

# Precautions in Planning and Construction for Trouble Free Maintenance

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**Abstract-** In modern day times, construction of Multistory Buildings has become a necessity due to scarcity of land and increase in population of towns and cities. Any city we travel , though we find a number of Multistory Buildings but at the same time it is found that they are facing numerous maintenance problems from civil engineering point of view and these maintenance problems occur due to not paying enough attention to serviceability and maintainability during planning and construction stage. The problems, author has written down in this research paper are very small and trivial common sense issues, but at the same time these are neglected by site engineers and their supervisors with the result, the occupants who have put their life time savings in purchase of such exorbitantly costly apartments, sometimes feel cheated and frustrated due to frequent occurrence of maintenance problems.

Thus in this research paper, the author has tried to pinpoint the fine detailing precautions to be kept in mind not only while planning and execution of Multistory apartments but also during maintenance post occupation of the apartments where most of the time a manager cum supervisor who has little knowledge of civil engineering is in-charge of stage the Maintenance Team.

**Index Terms-** Maintenance of Buildings, Precautions in Planning of Buildings, Problems in Multistory Buildings, Solution to Maintenance problems, Tips for Trouble-free Maintenance.

## I. INTRODUCTION

An house is the dream of every human being and due to increasing cost of land in cities and towns, multistory Apartment is the ready- made answer to housing problems for emerging middle class people who have the capacity to pay either in installments or in lump sum but don't have time to construct their own house. Mostly the builders spent good amount of money to ensure a good elevation of Multistory (MS) apartments but they are very careless and negligent about detailing issues which affect the occupants or the buyers of apartments .In order to avoid maintenance problems after taking possession of apartment, the site engineer and the supervisor of builder has to provide good attention towards the preventive as well as corrective maintenance issues of the buildings effectively and qualitatively. The traditional concept is that we start the process of maintenance, only when user starts to use it but the process of maintenance should start right from conceptual stage and should be continued up to construction stage. Most of the maintenance problems are inherent in nature and may be due to defective planning, co-ordination and execution. Subsequent dismantling in building, due to lack of co-ordination and

planning, not only weakness the structure but also creates complex maintenance problems.

### 1.1 Suggestions for Trouble-Free Maintenance

We can ensure trouble free maintenance with minimum cost, if we keep in our mind the following key issues:

- i) A building should be well conceived by an Architect keeping in view the maintenance and serviceability aspect.
- ii) A structure should be well designed based on sound engineering principles and practices.
- iii) Structure should be well constructed using quality material and workmanship.

## II. PRECAUTIONS IN PLANNING STAGE

Architects, Civil Engineers, Electrical Engineers and user as well should be involved in the planning process. The main points in planning from maintenance point of view are following:

### 2.1 PLANNING POINTS RELATED TO ARCHITECT

- i) Terraces should be accessible
- ii) Rain water pipes should be spaced around the building uniformly and not concentrated around the shaft.
- iii) RCC Landings of staircase at terrace level should be raised sufficiently above the roof slab to accommodate the thickness of terracing and to prevent rainwater coming inside the staircase from terrace.
- iv) Sufficient space should be provided for pipe shaft to accommodate all the pipes and provide sufficient space for workmen.
- v) Shaft should be accessible at every floor and should have adequate light and ventilation.
- vi) Proper drainage of the shaft floor should be ensured.
- vii) Pipe shaft should be covered at the top by transparent sheets at sufficient height to check the entry of rainwater in the shaft and to provide ventilation to shaft too.
- viii) External walls should be protected by projection of at least 60cm at roof level. For high rise buildings, slab projection at intermediate level should also be provided to break the flow of water and for maintenance convenience.
- ix) Chajjas with upward fascia should be avoided which will obstruct the free flow of water.
- x) Closed boxes in the elevation should be avoided. These boxes accumulate the dampness and transfer it to the buildings.
- xi) External walls should not be exposed concrete or sand stone tile veneering.

xii) Concealed rainwater and sanitary pipes should be strictly avoided.

xiii) Water bodies like, toilets, kitchen, water coolers etc. should be nearer to the shaft to minimize the distance of horizontal water disposal pipes.

xiv) A space for desert coolers and window A.C. should be clearly earmarked so that provision for water supply and disposal of water may be planned.

