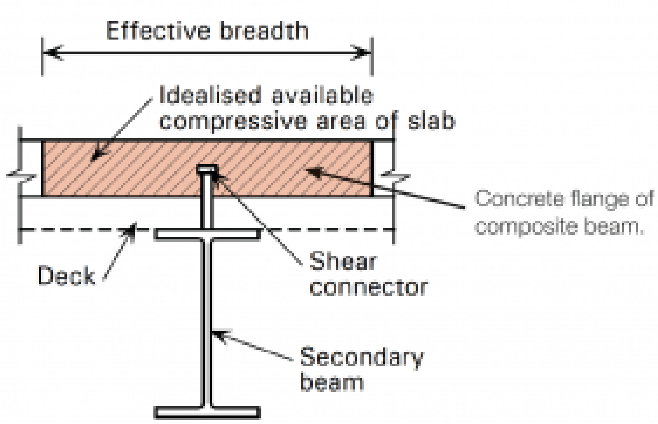
The increased performance of composite beams, in stiffness and bending resistance, allows the construction of longer spans and shallower floors when compared to non-composite methods. This could allow smaller storey heights, more floors for the same building height, more flexible column free areas and increased opportunities for services.

What is a shear stud for?

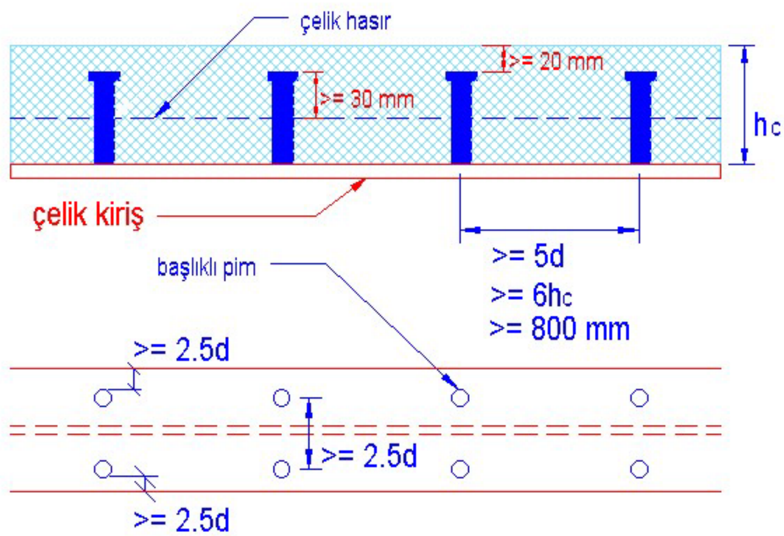
Composite beams are typically hot rolled steel sections that act compositely with a concrete slab. Shear studs are required to transfer force between the steel section and the concrete slab. The studs are welded to the beam, normally through the deck sheet. This enables the concrete slab to act like a large top flange to the composite beam when the concrete has hardened and creates a stronger section to support the loadings applied to the finished slab.



Steel designers design the steel frame to approved design standards (the latest being Eurocode 4). These design standards have formulae to calculate the amount of force that can be transferred by each shear stud. When designing the composite beams, the steel designer will calculate how many studs are needed for the beam design based on these values.

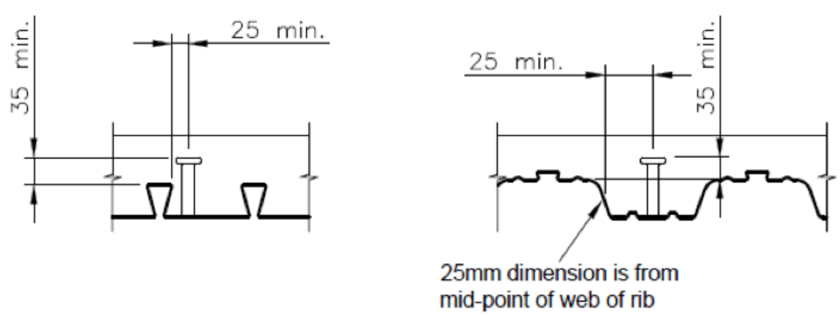
Shear stud configuration design rules

The values used by the steel designer for shear stud strength rely on a concrete ‘cone of failure’ around the stud (see photo below) and the studs being spaced to the design rules stated.



There are a number of rules and recommendations from approved design standards and industry best practice which specify spacings, dimensions and layout of studs in order to achieve the required stud resistance. Below is a selection of the most common examples.

When installing shear studs, the length after weld should extend at least 35mm above the top of the main rib of the deck profile.

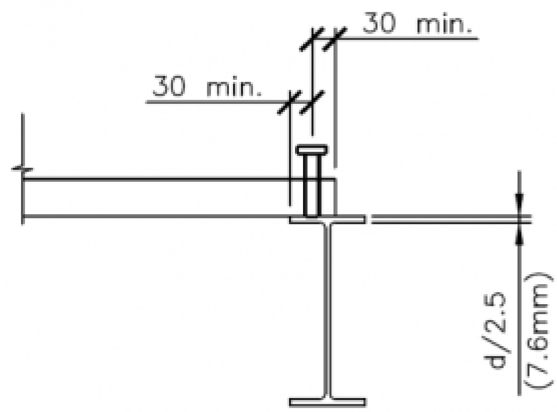


Minimum distance from deck rib = 25mm

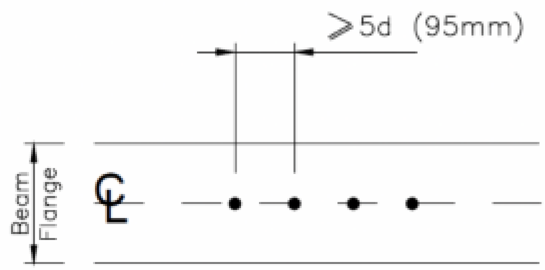
The recommended minimum concrete cover to the top of the stud is 15mm, this should be increased to 20mm if the shear stud is to be protected against corrosion.

