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FOUNDATIONS

- CURS 11 -

Design of shallow foundations

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CHAPTER VI – SHALLOW FOUNDATIONS

§ 6.9 Design of continuous foundations under walls

Sect.1-1

- □ The solution of **Continuous foundations under walls** is generally adopted in case of normal civil constructional works for:
 - Buildings with continuous concrete or brick walls;
 - Dual Concrete / Steel frame buildings with concrete walls;



- For any building when is intended to have a rigid infrastructure in order to assure a spatial work of the building;
- When the dimensions of the single foundations cannot be realized without overlapping (structures with small bays);
- In cases when the single foundations cannot be sufficiently extended (columns near other buildings or in joints).

Obs: As in case of single foundations, the continuous foundations can be realised as block foundations or as base plus concrete pillow foundation.

§ 6.9 Design of continuous foundations under walls Types of continuous foundations

□ The general typologies of continuous foundations are shown in below



continuous foundation

Continuous foundation in two steps

Continuous foundation for underground walls

□ In case of continuous foundations, the top part is a concrete strap of minimum 20 cm height, disposed under wall width (min 6 d14).

§ 6.9 Design of continuous foundations under walls Types of continuous foundations

- □ If the width B of the foundation results greater than the wall width with more than 15cm each side, then the foundation solution should be in two steps;
- □ The design of continuous foundations consists in establishing the height and the width dimensions of the foundation;
- □ The design is made on a unitary length of 1m (unitary length);
- □ The width of the foundation B results in function of:
 - soil pressure and conventional soil pressure;
 - wall width b: B>b+10cm;
 - minimum dimensions for execution of trenches.

Height of the trench	Minimum width
h≤0,40	0,30
0,40 <h≤0,70< td=""><td>0,40</td></h≤0,70<>	0,40
0,70 <h≤1,10< td=""><td>0,45</td></h≤1,10<>	0,45
h>1,10	0,50



§ 6.9 Design of continuous foundations under walls Types of continuous foundations

- Geometrical requirements (proportioning):
 - \square b_c/B=0.50...0.65 for single tread;
 - \square *b_c/B=0.40...0.50* for multiple treads;
 - □ $h_c \ge 300 \text{ mm}$ but $h_c / L \ge 0.25$;
 - □ tanβ≥0.65. If tanβ≥1.00 then the check to shear force is not required. Otherwise, the check to shear force should be performed according to Eurcode 2.
 - Concrete class: min C12/15

Obs: The final dimensions of the foundation will result by design checks (pressure and section checking).

□ For buildings located in seismic areas with $a_g < 0.15g$ the following solutions could be adopted:



- □ For buildings located in seismic areas with $a_g < 0.15g$: □ By respecting the *tanα* condition, the foundation could be made of plain concrete (without reinforcement);
- ☐ If the stresses are higher, the foundation could include a concrete strap and bottom reinforcement.



□ Strap reinforcement

Is disposed in order to create a bottom link on the foundation.

Generally is not designed:

- longitudinal: min 6 Φ14
 (*p_{min}=0.1%*)
- transversal: stirrups Φ8/300mm



□ For buildings located in seismic areas with a_g >0.15g the following solutions could be adopted:



Continuous foundation with concrete block foundation and reinforced concrete pillow.

□ For buildings located in seismic areas with $a_g > 0.15g$ the following solutions could be adopted:



Continuous foundation rigid concrete beams and reinforced concrete pillow.

□ For a **rectangular continuous foundation, centrically loaded**, the width of the foundation could be derived from:

 $p = \frac{Q + Gf}{B \cdot 1} \leq p_{conv}$

Obs: The resulting width *B* will be rounded to 5cm.

Where: Q is the load transmitted 1m of wall to the foundation [kN/m];

 G_f - is the proper weight of the foundation [kN/m];

 p_{conv} - is the conventional pressure of the soil.

□ In many cases the walls are disposed eccentric due to the presence of dead walls or other obstacles.

□ These foundations should be dimensioned in such a way that the resultant of all axial loads will be maintained in the inner third of the basis.

In this manner, the entire foundation basis will remain active.

§ 6.9 Design of continuous foundations under walls Design of continuous foundations under **masonry walls**

□ If this condition cannot be realized, but the effective width is $B_a > 1.5b$, and the pressure condition is not satisfied, there could be considered the favorable deformation effect of the soil and the foundation block, by considering an active width $B_a = 2.25b$.



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□ If $p_{eff,min}$ <0 then longitudinal reinforcing of the foundation should be assured.

- □ The design of continuous foundations under concrete walls should be made on unitary length (L=1m);
- □ The continuous foundations under concrete walls are realized as reinforced block foundation (a) or as reinforced pillow and base (b):

□ The geometrical requirements (proportioning) and the reinforcing (including concrete) conditions are similar to the equivalent foundation systems:

- reinforced concrete block
- reinforced pillow and base



- Reinforcing the continuous foundations under concrete walls:
- □ The **sole transversal reinforcement** is computed as in the case of block foundations.
- \Box The **longitudinal reinforcing** results from the evaluation of the longitudinal forces (*N*, *M* and *T*) and evaluation of contact pressure along the continuous foundation.
- □ The longitudinal reinforcement will respect the minimum requirements (*see continuous foundations under masonry walls*) and any additional reinforcement resulting from concrete design.
- □ The vertical reinforcement connecting the foundation with the RC wall results from:
 - □ slip check of concrete wall on the casting joints;
 - □ check to eccentric loading of the reinforced concrete wall;
 - check of the bottom section of the wall to soil pressure.

Obs: The wall reinforcement (usually mesh wires) should be anchored in the foundation on an anchoring length *I*_{bd}. Adrian Ciutina, Foundations

§ 6.9 Design of continuous foundations under walls Continuous foundations under **concrete columns**

The continuous foundations under concrete columns are made usually as foundation beams or as reinforced pillow and base:



Obs: The geometrical requirements for reinforced pillow and base continuous foundations are similar to the geometrical requirements of single foundations.

§ 6.9 Design of continuous foundations under walls Continuous foundations under concrete columns

Minimum geometrical requirements \square Minimum height: $H_c = \left(\frac{1}{3} \dots \frac{1}{6}\right) L_0$; 500mm L_0 – distance between two columns □ B_{min}>300mm \Box For T cross-sections: $H_t \ge Lc$ In case of splayed foundations: \square haunch length: $L_v = \left(\frac{1}{6} \dots \frac{1}{4}\right) L_0$ \square haunch height: $H_v \ge \frac{1}{3}L_v$

Other conditions:

- \square $H_t \ge 300mm; H' \ge 200mm$ for haunched beams
- $\square b_{min} \ge b_s + 50mm$

Obs: The reinforcing of the continuous foundations under concrete columns results from design. Similar design is performed as in case of continuous foundations under concrete walls. Adrian Ciutina, Foundations