## 2.2 In Staff Quarters following measures must be provided

a) We are not providing any separate stores in the staff quarters. Having transferable liability, lot of extra things are accumulated with the employees depending upon the climatic conditions and other local conditions and packing material etc. Therefore, sufficient space at 7 feet above the floor level must be planned for storage purpose.

b) Sufficient number of shelves or cupboards in the kitchen must be provided because requirement in today's context is much more as compared to past. Suitable arrangement sunken in walls, for keeping broom, utensil/washing aids etc. must be planned.

c) More electrical points must be provided in kitchen because nowadays more electro-mechanical appliances are used.

d) A space for washing machines along with electrical point, W/S & disposal arrangement must be planned.

e) Provision for keeping various types of soaps, detergents and other things must be planned may be sunken in walls.

f) In the same way, in W.C. also sunken space for cleaning aids must be planned.

g) Space Headway and width of landings & staircase flight must be designed keeping in view of shifting of house hold goods during transfer.

h) Provision for drying of clothes and in sufficient number must be kept in mind while planning the balcony. Solar movement from North to South Equinox must be also kept in mind while planning the orientation of balconies and kitchen.

i) Main door of quarters should preferably be of single leaf for safety point of view.

j) Traditionally locally available material and construction practices should be adopted.

## 2.3 PLANNING POINTS RELATED TO CIVIL ENGINEERS

- i. i) R.C.C. O/H tank on terrace should be provided sufficiently above the terrace level to attend the possible leakage from the bottom of tank & to attend the problems of water proofing treatment of terrace below the tank.
- ii. ii) Selection of correct type of water proofing treatment should be done very carefully keeping in view the climatic condition and temperature variation.
- iii. iii) New materials like P.V.C. based felt for water proofing and treatment with broken ceramic pieces may be introduced. P.V.C. pipes (U.V. Resistant) in sanitary installation should be used.
- iv. iv) Traditional cast iron grating at mouth of rain water pipe have hardly 40% net open area. This should be

modified with mild steel grating having large opening area.

- v. v) The over flow pipe from overhead storage tank should be taken directly to the rain water pipes. If two or more tanks are there, they should be interconnected at top.
- vi. vi) A working platform of steel structure should be provided 0.90 to 1.2m below the floor level in each shaft along with the provisions of foot rest.
- vii. vii) In heavy rainfall areas and in the areas where good quality of bricks are not available, it is desirable to plaster walls with 1:3 cement: sand plaster.
- viii. viii) Detailed plan of internal plumbing system of toilet or kitchen including floor slopes and detailing of depression or raised portion (difference of levels) etc. should be prepared in advance.
- ix. ix) There should be some standard color coding system for identifying the plumbing and drainage piping system.
- x. x) For balcony and staircase, floor landings should be depressed 15mm & sufficient slope should also be provided towards spout or pipe. Therefore, it is desirable to depress the structural slabs itself 30mm or more.
- xi. xi) Minimum depression in toilet with floor squatting pattern W.C. (Indian Style) should be 600mm and in bathrooms & kitchens general depression should be 250 mm so as to fix the traps in floor.
- xii. xii) Crossing of sanitary/drainage pipes through R.C.C. Beams should be avoided, by lowering the beams. If unavoidable, suitable opening should be provided in the beams by inserting across PVC pipe piece and beams should be designed accordingly.
- xiii. xiii) Minimum M 25 grade concrete should be used for sunken slabs with suitable water proofing compound.
- xiv. xiv) Integral cement based water proofing treatment must be provided over the sunken slab and along the walls keeping a slope of 1:80 towards outer wall. A 32 mm galvanized iron pipe piece working as a spout should be provided through the walls to drain out water in case of any eventuality and at the mouth of the spout, some loose aggregate must be filled.
- xv. xv) We should start the use of Flushing valves instead of flushing cisterns in W.C. & urinals since it will control the wastage of water and frequent maintenance of cisterns is a problem.
- xvi. xvi) We should provide bottle traps or any other type of traps in Wash Basins, Sinks & urinals after detailed and proper planning from long term maintenance point of view. Preferably Khurra & floor trap should be provided below the wash basins & sinks and waste pipe should be directly fixed with waste coupling & disposed directly to floor trap. In series of urinals, we should provide ceramic half round channels with sufficient slope and waste pipe disposal should be direct in these channels. Alternatively, PVC pipes with sufficient slope should be provided below the urinals.
- xvii. xvii) Expansion joints should be avoided as far as possible in toilets portion to avoid leakage.

