RAMA UNIVERSITY

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FACULTY OF RNGINEERING AND TECHNOLOGY (DEPARTMENT OF CIVIL ENGINEERING)

BUILDING CONSTRUCTION

DIPLOMA (IInd YEAR/ IIIrd SEM)

SATISH KUMAR

M.TECH (NIT, WARANGAL)

ASSISTANT PROFESSOR

(DEPARTMENT OF CIVIL ENGINEERING,

RAMA UNIVERSITY)

e. Bond (cl.34.2.4.3 of IS 456)

- The critical section for checking the development length in a footing slab shall be the same planes as those of bending moments in part (c) of this section. Moreover, development length shall be checked at all other sections where they change abruptly. The critical sections for checking the development length are given in cl.34.2.4.3 of IS 456, which further recommends to check the anchorage requirements if the reinforcement is curtailed, which shall be done in accordance with cl.26.2.3 of IS 456.

f. Tensile reinforcement (cl.34.3 of IS 456)

- The distribution of the total tensile reinforcement, calculated in accordance with the moment at critical sections, as specified in part (c) of this section, shall be done as given below for one-way and two-way footing slabs separately.

I. In one-way reinforced footing slabs like wall footings, the reinforcement shall be distributed uniformly across the full width of the footing i.e., perpendicular to the direction of wall. Nominal distribution reinforcement shall be provided as per cl. 34.5 of IS 456 along the length of the wall to take care of the secondary moment, differential settlement, shrinkage and temperature effects.

II. In two-way reinforced square footing slabs, the reinforcement extending in each direction shall be distributed uniformly across the full width/length of the footing.

III. In two-way reinforced rectangular footing slabs, the reinforcement in the long direction shall be distributed uniformly across the full width of the footing slab. In the short direction, a central band equal to the width of the footing shall be marked along the length of the footing, where the portion of the reinforcement shall be determined as given in the equation below. This portion of the reinforcement shall be distributed across the central band:

DESIGN CONSIDERATIONS

- Reinforcement in the central band = {2/(β +1)} (Total reinforcement in the short direction)
- where β is the ratio of longer dimension to shorter dimension of the footing slab.
- Each of the two end bands shall be provided with half of the remaining reinforcement, distributed uniformly across the respective end band.

