

Aam Aadmi Series - 4

HOUSE BUILDING DIGEST

(Construction Specifications-Foundations)



bmtpc

Creating Enabling Environment for Affordable Housing for All

This is an attempt by BMTPC to provide useful but often ignored information about multifarious activities involved in house construction and other technical and non-technical matters associated with building materials and construction technologies. The series is being brought out with a specific rationale to reach out to common people of our nation and make them acquainted about building construction. Every individual has a dream of owning a house and through this series which is aptly named Aam Adami Series, we will slowly unravel myths and misconceptions about building construction. The language used here is lucid and simple to comprehend. The complicated technicalities are explained in a parlance which can be understood by one and all.



Elements of Construction

The elements of house construction include the substructure i.e. foundation; superstructure i.e. walls, columns, beams, slabs, doors and windows, finishing items etc. For a common man, it is important to know some details of these elements so that they are constructed structurally sound and economical. Knowledge of these elements would also help in finalization of construction specifications.

1. Setting Out

The plot location and dimensions are provided by the local authority that provides the building permit. Having done so, the setting out works (demarcation of lines for walls etc as per the approved layout of the house) has to be carried out. If the setting out is not proper then the walls, columns, service lines etc may not fall in line, creating problems during construction and ending up in wall and other junctions which are not at right angles.

This is an important part of construction activity and should be carried out by the contractor under the guidance of the Architect, preferably along with the structural engineer.

A benchmark (usually in the shape of a small rectangular brick column) should also be constructed at the plot site such that the heights of walls, levels of the slabs and roof etc. can be taken and transferred appropriately.

2. Foundations

Foundations are the mainstay of house construction as the stability and the performance of the structure above is dependent on it. The main design parameters for consideration in this respect are the depth and width of the foundation. Whereas depth of foundation is a function of the 'Safe Bearing Capacity' (SBC) of soil at a specific depth





below ground level, the width is a function of the total loads of walls, slabs, finishing etc coming from the main structure.

Types of Foundations

Foundations for houses can be provided in a number of ways either in bricks, concrete or piles etc. The type of foundation to be provided is dependent on a number of factors including the nature and type of soil, number of storeys, construction specifications of the main structure etc. It is greatly influenced by the prevalent local practices.

Depth and Width

The depth at which the foundation shall have to be provided is dependant upon the depth at which soil with adequate SBC is available. Whereas SBC can vary from one site to another, typically the depth can be 90 cm (3'). Similarly the width of the foundation is a function of the load from the superstructure and the SBC, typically, it can be 90 cm (3'). The depth and width of the foundations, as above, are indicative only and both will be governed by the conditions at site. The advice of the structural engineer should be taken in this regard.

In any case, the minimum depth and width of the foundation should not be less than 75 cm (2 ½")

Foundations in Bricks

Normally, for a two or three storeyed house in areas having good SBC, stepped foundations in brickwork is a preferred option (Fig. 1). In this type of foundation, a base layer of concrete of about 7.5 cm (3") to 15 cm (6") is provided initially and then brickwork in cement sand mortar 1:6 or richer is raised in the shape of steps.

Care is however to be taken that the quality and strength of the bricks is adequate to take the load of the superstructure above the foundation. The advice of the Architect/ Structural Engineer should be taken in this regard.





The brick foundations should be provided all along the length of the load bearing walls (which are at least one brick thick) as also below the brick columns as and where necessitated.

Wherever half-brick walls (partition walls) are being provided in superstructure, the depth and width of the foundation can be reduced as per the directions of the engineer/ architect.

Damp Proof Course

A course is normally provided at the plinth level which is essential to prevent the moisture from travelling to the superstructure walls above the foundations. This course is called Damp Proof Course (DPC) and is made out of a cement mortar about 2.5 cm (1") thick with a layer of bitumen on its top. DPC should be provided with great care in order to prevent seepage from entering into the house.