- xviii. For covering the expansion joints, traditional asbestos cement sheet covering does not work. Instead aluminum moulded sheet covering etc. should be used.
- xix. Shelves in kitchen, bathrooms & cupboards of bed room etc. should be of Kota, Kadappa or similar types of hard stones instead of traditional wooden or R.C.C. shelves. Otherwise complete box of shelves made up of block board should be provided.
- xx. Flush door shutters and MDF shutters are not suitable for external doors, sanitary shaft, toilets, bathrooms & kitchen etc. Paneled shutters should be preferred. In toilets, shutters of moulded P.V.C. are also useful.
- xxi. Aluminum sliding door bolts are not safe on entry doors for safety point of view. Coated Mild Steel sliding door bolts or branded latch arrangement is safer on entrance or exit doors.
- xxii. Window sills should be provided of Kota, Kadappa or similar type hard stone keeping the slope outwards for effective rain water discharge.
- xxiii. In heavy rainfall areas & coastal regions, powder coated Aluminum window should be provided.
- xxiv. There should be no compromise in deciding the plinth level of Buildings. Future raising of roads should always be kept in mind. Invert level of municipal sewer should also be checked before deciding plinth level.
- xxv. Complete drainage plan should be prepared in advance.

### III. PLANNING POINTS RELATED TO ELECTRICAL ENGINEERS

- i) Cooling Towers, make up water tanks & condenser units should be avoided at terrace. If not possible, details of these structure may be given in advance so that supporting structure may be provided at terrace without disturbing the water proofing treatment and structural slab.
- ii) Details of all the cutouts in slab & walls, power and data cable ,exhaust fan opening etc. should be given in advance to civil Engineers to avoid any subsequent dismantling.
- iii) Cutouts in terrace slab should be avoided.
- iv) In machine rooms of lifts, details of cutouts for rope & wheel, design of hook etc should be planned in advance to avoid any subsequent cutting in slab.
- v) Electrical components i.e. switches, panels, boards etc should be planned away from water bodies.
- vi) RCC platform along with diesel generator and transformer etc should be planned in advance so that structural arrangements can be made accordingly.
- vii) Details of RCC Hume pipes, to be provide below the road considering future requirement also, should be planned and given in advance to avoid any subsequent road cuttings.

### IV. PLANNING POINTS RELATED TO USER

- i. Details of all the cutouts, cable entry, fire hydrants, fire risers and smoke detectors, earthing etc. should be planned in advance before release of working drawings.

- ii. Details of roof antennae, mast or any other feature to be mounted at terrace, should be planned and space marked before construction.
- iii. Structural additions, alterations & deletions should be avoided as far as possible.
- iv. Provision of vertical extension should be avoided. At least R.C.C. Structure of complete building along with external wall & finishing should be done in one stroke only.
- v. Terraces, Stair case & pipe shafts etc. should not be used as dumping ground of old furniture & wooden packing cases etc.
- vi. A list of 'Dos' & 'DONTs' should be prepared and wide publicity of the same should be given among users.

### V. PRECAUTIONS IN CONSTRUCTION STAGE

Following precautions should be taken in construction stage:

- i. Pipe connections to service tanks should be built into tanks at the time of concreting.
- ii. Rain water pipes and spouts should cover the full thickness of the wall. If necessary, extra length of pipe should be provided. Its inlet level should be just below the finished level of Khurra.
- iii. Pipes should not be laid just over the terrace but suitably fixed over masonry/concrete blocks.
- iv. Sufficient care must be taken for treatment of Expansion joints and cutouts in terrace slab in case of future vertical expansion.
- v. Sufficient care must be taken for the constructing & treatment of dummy column at terrace. Because they become a very big source of leakage.
- vi. Concrete for Khurras to be laid before construction of Parapet and integral water proofing treatment.
- vii. Tiles on terrace , if provided ,to over lap the concrete of Khurra by not less than 7.5 cm.
- viii. PVC sheet under Khurra should not be less than 400 micron.
- ix. Chase for C.C. Gola should not be less than 75mm wide & 75mm deep. C.C. Gola should be completed before plaster of Parapet.
- x. Mumty door should open outside.
- xi. Mumty should be well protected from rains by providing chajja & side walls. The sill level and lintel level of the mumty door should be suitably increased depending upon the thickness of water proofing treatment
- xii. The holes in the walls around the sanitary and drainage pipes should filled with the concrete to check leakage.
- xiii. All the pipes, fittings and fixtures and their joints must be tested under the specified pressure before covering.
- xiv. Drainage pipes, from bath toilet and kitchen etc. should not be less than 100 mm dia.
- xv. Special care must be taken for the quality of G.I. fittings like elbow, tee, unions etc.
- xvi. Enough valves should be provided in water supply system to regulate the supply in case of break down.