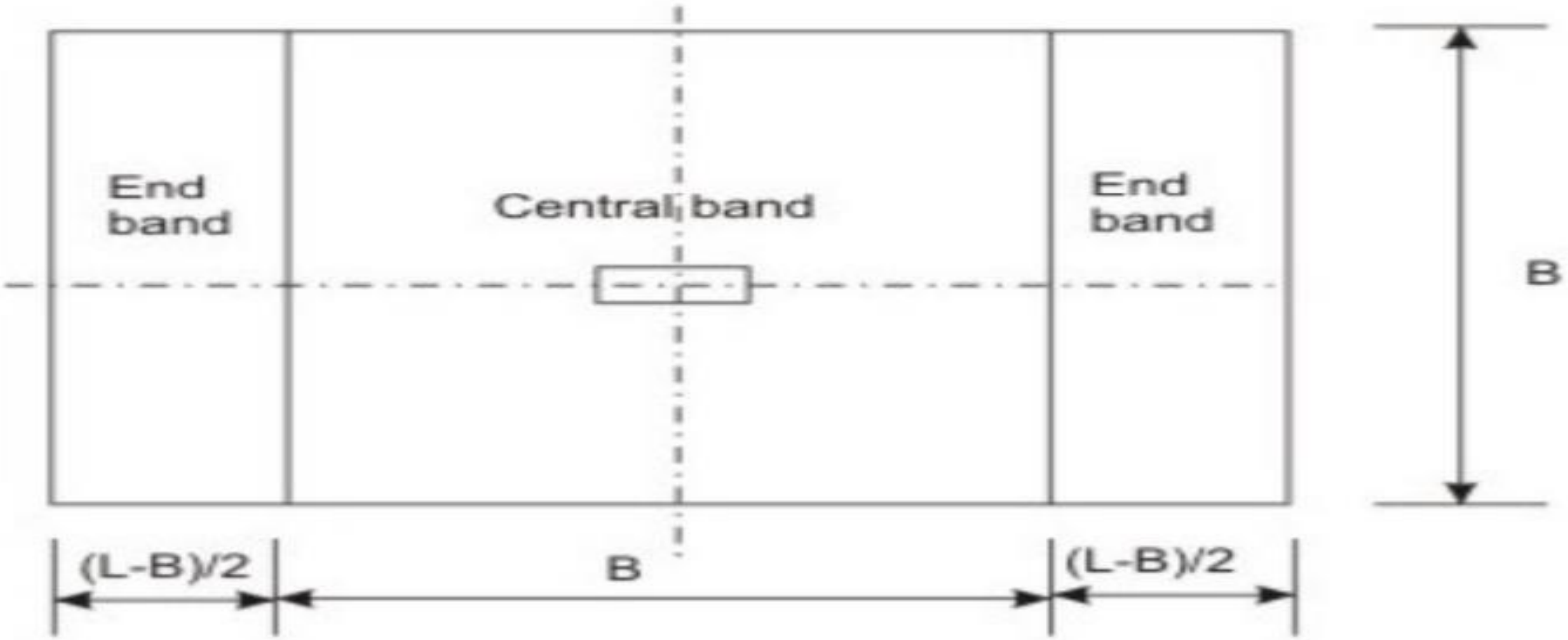

Fig. 11.28.14: Bands for reinforcement in a rectangular footing

DESIGN CONSIDERATIONS

Transfer of load at the base of column (cl.34.4 of IS 456)

- All forces and moments acting at the base of the column must be transferred to the pedestal, if any, and then from the base of the pedestal to the footing, (or directly from the base of the column to the footing if there is no pedestal) by compression in concrete and steel and tension in steel. Compression forces are transferred through direct bearing while tension forces are transferred through developed reinforcement. The permissible bearing stresses on full area of concrete shall be taken as given below from cl.34.4 of IS 456:

- If the permissible bearing stress on concrete in column or in footing is exceeded, reinforcement shall be provided for developing the excess force (cl.34.4.1 of IS 456), either by extending the longitudinal bars of columns into the footing (cl.34.4.2 of IS 456) or by providing dowels as stipulated in cl.34.4.3 of IS 456 and given below:

I. Sufficient development length of the reinforcement shall be provided to transfer the compression or tension to the supporting member in accordance with cl.26.2 of IS 456, when transfer of force is accomplished by reinforcement of column (cl.34.4.2 of IS 456).

II. Minimum area of extended longitudinal bars or dowels shall be 0.5 per cent of the cross-sectional area of the supported column or pedestal (cl.34.4.3 of IS 456).

III. A minimum of four bars shall be provided (cl.34.4.3 of IS 456).

IV. The diameter of dowels shall not exceed the diameter of column bars by more than 3 mm.

V. Column bars of diameter larger than 36 mm, in compression only can be doweled at the footings with bars of smaller size of the necessary area. The dowel shall extend into the column, a distance equal to the development length of the column bar and into the footing, a distance equal to the development length of the dowel, as stipulated in cl.34.4.4 of IS 456.