Foundations in Stone

In large parts of the country, especially in the hilly regions as well as southern region stones are locally available which can be used for construction. Usually in such regions, good quality bricks for construction are not locally available and have to be transported from long distances, thereby making it costlier. In these areas use of stones for construction of foundations brings economy in construction.

The method of providing a foundation with stones is similar to that of providing foundations in bricks. A major deviation relates to the number of steps to be provided in the foundation, which normally is restricted to a maximum of two to three (Fig.2).

The type of stone to be used should be hard, sound and durable and free from defects. The advice of the engineer/architect can be taken in this regard. The owner can also get guidance from the houses being constructed in the vicinity.





The size of the stones should be such that they can be placed and lifted by hand. The stones should also be washed before use to get rid of the sticking mud or such material. The hard stones to be used for foundations are generally laid in 'Random Rubble Masonry' with leveling up with cement concrete of proportion 1:6:12 (1 cement : 6 course sand: 12 graded stone aggregate 20 mm nominal size & down).

Foundations in stone can also be provided for isolated column footings also.

Foundations in Concrete

Foundations in concrete can be provided in a number of ways i.e. in the form of isolated (single) column footing, combined footing, raft footing etc. The type of concrete foundation to be provided is again dependent on the sub-soil conditions, extent of load coming from the top etc.

Isolated Column Footing

Houses can be constructed (a) with load bearing brick walls (i.e. having brick walls for superstructure and foundations), (b) with Reinforced Cement Concrete (RCC) framed construction (i.e. having a frame of concrete columns and beams with brick walls filled in between) or in a combination of both (i.e. having individual RCC columns as well as brickwork upto foundations). Isolated column footing can be provided in both the latter cases.

In such cases, individual foundations are excavated for the required depth and width which are usually square in shape (Fig 3). The base of the foundation is provided in plain cement concrete (base concrete) which may have a thickness of about 7.5 cm to 15 cm (3" to 6"). Steel reinforcement of required diameter is then placed, having the required spacing in between. The reinforcement is placed in both directions and tied up. Reinforcement for the columns which has to





commence from the foundation level, is also placed and then concreting is carried out. These foundations are usually trapezoidal in shape as indicated in the Figure 3. As in earlier cases, the foundation should be got designed by a structural engineer.

Once the concreting has been carried out, proper curing (wetting by water) shall be carried out for about a week or 10 days such that the concrete may gain the desired strength

Combined Footing

At times the dimensions of the footing may be such that the dimensions of the two footing may not be able to get adjusted in the space available. In such cases two footings may be joined to get a combined footing. The structural design has to be carried out accordingly.

Raft Footing

In areas where the SBC is quite low, it is not possible to provide isolated or combined footing for the house. In such cases base concrete is laid in the entire foundation width and the reinforcement placed over the entire foundation and columns provided at the required places. This is a specialized type of foundation and its structural design should be done with great care.

Pile Foundations

Pile foundations are normally not required for putting up foundations for individual houses. However in exceptional cases where the soils are very weak and do not have a good Safe Bearing Capacity (SBC) at the desired depths, pile foundation may be the only option (Fig.4).

Piles for foundations can be made in in-situ concrete, precast concrete, steel, timber or in a combination of any two of these. One





of the latest techniques is to provide under-reamed piles which are bored concrete piles with a bulb like shape towards the bottom.

The main elements of the pile are its diameter, depth and the reinforcement. All these are dependant upon the conditions of the soil and the load of the superstructure. For providing the pile, holes of the required diameter are made in the ground and the reinforcement provided. The concrete is then poured and vibrated properly to get good compaction. The piles are usually provided at the corner and junctions of the walls and are connected with a pile cap. The superstructure is then constructed over the pile caps.

3. Foundations along Property Line

Property line for the purpose of understanding can generally be described as the legal boundary of the plot of land on which the house has to be constructed. Accordingly, it can said to be the line between the two adjacent properties or between the plot of the owner and the municipal land and the like.

