

This Sheet Has Been Replaced



- 1 -

A REINFORCING COMPONENT

The present invention relates to a reinforcing component for a composite element for the building industry and to a composite element which incorporates the reinforcing component.

The term "composite element" is understood herein to mean a beam, preferably but not necessarily formed from steel, and a solid or composite slab that are interconnected by shear connections to act together to resist action effects as a single structural member.

The term "shear connection" is understood herein to mean an interconnection between a beam and a solid or composite slab which enables the beam and the slab to act together as a single structural member.

In conventional composite elements, typically, the shear connections include: (a) shear connectors, such as studs or reinforcing bar ligatures, (b) slab concrete, and (c) transverse reinforcement.

The term "shear connector" is understood herein to mean a mechanical device such as a stud attached to a beam which forms part of the shear connection.

In particular, the present invention relates to composite elements of the type that includes the following components:

- (a) a horizontal beam (typically but not necessarily steel) supported at each end;
- (b) a composite slab positioned on and supported by the beam and including:

This Sheet Has Been Replaced



- 2 -

(i) sheeting, preferably profiled
(typically but not necessarily steel) ;

(ii) concrete cast on the sheeting; and

(iii) reinforcement embedded in the concrete;
and

(c) a plurality of shear connectors, typically
in the form of headed studs, embedded in the
concrete and extending through the sheeting
or adjacent to the ends or sides of the
sheeting and connected to the beam thereby
to connect the composite slab to the beam.

The present invention is concerned particularly
with reinforcing the type of composite element described
above so that the composite element has sufficient shear
capacity at the interface between the beam and the slab of
the composite element to accommodate forces arising from
compressive or tensile stresses caused by flexure of the
beam to prevent premature shear failure (hereinafter
referred to as "longitudinal shear failure") of the
composite element.

The conventional reinforcement for preventing
longitudinal shear failure in the type of composite
elements described above includes deformed reinforcing bars
or welded wire fabric embedded in a horizontal position in
the concrete of composite slabs. These reinforcing
components are typically arranged to extend transversely to
the longitudinal axis of the beam and therefore cross
potential longitudinal shear surfaces and by this mechanism
are known to contribute to the shear capacity of composite
elements.

An object of the present invention is to provide

This Sheet Has Been Replaced



- 3 -

a shear reinforcing component which is an alternative to and has advantages over the conventional reinforcement described in the preceding paragraph.

5 According to the present invention there is provided a shear reinforcing component for a composite element for the building industry, which shear reinforcing component is a flat sheet of mesh that includes a plurality of parallel reinforcement members that are interconnected
10 by members that are "non-structural" as described herein but have sufficient strength and stiffness to support the reinforcement members.

 The term "non-structural" means that the members
15 do not provide a major reinforcement function when embedded in a slab of a composite element.

 In a situation where the composite element includes a horizontal beam and profiled sheeting that has
20 pans separated by parallel ribs with the ribs transverse to the longitudinal axis of the beam, the reinforcing component can be positioned (prior to pouring concrete onto the sheeting to complete construction of the composite element) with the reinforcement members positioned between
25 the ribs and extending parallel to the ribs and the non-structural members contacting the ribs and spanning the spaces between the ribs and supporting the reinforcement members. In this situation it is not necessary to mount the reinforcing component (and more particularly the
30 reinforcement members) on chairs or other supports in order to position the reinforcement members in an optimum position.

 Preferably the non-structural members are wires
35 that enable the reinforcing component to have the form of a flat sheet mesh and to be handled as a flat sheet of mesh.

This Sheet Has Been Replaced



- 4 -

Preferably the non-structural members are wires of 1-8mm in diameter.

Preferably the non-structural members are wires of at least 3mm in diameter.

Preferably the reinforcement members are deformed bars.

Preferably the bars are at least 10mm in diameter.

Preferably the reinforcement members are deformed steel bars having a yield stress of at least 400MPa.

More preferably the reinforcement members are deformed steel bars having a yield stress of at least 450 MPa.

Preferably the ratio of the diameter of the bars and the wires is at least 5:1.

According to the present invention there is also provided a composite element which includes:

- (a) a beam;
- (b) a composite slab positioned on the beam, the composite slab including:
 - (i) sheeting;
 - (ii) concrete cast on the sheeting;
- (c) a plurality of shear connectors which connect the composite slab to the beam; and

This Sheet Has Been Replaced



- 5 -

(d) a shear reinforcing component embedded in the concrete slab, the reinforcing component being a flat sheet of mesh that includes a plurality of parallel reinforcement members which are transverse to the longitudinal axis of the beam and a plurality of members that are "non-structural" as described herein and interconnect the reinforcement members.

