute. The drum should be rotated for at least 1 minute after adding the plasticizer to ensure proper dispersion. In the case of Controlled Concrete all aggregates and cement shall be measured by weight in approved weigh batching equipment. Mixing water shall be measured in graduated liter Cans.

**5.7 PLASTERING:** Ensure all the checks after brick work is compiled with. The template for openings from SIPL should be available at site. The brick work should have been cured for 7 days and dry before plastering is started. Distance of button marks should be within an aluminums straight edge length. Check for Frame Box, MS Sheet, Measuring Can, Barrel, Line Dore, Cut Tile Pieces, Aluminum Straight Edge, Teak Wood Randa, Trowel, Lime Paste, Plumb Bob, Halogen Lamps. Fire galvanized rhombus mesh 400mm wide rolls over the brick work and concrete either beam or column equally on both

with steel nails/wooden plug and nails. Get the plastering specs like lime finish, trowel finish, sponge finish, rough plaster and zone of application along with the interface line clarified from architects. In case of external plaster, grooves can be incorporated to break the day's work without creating an uneven joint. The proposal should be cleared on aesthetics from architect. Do not plaster for a thickness of more than 15mm. In case it is required the Plastering should be done in 2 coats. The first layer applied should be cured for a day before applying the subsequent coats. Cement PPC within 90 days old, sand FM 2 to 2.2 clean, fine silt content low (<5%) and potable water should be used for mixing mortar. All surfaces in concrete should be hacked before plastering.

**5.8 Electrical Works:** The Distribution Board shall be fabricated out of 16 SWG Sheet Steel and shall be factory fabricated and shall be duly prewired in the works ready for installation at site. The MCBs shall have quick make and break non welding self-wiping silver alloy contacts. They shall have short circuit rating of 9 KA. Each poles of MCB shall be provided with universe time thermal overload and instantaneous over current magnetic tripping elements with trip free mechanism.

**5.9 Painting Works:** Shade, Type of paint as approved by the architect and duly certified. Ensure that the wall and ceiling surfaces are completely dry prior to the application of paint. Proper scaffolding arrangement with safety measures to be taken. All loose particles, dirt and dust must be thoroughly scrubbed off from the surface using sand paper. All painting accessories like brush, roller and mixing tray etc. to be thoroughly cleaned and washed outside before starting the works. A drying period of 24 hours is required before the putty application. Application of 2 coats of putty ensures that first coat is thoroughly dried before applying the final coat. Putty is applied uniformly to cover all undulations. Primer application with brush dilution ratio not to exceed 1:1 with water or thinnable solvent. Proper sanding of the surfaces to render a smooth surface prior to the application of paints. Ensure that the dust on the surface is thoroughly wiper off after sanding the puttied surface. First coat paint to be applied with brush and finished with roller preferably with single mix and dilution ratios not to exceed the below said criteria i.e., 2 parts of paint to 1 part of water or as per manufactures specifications. Ensure a drying period of 4 to 6 hours before application of the final coat of paint.

**5.10 Sanitary Fixtures & Fittings:** Installation of Fixtures and Fittings: The sanitary fittings shall be installed at the correct assigned positions as shown on the drawings and as directed by the Engineer-in-charge / Consultants and shall fully meet with the aesthetic and symmetrical requirements as demanded by the Architects. Fixtures shall be installed by skilled workmen with appropriate tools according to the Standard practice in the trade. When fixtures are being mounted, attention shall be paid to the possibility of movement/settlement by other causes. A check shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, lavatory basin sinks,



flushing cisterns and other appliances. Where the built-in types of brackets are used, they shall be securely fixed to the walls and slabs by approved means. It shall be ensured that while fixing the fixtures and fittings, no tool marks or scratches are developed. All steel brackets and supports shall be painted.

**Protection of Fixtures:** Care shall be taken at all times, particularly after fixing to protect fixtures from damage. All offsets shall be temporarily plugged during progress of work to prevent obstruction. Fixtures shall be finally cleaned to the satisfaction of the Engineer-in-charge.

## 6. Cost Estimation

Requirements are differs as per client needs. For example we can take the below details and estimate the billing of quantity.

CITY	: Coimbatore
LAND AREA	: 14004 Sq.ft
FLOORS	: Ground +3 Floors
BHK	: 2 BHK
PAINT TYPE	: Premium
DOOR TYPE	: Sal Wood
FLOORING	: Wooden

### SUB-STRUCTURE

#### 1. Earthwork and Excavation

Labour and Earth Filling 52,515 cubic ft @ Rs 10 per unit 5,25,150

#### 2. Cement Concrete

Cement 31 bags @ Rs 390 per unit 12,090  
 Sand 9 cubic meters @ Rs 7,000 per unit 63,000  
 Course Aggregate 18 @ Rs 600 per unit 10,800  
 Total Price 85,890

#### 3. Brick Work

Bricks 25,830 nos. @ Rs 6 per unit 1,54,980  
 Cement 82 bags @ Rs 390 per unit 31,980  
 Sand 17 cubic meters @ Rs7,000 per unit 1,19,000  
 Total Price 3,05,960

#### 4. DPC

Horizontal DPC 460 sq.ft @ Rs 130 per unit 59,800

#### 5. Labour

Labour Cost excl Earthwork 1,575 man days @ Rs 600 per unit 9,45,270

**TOTAL FOR FOUNDATION Rs 19,22,070**

### SUPER-STRUCTURE

#### 1. RCC Pillars

Cement 415 bags @ Rs 390 per unit 1,61,850  
 Sand 43 cubic meters @ Rs7,000 per unit 3,02,203  
 Coarse Aggregate 86 cubic meters @ Rs600 per unit 51,600  
 MS Steel 5,652 cubic meters @Rs50 per unit 2,82,600  
 Total Price 7,98,253