As is evident, the foundations in bricks, concrete or stone etc. have to be of a different shape than those being provided for the inner walls. This being so because the foundations along the Property Line cannot extend into the others property

Accordingly, the face of the foundation along the other person's property has to be vertical in shape. A typical sketch of such a foundation is given at Fig.5.

4. AntiTermiteTreatment

Termites are insects that are capable of making severe damages in the house, be it the foundation, wooden structures or furniture, carpets, paper or curtains etc. Their habit of remaining concealed results in their presence go undetected, until the damages surface.





It is, therefore, essential to protect the house against termites by providing anti-termite treatment. This can best be done during the preconstruction stage of the house and provided in the foundations after the soil has been excavated and is exposed.

The treatment consists of providing a layer of chemical meant for the purpose, on the exposed surfaces of the soil in the foundations. The layer creates a barrier on account of which the termites are unable to make their way into the foundations and subsequently to the other parts of the structure including wooden doors and windows, furniture etc.

The chemicals are available in the market in concentrated form and are poisonous in nature. A great care has to be exercised during the application of the anti-termite treatment as they can cause injuries to the body, both externally and internally.

It is advisable to engage the services of the firms/agencies that specialise in carrying out the work. A large number of such firms/agencies also have their own website and accordingly it is easier to locate them. The cost of carrying out the treatment and the guarantee period has, however, to be negotiated.

Anti-termite treatment is also suggested to be provided to doors and windows, furniture items etc. This is in the form of protective coatings and is different from the treatment provided in the foundations.

5. Do's and Don'ts

It would be observed that design and construction of foundations has to be carried out carefully and there should be no laxity in this regard. If the following precautions are taken, a good foundation can be provided for the house:-

- 1) There should be no trees or their roots near the area where foundations are to be provided.





- 2) Foundations on natural drains of water should be avoided.
- 3) The depth and width of foundations in bricks and/or concrete should be designed properly.
- 4.) The foundation surface should be watered and left open for sometime and finally compacted either by hand compactor or rollers.
- 5) Anti termite treatment should essentially be done in a proper and prescribed manner.
- 6) Proper shuttering should be provided on the side walls of foundations to prevent soil caving.
- 7) It should be ascertained that the foundations are laid in an absolutely straight line.
- 8) Brick should be properly soaked in water before use. Similarly stones should be washed before use.
- 9) The base concrete to be provided should be 7.5 cm to 15 cm (3" to 6") more on either side of the foundation design width.
- 10) The base concrete should also be cured and rammed properly before commencement of work either for brick/stone foundation or for foundations in concrete
- 11) The reinforcement bars to be provided for seismic strengthening should be properly embedded in the foundation as per directions.
- 12) The foundations should be constructed in an absolutely vertical manner.
- 13) The steel reinforcement for foundations in concrete should be provided as per design and placed with a proper cover.
- 14) Proper cover to the reinforcement can be provided by placing cover blocks on base concrete. These can be made out of wood





or concrete etc, say of size 2.5x2.5x2.5 cm (1"x1"x1") or as may be required.

- 15) Proper curing of RCC work in foundations should be carried in order to obtain the required strength.
- 16) The entire depth of foundation should be at the same level to prevent differential settlement. Engineers advice should however be taken in this regard.
- 17) Foundations should also be provided for half brick walls although they can be at a lesser depth and of lesser width.
- 18) A cement mortar/concrete course, say of about 45 cm width, should be provided all along the outer side of the house at ground level. This is known as plinth protection course and prevents ground water from entering the foundations.
- 19) Damp Proof Course (DPC) should be laid properly and its top surface should be at the same level all along the foundation walls.

6. Conclusion

Providing a good and appropriate foundation for the house is a key to safe construction. Accordingly, it has to be seen that the soil on which the foundation is resting has a good SBC and has the capacity of taking the load of the structure over it. Soil testing is recommended in this regard.

