3.1.1 Lap-splices in columns

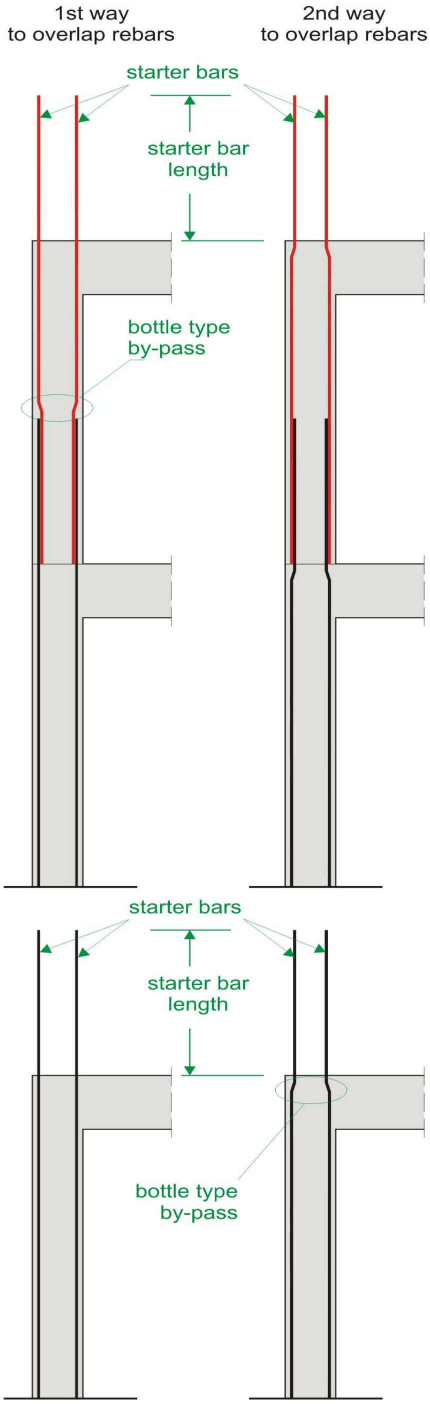
In multi-storey buildings it would be ideal if each of the column's longitudinal rebars could be placed as one single piece throughout the structure's entire height. This however cannot be accomplished for practical reasons therefore, the length of the longitudinal rebars is equal to the height of each storey.

When lapping steel bars from successive stories, it is important to ensure the correct transmission of forces from the rebars of the subjacent floor to the rebars of the superjacent floor. This can be achieved by welding, however this method has a number of technical difficulties and it is used only in special occasions. The practice usually followed is the rebar lap-splicing i.e. rebar lapping by means of contact.

The length of the placed bars must be extended by an additional length called **'lap length'**, which has to be equal or greater than the length required for the lapping of corresponding rebars between two successive storeys. This length is equal to the rebar's diameter multiplied by the 'contact coefficient' (its value varies from 45 to 60).

It is important to thoroughly understand how the lap-splices are being done in practice. One must always keep in mind that in order for the stirrups to provide confinement, every rebar must be placed inside one of their corners. This however is difficult to be done at the beginning and at the end of the lap-splice and it can be achieved only with special practices. In case the rebars are wired together on the site, the lap-splice is mandatory to be done according to the first way shown at the opposite figure.