Preferably the sheeting has a plurality of pans separated by parallel ribs.

The sheeting may be positioned so that the ribs are parallel to or transverse to the longitudinal axis of the beam.

In a situation where the composite element includes a horizontal beam and profiled sheeting that has pans separated by parallel ribs with the ribs transverse to the longitudinal axis of the beam, preferably the reinforcing component is positioned with the reinforcement members positioned between the ribs and extending parallel to the ribs and the non-structural members contacting the ribs and spanning the spaces between the ribs.

Preferably the reinforcement members are embedded in the slab below upper ends of the shear connectors.

Preferably the beam is a steel beam.

Preferably the beam is supported at each end.

In one embodiment, it is preferred that the beam be an internal beam.

In another embodiment, it is preferred that the



beam be a perimeter beam.

It is preferred that the composite element further includes reinforcement such as welded wire fabric
5 embedded in the concrete of the composite slab.

It is preferred that the shear connectors be headed studs. The shear connectors may be of any other suitable form such as structural bolts or channels.
10

The present invention is described further by way of example with reference to the accompanying drawings in which:

15 Figure 1 is a perspective view which illustrates, in simplified form, a preferred embodiment of a longitudinal shear reinforcing component of the present invention located as a part of a preferred embodiment of a composite element of the present invention; and

20 Figure 2 is an elevation of the composite element shown in Figure 1 in the direction of the arrow A in Figure 1.

25 The preferred embodiment of the composite element in accordance with the present invention that is shown in the figures and is identified generally by the numeral 3 is in a simplified form to illustrate the composite element 3 more clearly.

30 With reference to the figures, the composite element 3 includes:

35 (a) a horizontally extending hot-rolled or fabricated steel beam 5 which is supported at each end;



(b) a composite slab including:

- 5
- (i) profiled steel sheeting 7 in contact with a top flange 9 of the steel beam 5, the sheeting 7 including a plurality of parallel steel ribs 11 separated by pans 13 and being positioned so that the ribs 11 extend in a direction that is transverse to the longitudinal axis of the beam 5; and
- 10
- (ii) concrete (shown only by the dotted line in Figure 2 illustrating an upper surface of the concrete) cast on the sheeting 7;
- 15
- (c) a plurality of shear connectors in the form of headed studs 15 which extend through the sheeting 7 and are welded to the top flange 9 of the beam 5; and
- 20
- (d) the preferred embodiment of the longitudinal shear reinforcing component embedded in the concrete slab for preventing premature longitudinal shear failure of the composite beam 3.
- 25

The preferred embodiment of the longitudinal shear reinforcing component is a flat sheet of mesh that

30 includes:

- (a) a plurality of reinforcing members (only two of which are shown) in the form of 700mm long, 10mm diameter bars 21 that extend
- 35 transversely to the longitudinal axis of the beam 5 and parallel to the ribs 11 of the sheeting 7 and are spaced apart by 400mm;



and

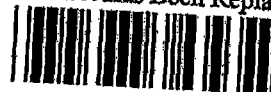
- 5 (b) a pair of "non-structural" members in the form of a 2.4m long, 2mm diameter guide wires 23 that are spaced apart by 300mm and are welded to the bars 21 and thereby interconnect the bars 21.

10 The guide wires 23 are selected so as to be able to support the bars 21 in the positions shown in the figures in close proximity to the studs 15 prior to and while concrete is being cast onto the sheeting 7 to form the composite element 3.

15 Specifically, the guide wires 23 are selected so that, prior to casting the concrete, the reinforcing component can be positioned with the guide wires 23 extending across the ribs 11 and supporting the bars 21 above the pans 13 closely adjacent the studs 15 and below
20 the level of the heads of the studs 15.

In overall terms, the guide wires 23 are "non-structural" in the sense that the members do not provide a reinforcement function in the composite element 3. In this
25 context, such a reinforcement function is unnecessary when the composite element 3 is used as described in relation to the figures.

The above-described reinforcing component greatly
30 improves the efficiency of reinforcing around the studs 15. Consequently, it is possible to achieve materials savings of the order of 40% compared to conventional reinforcing mesh. It is also possible to achieve significant labor savings in constructing composite elements. In addition,
35 congestion of reinforcement in thin cover slabs can be avoided while maintaining minimum concrete cover.



