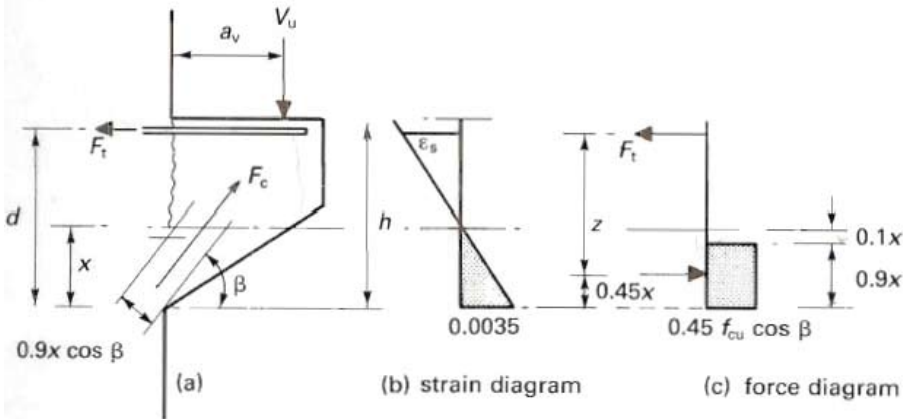


Beam to column connections

Published Date: 03/08/2009

The simplest support for a beam onto a column is to sit the beam on top of the column. However, it is normal practice to have columns at least 2 or 3 storeys high, and as a result, beams may need to be supported part way up a column. The 'traditional' way of achieving this is by using a corbel projecting from the face of the column.



The usual way of designing such corbels is by a 'strut and tie' analogy. The applied vertical load is resolved into a horizontal force, (the tie), and a corresponding inclined strut. The diagram shown is based on BS8110 methods, but the principle is also used in EC2 with some minor tweaks. There are several guides available to designing such corbels.

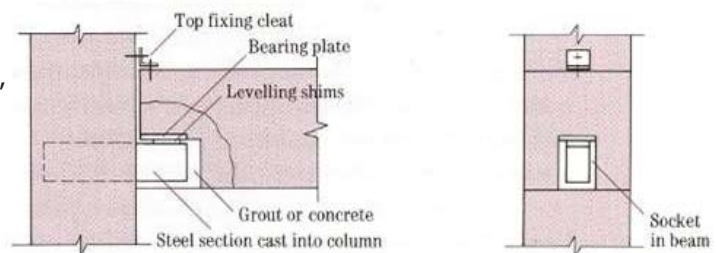
There are however, practical drawbacks to this type of support.



It is visually intrusive, although if there is to be a suspended ceiling hiding the corbel then this is less important. It reduces headroom locally at the column. (A halving joint reduces this, but leads to more complex details at the beam end.)

It creates much more complex mould requirements, particularly with multiple corbels. Steel moulds, in particular, do not lend themselves to this type of construction.

A better option is to include a steel 'billet' in the column. This may be in the form of a standard section such as SHS or a rolled I section. The billet projects beyond the face of the column and can be mated with a recess in the end of the beam, thus addressing the headroom problem. These billets are designed using normal steel methods for a combination of shear and bending. As they are normally located towards the bottom of the beam section, it is common for a secondary connection at the top of the beam to deal with instability during erection. For higher eccentricities, for example on an L shaped edge beam, measures must be taken to cater for torsion. This may take the form of a moment connection with a slab along its length, or a rigid connection between column and beam. They can still create problems in the mould however as they penetrate the side formwork. They also require protection against fire, which results in extensive grouting.



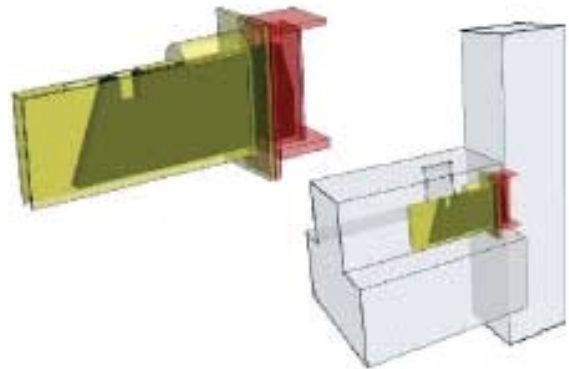
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In recent years, proprietary systems have been developed that address the above problems. This bolt-on corbel has a capacity of up to 1500 kN. A serrated plate cast into the column matches serrations on the corbel. It allows the mould to be simple, but still requires treatment to provide fire resistance.

Other heavy duty systems consist of a steel box cast into the end of the beam. Inside this is a steel, loadbearing, plate or 'knife'. During erection, the knife is extended beyond the beam to engage in a corresponding box in the column face. The complete assembly is then grouted to give protection against fire and corrosion. Capacities go up to 950 kN. Since the load is applied at the column face, the induced moments in the column are considerably lower than for corbels or billets having a higher eccentricity. This can be a considerable advantage when designing the column, allowing a more slender section.



The main advantage of both these systems is that they do not require work on the column mould, and result in a simpler section. The three-storey columns shown below are considerably lighter from not having corbels.