Another area of importance is the type of foundation to be provided for the house. If need be, the advice of a Civil Engineer/foundation expert can be taken who can provide a structurally safe and economical way to provide/construct the foundation.

A good and robust foundation is the first step towards providing structural safety to the house.



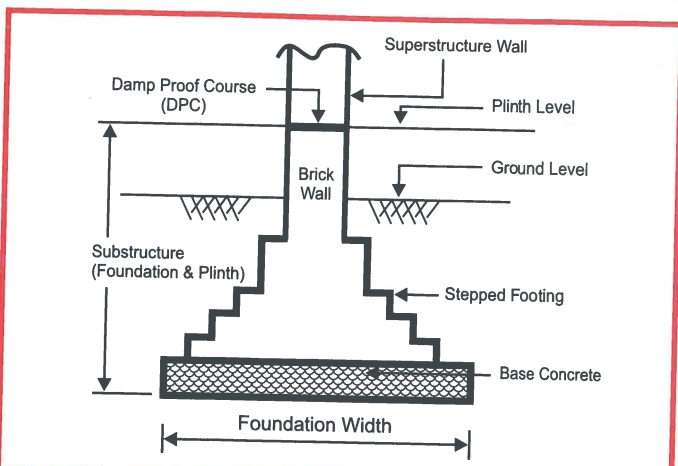


Fig. 1 : Stepped Footing in Brickwork

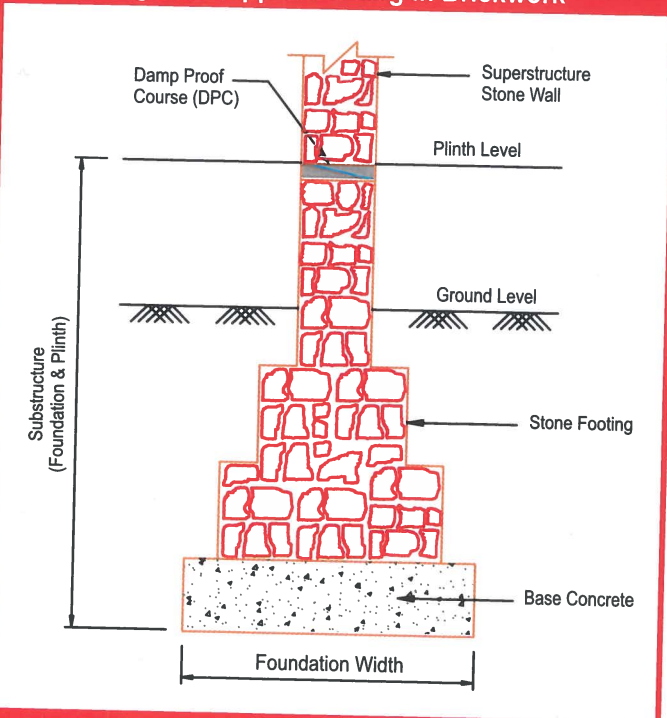
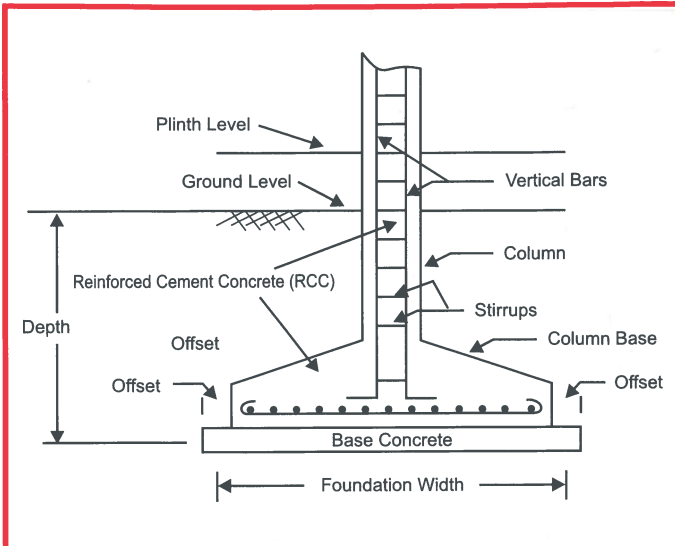
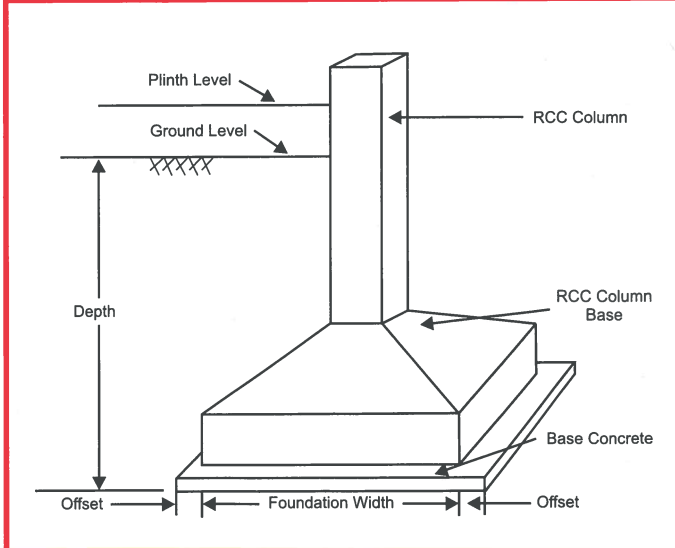