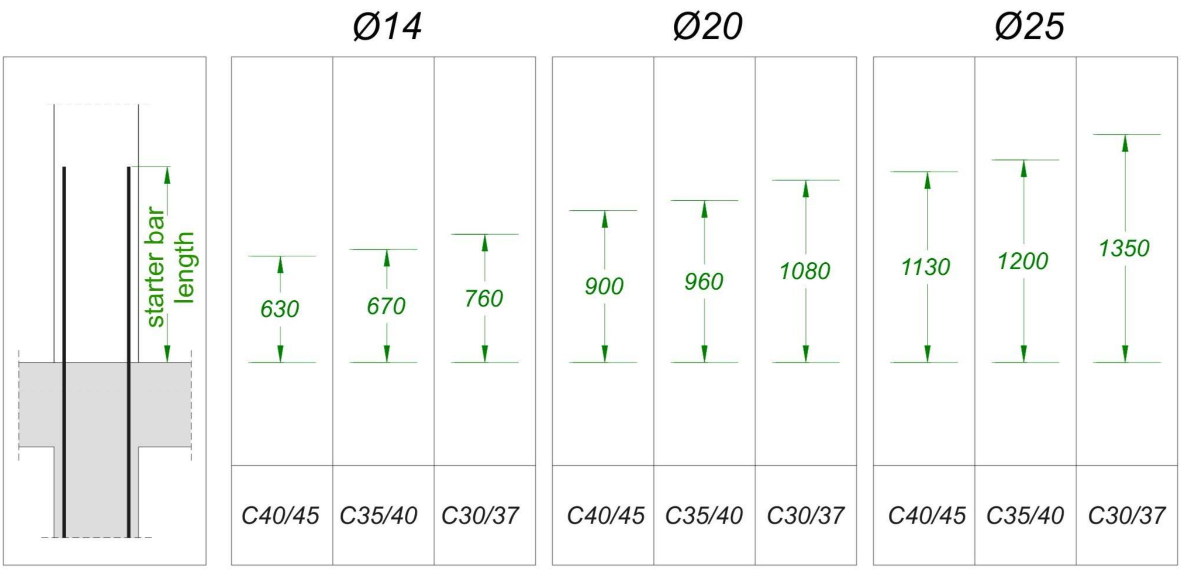
The starter bars of the subjacent storey must be kept straight while the rebars of the above floor must be bent at their joint point. The bent part must extend to one or two stirrups. The use of rebars with diameters greater than Ø20 or Ø25 makes bending in situ extremely difficult if not practically impossible, that is why the rebars have to be bent prior to their placement with the use of a bending machine.



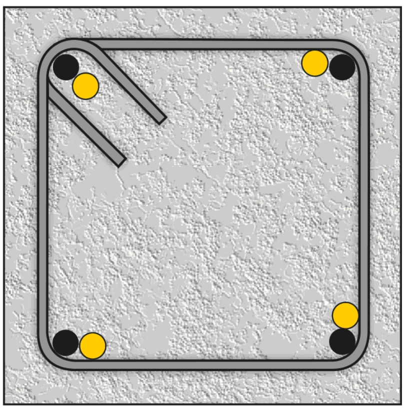
Note:

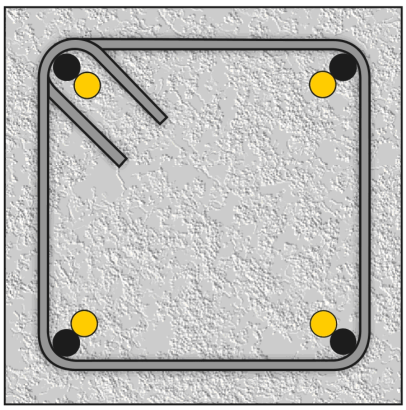
The 'contact coefficient' is proportional to the steel's yielding strength and reverse proportional to the concrete's compressive strength[1]*.*

The following table shows the necessary lap lengths in cm, for three different rebar diameters in combination with three different concrete grades



The bent rebars can be placed in contact with the straight ones in any direction as shown at the following figures.





In case there are no seismic design requirements and for serviceability reasons, it is preferred to place more bars with smaller diameter around the perimeter instead of fewer bars with larger diameter. When seismic design is required, as it is for the columns referred in this book, it is preferred to place rebars only inside the corners of the stirrups thus ensuring that no buckling will occur. Therefore, it is better to use fewer bars with larger diameter. Moreover, structures designed to withstand the seismic hazard, have a considerable amount of steel reinforcement in their joint areas so the small number of column rebars enables the proper reinforcement.

[1] For B500 steel and C30/37 concrete, the 'contact coefficient' is a= 54 > starter bar length l_o = 54*20 = 1080 mm.