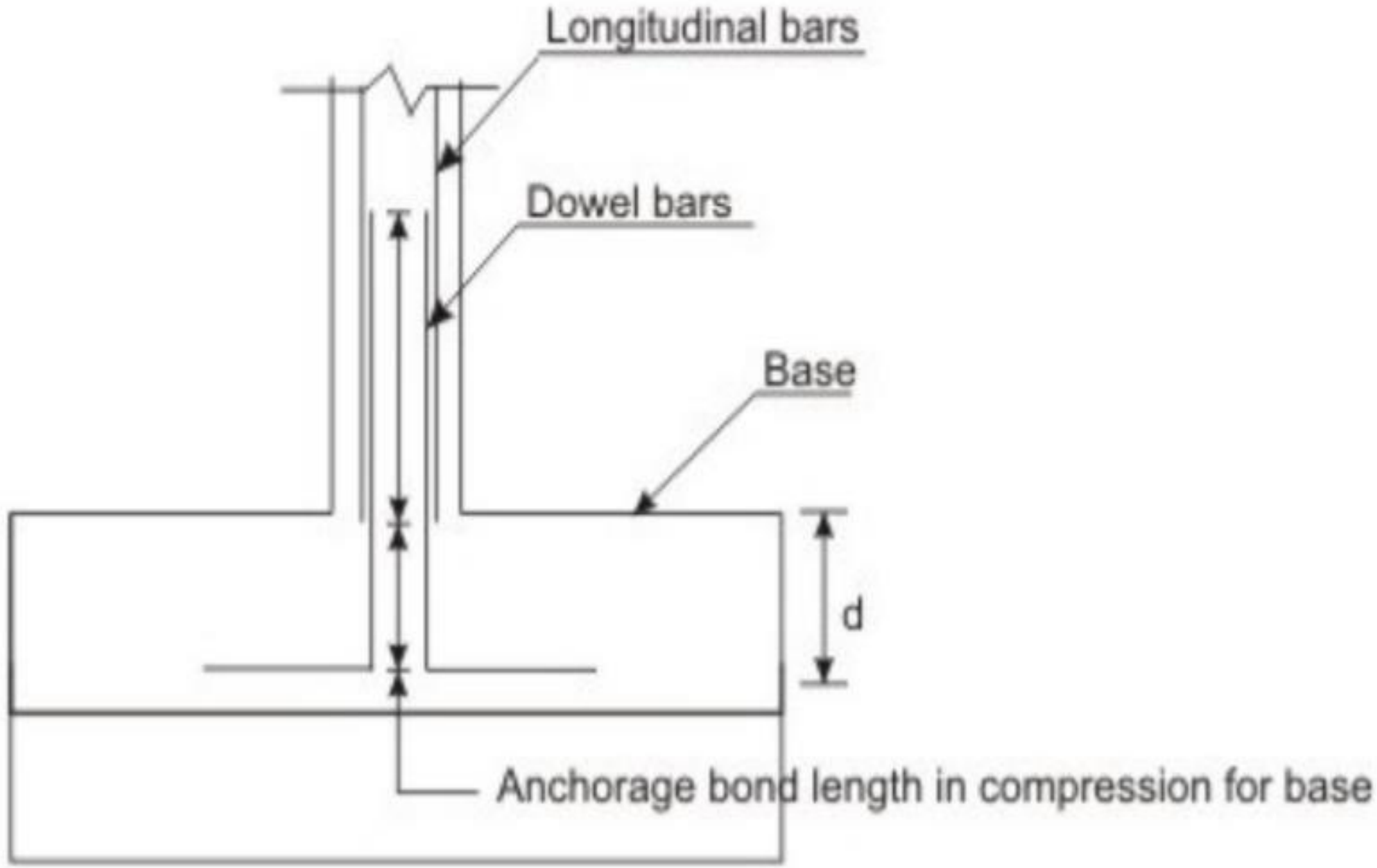

Fig. 11.28.16: Anchorage length of dowels

PILE FOUNDATIONS

- The deep foundations are classified as below:

I. Pile foundation

II. Cofferdams

III. Caissons

PILE FOUNDATIONS

- Pile foundation are used extensively for the support of buildings, bridges, and other structures to safely transfer structural loads to the ground and to avoid excess settlement or lateral movement.

- They are very effective in transferring structural loads through weak or compressible soil layers into the more competent soils and rocks below.

- A slender, structural member consisting steel or concrete or timber.

- It is installed in the ground to transfer the structural loads to soils at some significant depth below the base of the structure.