- xvii. Enough G.I.(galvanized iron) unions should be provided in pipes to have more flexibility in maintenance operations.
- xviii. Top of floor trap and finished floor should be connected with PVC pipe, not by C.C. blocks.
- xix. Sufficient care must be taken for making joints of W.C. pan, trap and soil pipes. After jointing and testing, a polymer coating should be provided on the joint for a length of 150 mm on both sides of joint. This will provide a flexible polymer sleeve to give additional protection. Alternatively joint may be covered with 1: 2: 4 concrete.
- xx. Discharging of one floor trap into another should be avoided.
- xxi. Pipe from floor trap to the stack should have a slope not less than 1 in 50.
- xxii. Collar joints should be avoided in the horizontal pipe from floor trap to stack.
- xxiii. Pipe socket in case of European WC should project over the floor.
- xxiv. Use of Rigid PVC pipe is recommended in toilets, kitchen & bathrooms.
- xxv. Provide the paint on all pipes as per planned colour code.
- xxvi. G.I. waste pipes from wash basin, sink and urinals should be firmly fixed in the walls and not be left hanging.
- xxvii. Traditional holder bat clamps to hold the PVC or cast iron pipes are not satisfactory. Holding arrangement with angels & long bolts are very useful. Pipe should be projected 50 to 60mm away from the wall of the shaft to avoid any dampness in the wall in case of leakage.
- xxviii. We should not forget to provide required slope in the channel of manhole
- xxix. All the drawings and details of water supply and sanitary installations must be prepared after construction is over and should be available with the user for reference at the time of maintenance.
- xxx. All special care must be taken in the joinery work of wood. Glue should be applied liberally and bamboo pins should not be very near to the edges.
- xxxi. Wooden cleats spoils the veneering of flush door shutter. Instead of cleats, floor door stoppers should be used.
- xxxii. Wooden window grills should be so designed that window fittings may be operated easily
- xxxiii. Size of steel windows should be 20mm less than the size of brick work opening.
- xxxiv. Special attention should be given for steel windows. After plastering, traditional hinges create the problem. Box type hinges are much better instead of traditional hinges as specified in specifications.
- xxxv. To prevent leakage from bathroom or kitchen from upper floors which is generally due to seepage from fittings, bathtubs, shower trays, buried pipes or drains or due to improper construction of joints, or improper use of sealants – a proper workmanship and strict supervision during construction work is required in such vulnerable areas of water seepage.
- xxxvi. Waterproof cement should be laid below floor tiles in bathrooms and kitchen and joints of tiles are to sealed properly with sealant compounds to prevent any seepage.
- xxxvii. The exit to emergency staircase should be outside the building and not on ground floor.
- xxxviii. On external walls where rains hit directly, walls should be plastered in rich cement sand mortar in 1 : 3 ratio.
- xxxix. Any holes, cracks, joints, or spalling of concrete etc on external face of the building should be sealed with water proof sealant compound to prevent seepage of water at a later date

## VI. CONCLUSION

A sweet home is a dream for most of the people and with land prices ever increasing and family size becoming smaller and smaller, more and more people are turning towards purchasing Apartments into a multistory building. But Apartments owners face the problems of Maintenance over a period of time and a small carelessness or poor planning during construction leads to many complex problems of maintenance for the residents. Therefore, in this article, the author has tried to list out the major problem areas and their solution in a very simple manner. Most of the solutions are time tested during the long service period of the author. Thus the designer and executing authority must keep the idea of maintainability in their mind for minimal maintenance. This will not only reduce the expenditure on maintenance but will also provide the consumer satisfaction. Precautionary measures during planning and construction stage cost for little but due to negligence on these aspects, maintenance cost increases manifold. For a durable, serviceable and healthy built environment maintenance issues have to be tackled in the first stage only. Computerized Maintenance Management Systems are being followed in modern built environment although problem areas and solutions as mentioned in this research paper are always to be kept in mind for trouble free minimal maintenance.

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