#### 2. RCC Beams

Cement 5,239 bags @ Rs 390 per unit 20,43,210  
 Sand 546 cubicmeters@ Rs7,000 per unit 38,22,000  
 Coarse Aggregate 1,083 cubic meters @ Rs600 per unit 6,49,800  
 MS Steel 71,395 Kg @ Rs 50 per unit 35,69,750  
 Total Price 1,00,84,760

#### 3. Brick Work - Sidewalls

Bricks 1,34,470 nos. @ Rs 6 per unit 8,06,820  
 Cement 427 bags @ Rs 390 per unit 1,66,530  
 Sand 88 cubic meters @ Rs7,000 per unit 6,16,000  
 Total Price 15,89,350

#### 4. Brick Work - Innerwalls

Bricks 22,931 nos. @ Rs 6 per unit 1,37,586  
 Cement 73 bags @ Rs 390 per unit 28,470  
 Sand 15 cubic meters @ Rs7,000 per unit 1,05,000  
 Total Price 2,71,056

#### 5. Labour

Labour 10,503mandays @ Rs600 per unit 63,01,800  
 Total Price 63,01,800

**TOTAL FOR SUPER STRUCTURE Rs 1,90,45,219**

### FLOORING

#### 1. Main Flooring

Wooden 29,410sq.ft @ Rs390 per unit 1,14,69,900  
 Labour 1,176 man days @ Rs600 per unit 7,05,600  
 Miscellaneous LUMP SUM 68,81,940  
 Total Price 1,90,57,440

#### 2. Bathroom and Kitchen Flooring

Tiles 8,400 sq.ft @ Rs 75 per unit 6,30,000  
 Labour 336 man days @ Rs 600 per unit 2,01,600  
 Miscellaneous LUMP SUM 3,78,000  
 Total Price 12,09,600

**TOTAL FOR FLOORING Rs 2,02,67,040**

**PLASTERING & WALL TILES****1. Plastering - Walls**

Cement 194 bags @ Rs 390 per unit 75,660  
Sand 41 cubic meters @ Rs7,000 per unit 2,87,000  
Labour 2,750 man days @ Rs600 per unit 16,50,000  
Wood Work Rs 2,30,800  
Painting Rs 24,88,710  
Total Price 20,12,660

**2. Plastering - Ceiling**

Cement 232 bags @ Rs 390 per unit 90,480  
Sand 49 cubic meters @ Rs7,000 per unit 3,43,000  
Labour 3,280 man days @ Rs600 per unit 19,68,000  
Total Price 24,01,480

**3. Wall Tiles**

Glazed Tiles - Kitchen 3,010 @ Rs 40 per unit 1,20,400  
Glazed Tiles - Bathroom 2,690 @ Rs 40 per unit 1,07,600  
Labour 228 man days @ Rs 600 per unit 1,36,800  
Total Price 3,64,800

**TOTAL PLASTERING & WALL TILES  
Rs 47,78,940**

**WOOD WORK****1. Doors**

Hardwood Frames 820ft @ Rs90 per unit 73,800  
Hardwood Shutters 640sq.ft @ Rs95 per unit 60,800  
Iron grilling with labour 640sq.ft @ Rs20 per unit 12,800  
Total Price 1,47,400

**2. Windows**

Hardwood Frames 390 ft @ Rs90 per unit 35,100  
Hardwood Shutters 420sq.ft @ Rs95 per unit 39,900  
Iron grilling with labour 420sq.ft @ Rs20 per unit 8,400  
Total Price 83,400

**TOTAL FOR WOOD WORK Rs 2,30,800**

**PAINTING****1. Exterior Painting**

Putty and primer - ceiling 8,400 sq.ft @ Rs 12 per unit 1,00,800  
Paint- ceiling 8,400 sq.ft @ Rs 15 per unit 1,26,000

Putty&primer - walls 18,040 sq.ft @ Rs 12 per unit 2,16,480

Paint - walls 18,040 sq.ft @ Rs 15 per unit 2,70,600  
Total Price 7,13,880

**2. Interior Painting**

Putty & primer - ceiling 42,010 sq.ft @ Rs 12 per unit 5,04,120

Paint - ceiling 42,010sq.ft @ Rs15 per unit 6,30,150  
Putty and primer - walls 23,080 sq.ft @ Rs 12 per unit 2,76,960

Paint - walls 23,080 sq.ft @ Rs 15 per unit 3,46,200  
Paint - Doors and Windows 1,160 sq.ft @ Rs 15 per unit 17,400

Total Price 17,74,830

**TOTAL FOR PAINTING Rs 24,88,710**

**ELECTRICAL AND PLUMBING**

**1. Electrical LUMP SUM 18,87,100**

**2. Plumbing LUMP SUM 23,06,400**

**TOTAL FOR ELECTRICAL AND PLUMBING  
Rs 41,93,500**

**7. CONCLUSIONS**

From the above study we can get the exposure that how to construct an apartment building. The conventional and cost effective technologies are available in the field of apartment housing construction. Among these, the cost effective technology has the advantage of economy in construction, saving of time and energy and of the optimum use of materials. Since the building materials are available in frequent times so the huge transportation costs incurred for transporting the materials and the delay in construction can be avoided. Thus, cost-effective technology, no doubt, can be adopted as a permanent remedy to overcome the severe housing inadequacy in the country. It is seen that some people just imitate others in house-building. They most often forget about their income capability affordability level. By doing so, they actually sacrifice their family's aggregate welfare by getting trapped into a huge financial debt. So, a point which needs to be taken care of in the interest of better housing may be that one should not imitate others in house-building and it is better to construct houses according to the income-affordability of each.

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