Fig. 2 : Stepped Footing in Stone





Typical Section of Isolated RCC Foundation



Typical View of Isolated RCC Foundation

Fig. 3



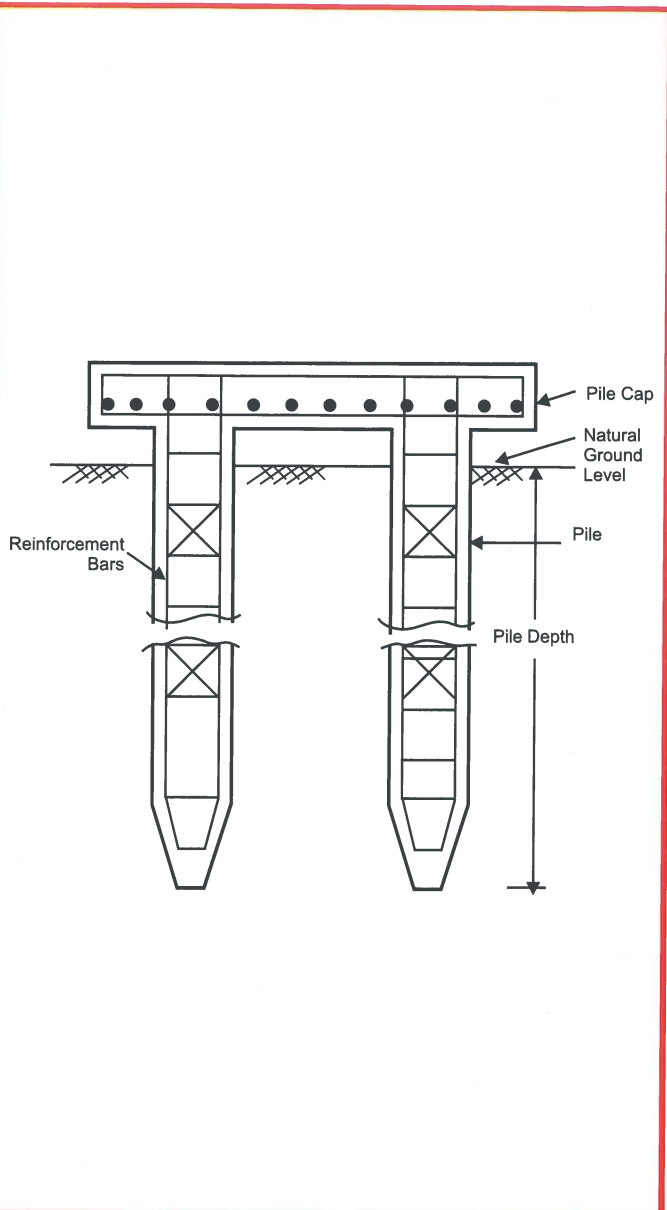
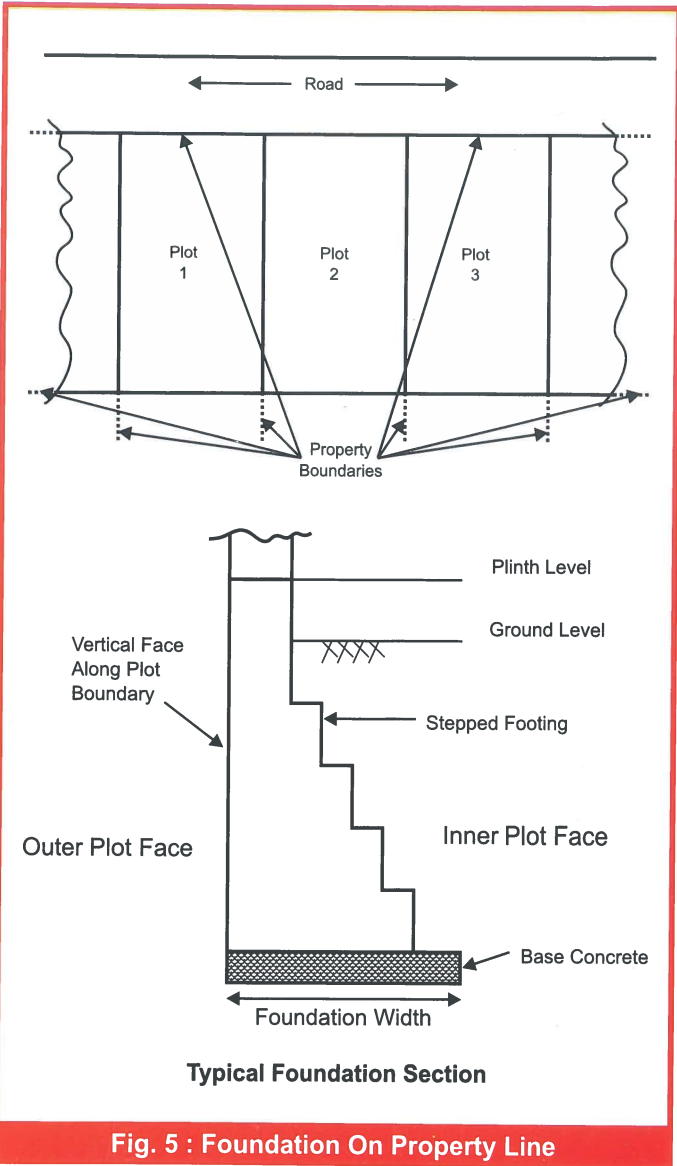


Fig. 4 : Typical Sketch of Pile Foundation





This is fourth of BMTPC 'House Building Digest Series' for creating awareness about construction of a house.



BMTPC

The Building Materials & Technology Promotion Council (BMTPC) was setup in 1990 as an inter ministerial organisation under the Ministry of Housing and Urban Poverty Alleviation to bridge the gap between the laboratory research and field level application.

VISION

BMTPC to be world class knowledge and demonstration hub for providing solutions to all with special focus on common man in the area of sustainable building materials, appropriate construction technologies & systems including disaster resistant construction.

MISSION

To work towards a comprehensive and integrated approach for promotion and transfer of potential, cost effective, environment-friendly, disaster resistant building materials and technologies including locally available building materials from lab to land for sustainable development of housing.

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