The beam 5 and the composite slab may be of any suitable dimensions and construction. Typically, the composite slab has an overall thickness of at least 120mm. In addition, whilst the sheeting 7 shown in the figures has a dovetail profile, the sheeting 7 may be trapezoidal or any other suitable shape.

When a structural composite element 3 of the basic type shown in the figures is loaded, longitudinal slip is induced between the composite slab and the beam 5 which is resisted by the shear connection between these components.

In a conventional structural composite element (ie without the preferred embodiment of the reinforcing component) the shear connection typically includes:

- (a) the studs 15;
- (b) the concrete of the composite slab; and
- (c) conventional horizontal reinforcement (not shown) in the vicinity of the shear connectors 15.

In the conventional structural composite element the shear connection also includes the sheeting 7 if the sheeting is attached by some means to the steel beam 5, for example by puddle welds.

However, in accordance with the present invention, the shear connection of the structural composite element also includes the reinforcing component as shown in the figures.

Many modifications may be made to the preferred embodiment of the reinforcing component and the composite

This Sheet Has Been Replaced



- 10 -

element shown in the figures without departing from the spirit and scope of the present invention.

By way of example, the present invention is not
5 limited to the dimensions of the reinforcing component described above. Typically, the centre-centre spacing of the bars 21 may vary from 100-600mm with 50mm increments.

By way of further example, the present invention
10 extends to arrangements in which the profiled steel sheeting is positioned with the ribs extending parallel to the longitudinal axis of the beam.

Furthermore, by way of example, the present
15 invention extends to arrangements in which the beam is an edge beam and the reinforcing members are formed with hair pin bends at the ends of the beams to reduce the anchorage length of the reinforcing members.

Furthermore, by way of example, the present
20 invention extends to arrangements in which there is a non-uniform spacing of the reinforcing members.



Claims:

1. A shear reinforcing component for a composite element for the building industry, which shear reinforcing component is a flat sheet of mesh that includes a plurality of parallel reinforcement members that are interconnected by members that are "non-structural" as defined herein but have sufficient strength and stiffness to support the reinforcement members.
2. The reinforcing component defined in claim 1 wherein the non-structural members are wires which enable the reinforcing component to have the form of a flat sheet of mesh and to be handled as a flat sheet of mesh.
3. The reinforcing component defined in claim 2 wherein the non-structural members are wires of 1-6mm diameter.
4. The reinforcing component defined in any one of claim 2 or claim 3 wherein the non-structural members are wires of at least 3mm diameter.
5. The reinforcing component defined in any one of the preceding claims wherein the reinforcement members are deformed bars.
6. The reinforcing component defined in claim 5 wherein the bars are at least 10mm diameter.
7. The reinforcing component defined in any one of the preceding claims wherein the reinforcement members are deformed steel bars having a yield stress of at least 400MPa.
8. The reinforcing component defined in any one of the claims 2 to 7 wherein the ratio of the diameter of the





- 12 -

bars and wires is at least 5:1.

9. A composite element which includes:

- 5 (a) a beam;
- (b) a composite slab positioned on the beam, the composite slab including:
 - 10 (i) sheeting;
 - (ii) concrete cast on the sheeting;
- 15 (c) a plurality of shear connectors which connect the composite slab to the beam; and
- (d) a shear reinforcing component embedded in the concrete slab, the reinforcing component being a flat sheet of mesh that includes a
 - 20 plurality of parallel reinforcement members which are transverse to the longitudinal axis of the beam and a plurality of members that are "non-structural" as defined herein and which interconnect the reinforcement
 - 25 members.

10. The composite element defined in claim 9 wherein the sheeting has a plurality of pans separated by parallel ribs.

30

11. The composite element defined in claim 10 includes a horizontal beam and profiled sheeting that has pans separated by parallel ribs with the ribs transverse to the longitudinal axis of the beam and the reinforcing component is positioned with the reinforcement members positioned between the ribs and extending parallel to the ribs and the non-structural members contacting the ribs and



This Sheet Has Been Replaced



- 13 -

spanning the spaces between the ribs.

12. The composite element defined in any one of
claims 9 to 11 wherein the reinforcement members are
5 embedded in the slab below upper ends of the shear
connectors.

13. A shear reinforcing component substantially as
hereinbefore described with reference to the accompanying
10 drawings.

14. A composite element substantially as hereinbefore
described with reference to the accompanying drawings.



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