- Our building is rested on a weak soil formation which can't resist the loads coming from our proposed building, so we have to choose pile foundation. Pile cap Piles Weak soil Bearing stratum Piles are structural members that are made of steel, concrete or timber.

PURPOSE OF PILE FOUNDATION

- The shallow foundations need more plan areas due to the low strength of soil compared to that of masonry or reinforced concrete. However, shallow foundations are selected when the soil has moderately good strength, except the raft foundation which is good in poor condition of soil also.

- Raft foundations are under the category of shallow foundation as they have comparatively shallow depth than that of deep foundation. It is worth mentioning that the depth of raft foundation is much larger than those of other types of shallow foundations.

- However, for poor condition of soil near to the surface, the bearing capacity is very less and foundation needed in such situation is the pile foundation.

- Piles are, in fact, small diameter columns which are driven or cast into the ground by suitable means. Precast piles are driven and cast-in-situ are cast. These piles support the structure by the skin friction between the pile surface and the surrounding soil and end bearing force, if such resistance is available to provide the bearing force. Accordingly, they are designated as frictional and end bearing piles. They are normally provided in a group with a pile cap at the top through which the loads of the superstructure are transferred to the piles.

- Piles are very useful in marshy land where other types of foundation are impossible to construct. The length of the pile which is driven into the ground depends on the availability of hard soil/rock or the actual load test. Another advantage of the pile foundations is that they can resist uplift also in the same manner as they take the compression forces just by the skin friction in the opposite direction.

- However, driving of pile is not an easy job and needs equipment and specially trained persons or agencies. Moreover, one has to select pile foundation in such a situation where the adjacent buildings are not likely to be damaged due to the driving of piles. The choice of driven or bored piles, in this regard, is critical. Exhaustive designs of all types of foundations mentioned above are beyond the scope of this course. Accordingly, this module is restricted to the design of some of the shallow footings, frequently used for normal low rise buildings only.

FUNCTION OF PILES

Function of piles:

- As with other types of foundation, the purpose of a pile foundation is:

I. To transmit a foundation load to a solid ground

II. To resist vertical, lateral and uplift load

- **Uses of piles**

I. The load of the superstructure is heavy and its distribution is uneven.

II. The top soil has poor bearing capacity.

III. The subsoil water is high so that pumping of water from the open trenches for the shallow foundations is difficult and uneconomical.

IV. There is a large fluctuation in subsoil water level.

V. Where timbering to the trenches is difficult and costly.

VI. The structure is situated on the sea shore or river bed, where there is danger of scouring action of water.

VII. canal or deep drainage lines exist near the foundations.

VIII. The top soil is of expansive nature.

IX. Piles are used for the foundations of transmission towers, off- shore platforms which are subjected to uplift forces.

FACTORS AFFECTING THE SELECTION OF TYPE OF PILES

Factors affecting the selection of type of piles are as follows:

- Nature of structure
- Loading conditions
- Availability of funds
- Availability of materials and equipments
- Types of soil and its properties
- Ground water table
- Self weight of pile
- Durability of pile
- Cost of pile
- Maintenance cost
- Length of pile required, Number of piles required, Facilities available for pile driving
- Presence of acids and other materials in the soil that would injure the pile

TYPES OF PILES

a. Classification based on Function or Use

I. Bearing Piles or End Bearing Piles

II. Friction Piles or Skin Friction Piles

III. Sheet Piles

IV. Tension Piles or Uplift Piles

V. Anchor Piles 6. Batter Piles

VI. Fender Piles 8. Compaction Piles

b. Classification based on Materials

I. Timber Piles

II. Concrete Piles

III. Composite Piles

IV. Steel Piles

V. Sand Piles

TYPES OF PILES

c. Classification based on Method

I. Driven Piles

II. Driven and cast-in-situ Piles

III. Bored and cast-in-situ Piles

IV. Screw Piles

V. Jacked Piles

THANK YOU