Site welding of the shear studs to the beam requires the top surface of the beam flange to be left unpainted during fabrication. When decking ribs run perpendicular to the beam, areas will remain unpainted following completion. This is not a problem unless the beam is in a corrosive environment (for example outdoors, or part of a swimming pool roof). The same areas of the beam may also be left free from fire protection for many situations[49]. This is because the steel top flange is near to the plastic neutral axis and therefore makes a relatively minor contribution to the moment resistance of the composite section.

An alternative to through-deck site welding is to weld the studs to the beam in the fabricator's works. This may have implications for the fabrication programme. If the designer specifies shop welding, holes must be cut in the decking so it can pass over the studs. Alternatively, the steel decking must be cut on site at each beam and butted-up to the line of studs. As a consequence, all the decking is simply supported, reducing its efficiency, and the ends of the decking ribs must be sealed to prevent concrete loss during casting of the deck. Shop welding is not often adopted in the UK.

Test procedures are specified in the NSSS for ensuring that the studs are correctly welded to the beam flange, and therefore provide shear resistance and ductility which are compatible with the designer's calculations. All welds should be visually inspected. In addition, at least 5% of the studs should be bent a lateral distance equal to approximately one quarter of the stud height using a hammer. The welds are then checked for any signs of cracking or lack of fusion. There is no need to straighten these studs after testing. Weld quality may also be assessed by tapping the studs with a hammer and listening to the ringing tone.

Occasionally, when site conditions dictate, shot-fired shear connectors may be used (Figure 1). These eliminate the need for site welding, and so are appropriate in certain circumstances:

- small projects where the limited number of connectors does not justify the semi-skilled labour and plant needed for welding studs,
- when it is not possible to adequately clean and dry the flange before the connectors are fixed.

As for welded studs, the designer must respect codified rules for the layout of the connectors; the transverse spacing (perpendicular to the beam axis) between connectors must be at least 50 mm, and the longitudinal spacing between 100 mm to 600 mm.

The principal disadvantage of shot-fired connectors, which currently (1996) cost approximately £l per applied connector, is that they only have around half the strength of a 19 mm welded stud. Provided a sufficient number are needed, 19 mm welded studs can be fixed for a similar price.

6.4.3 Decking

Some typical examples of decking profiles are shown in Figure 6.8. These fall into two basic categories, dovetail and trapezoidal. The designer's choice of decking is influenced by several factors, as discussed below.

The required fire resistance of a slab is achieved by limiting the conduction of heat to the upper surface of the slab, and by including within the slab an appropriate amount of reinforcement. The conduction is affected by the insulating thickness of concrete, the decking profile, and the type of concrete. The designer must specify an appropriate combination of thickness, decking and concrete to achieve the required fire resistance. Table 6.1 quantifies insulation thickness requirements for different cases, but structural considerations will often determine the final slab thickness.

The amount of reinforcement required in a slab depends not only on the loading, but also on the required fire resistance. Normally a single layer of mesh (minimum A142) is needed. For additional information see Reference 49.

Table 6.1 *Insulation thickness requirements (all values for lightweight concrete)*

Fire resistance period	Insulation thickness * (mm)	
(hours)	Trapezoidal	Dovetail
0.5	50	90
1.0	60	90
1.5	70	105
2.0	80	115
3.0	100	135
4.0	115	150

* For trapezoidal profiles the insulation thickness is the depth of concrete above the top of the decking ribs. For dovetail profiles it is the overall depth of slab.

The self weight of the slab clearly depends on the volume of concrete used. This is a function of the slab thickness and the decking profile, which determines the volume of voids in the slab. Slab thickness is primarily a function of structural and fire resistance requirements. Dovetail profiles generally require a shallower overall slab depth for a given fire resistance.

The form of the decking ribs has an influence on the ease with which services can be hung from the ceiling. Several profiles offer the facility to fix hangers within the ribs. This may be a particularly useful feature, because services can then be suspended from virtually any part of the soffit.

When decking is present, the capacity of the shear connectors is influenced by the orientation and geometry of the decking ribs. For ribs running perpendicular to the axis of the beam, the connector capacity is less in a rib which is narrow relative to its own height (see Figure 6.9a), or a rib which is high relative to the connector height (see Figure 6.9b). This may have an influence, albeit small, on the number of connectors which are needed. Connector strength is also reduced when there are multiple connectors per rib (see Figure 6.9c).