Minimum Flange Thickness to prevent localized bending of the flange at ultimate loading and minimize the chance of weld blow-through = 0.4 x diameter of shear stud = 7.6mm for a standard 19mm stud.

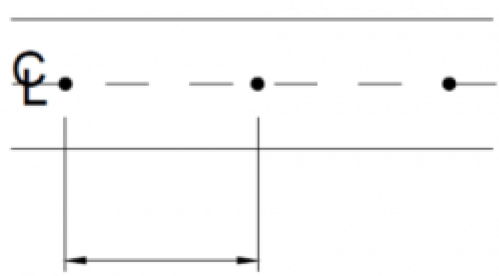
Minimum distance from edge of beam = 30mm



Minimum spacing

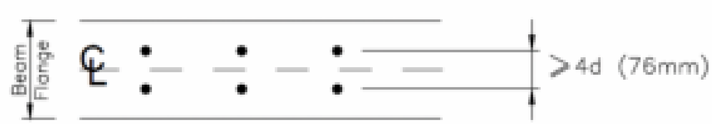


Single studs to be located on the center line of the beam except at butt joints where studs should be staggered in line with typical details, minimum spacings as indicated in Eurocode 4.



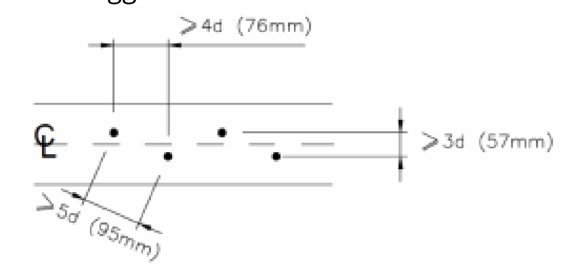
Studs in pairs

Studs in pairs are only achievable on beams with a beam flange of 133mm or greater.



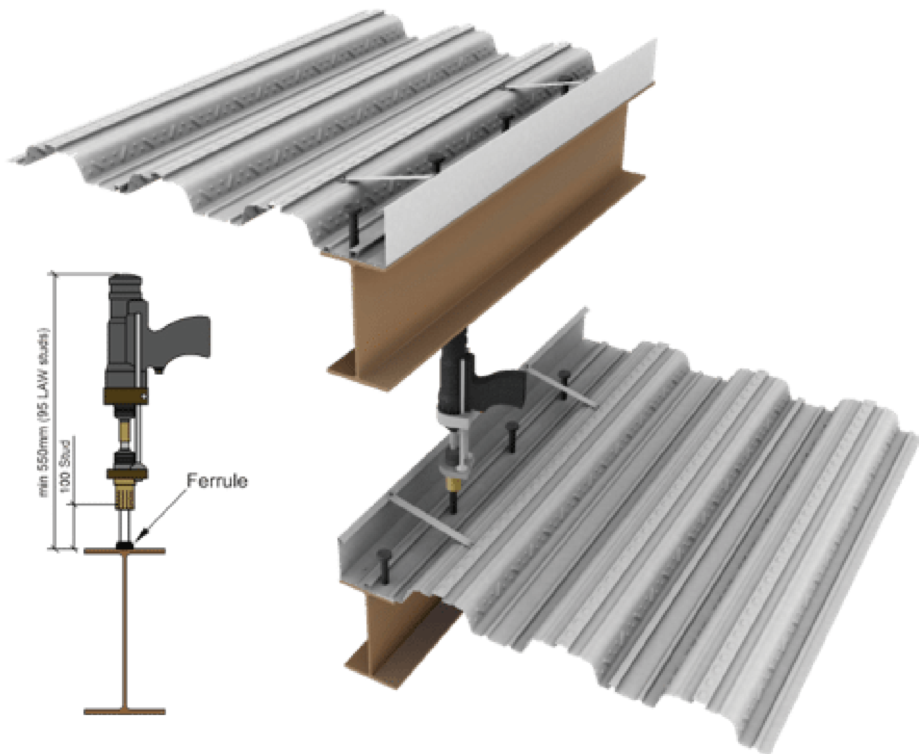
Staggered studs

Studs at butt joints to be staggered.



Practical implications during installation

From an installation perspective, a clear height of 450mm + stud length (before weld is required), normally a dimension of 570mm. Overhead obstructions can include steps in level, beams, overhanging slabs, cladding or services.



For all sections to receive welded studs, the top surface must be free of contaminants, paint and rust.

Poor connection between studs and beam due to paint contaminants, mean that the weld cannot be concentrated into a localized area inside the ferrule resulting in an erratic weld patter and ultimately a failure of the stud. If the underside of the top flange is painted, then welding can cause blistering which will require remedial work for aesthetic reasons (or safety reasons if intumescent paint has been used). It is also important to note that galvanized sections cannot be welded to.