

**PRECAST FLOOR SLAB COMPOSED OF A STEEL PLATE
AND CONCRETE AND JOINT STRUCTURE THEREOF**

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a precast floor slab composed of a steel plate and concrete. More particularly, this invention relates to a precast floor slab composed of a steel plate and concrete in which high-strength bolts friction-jointed to the steel plate as used as shear connector structure are used and jointing portions of precast floor slabs are friction-jointed each other by means of the high-strength bolts together with an auxiliary plate, the high-strength bolts being used as a shear connector inclusively.

Prior Art

Bridge floor slabs include a cast-in-place slab in which form assembling, reinforcing and concrete placing processes are conducted on the field, and a precast floor slab in which such processes as described above are carried out in advance in the shop and then brought to the field.

The present invention provides a novel precast floor slab composed of a steel plate and concrete above all.

Conventionally, as shown in Fig.7, a precast floor slab composed of a steel plate and concrete is prepared by welding shear connectors 13 of stud type, pipe type and the like at predetermined intervals on a concrete placing portion 12a of a steel plate 12 of predetermined size comprising the concrete placing portion and a



jointing portion, and then placing concrete on the concrete placing portion 12a. Two panels are connected each other by opposingly facing each jointing portion 12b, welding an attaching plate 14 on an undersurface of the jointing portion 12b and then placing concrete thereon so as to keep continuity of the steel plate 12. In Fig. 7, there is shown a situation where concrete is not placed on the jointing portions, numerals 17 and 18 designating reinforcing bars.

Operation of welding considerably depends on welder's skill and is easily influenced by operating environment including wind, ambient temperature around the site in the case of field welding. Such disadvantages make deck welding less reliable. Further, distortion (internal stress) and change in hardness derived from welding would decrease the resistance to fatigue of decks.

On the other hand, structural continuity of jointed decks is weakened because of difference between structure of main body and that of jointing portions.

Accordingly, it is an object of the present invention to solve these conventional problems by applying the following deck and joint structure thereof in which fixture of shear connectors to a steel plate and connection of each steel plates are conducted without welding.

SUMMARY OF THE INVENTION

To achieve the above mentioned object, there is provided a precast floor slab composed of a steel plate and concrete, in which high-strength bolt holes are formed on the steel plate at predetermined intervals, high-strength bolts are inserted in the



high-strength bolt holes and fitted with nuts to form shear connectors, and then concrete is placed thereon.

There is also provided joint structure of a precast floor slab composed of a steel plate and concrete, in which jointing portions of precast floor slabs to be connected are opposingly faced each other, a splice plate, which has high-strength bolt holes corresponding to those high-strength bolt holes formed on the jointing portions, is attached on an undersurface of the jointing portions, high-strength bolts are inserted in the high-strength bolt holes and fitted with nuts to form shear connectors, precast floor slabs to be jointed are connected each other, and then concrete is placed thereon.

As the high-strength bolts used in the present invention are friction-jointed, each bolt functions as reliable shear connector structure of the floor slab composed of a steel plate and concrete without decreasing the resistance to fatigue which has been inevitable to conventionally welded shear connectors because of distortion and change in hardness thereof.

As the jointing portions of precast floor slabs to be connected are opposingly faced each other in the joint structure, attached by the splice plate on the undersurface thereof and friction-jointed by means of the high-strength bolts similarly as the concrete placing portion, structure of the concrete placing portion and the joint structure are about the same, thereby improving continuity of both structure as a whole and, because of the same shear connector structure, improving reliability.

As has been described above, effects of the present



invention are as in the following.

According to Claim 1, because the high-strength bolts are friction-jointed by driving nuts from both surfaces of the steel plate, fixing of shear connectors is not affected conventionally by a welder's skill and can be conducted conveniently without a decrease in the resistance to fatigue caused by distortion (internal stress) and change in hardness due to a welding operation.

According to Claim 2, because of such structure that the jointing portions of the precast floor slabs to be connected by means of the joint structure are opposingly faced each other, attached with the auxiliary plate thereunder and friction-jointed by the high-strength bolts similarly as in the case of the concrete placing portion, it is possible to avoid conventional problems arising from field welding conditions such as wind, ambient temperature, etc. as well as other inconvenience accompanied by welding, thereby rendering structure of the concrete placing portion and the jointing portions substantially identical and improving continuity thereof as a whole.

Accordingly, a reliable shear connected-structured precast floor slab composed of a steel plate and concrete and joint structure thereof can be provided by the present invention.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a section taken on line A-A in Fig. 2, showing a precast floor slab composed of a steel plate and concrete.

Fig. 2 is a plan view of the precast floor slab composed of a steel plate and concrete.

Fig. 3 is a section taken on line B-B in Fig. 4, showing



joint structure of a precast floor slab to be connected.

Fig. 4 is a plan view of joint structure of a precast floor slab to be connected.

Fig. 5 is a section showing how to fix a high-strength bolt.

Fig. 6 is a section of an another embodiment how to fix a high-strength bolt.

Fig. 7 is a section of a conventional precast floor slab composed of a steel and concrete and joint structure thereof.

DETAILED DESCRIPTION AND THE PREFERRED EMBODIMENTS

The present invention will be described in detail by referring the drawings.

In Fig. 1, only outlines of placed concrete are drawn and inside thereof is shown as if concrete is not placed for convenience.

An embodiment of a precast floor slab 1 is shown in Figs. 1 and 2. A steel plate 2 is consisted of a concrete placing portion 2a and a jointing portion 2b and may have arbitrary size decided by considering conditions of a bridge where floor slabs thereon are replaced and effective conveyance of the panel.

Bolt holes 9 for high-strength bolts 3 are formed on the steel plate at predetermined intervals. In Fig. 2, the high-strength bolt holes 9 formed on the concrete placing portion 2a are invisible because the high-strength bolts 3 are inserted therein. Distances of the high-strength bolt holes 9 are different between the concrete placing portion 2a and the joint portion 2b in Fig. 2.

The high-strength bolt 3 is fitted with a washer 6a and a nut 5a at a downward portion thereof and inserted from upside of the



concrete placing portion 2a in the high-strength bolt hole 9 formed thereon as shown in Fig. 5. The high-strength bolt 3 is then fitted with a washer 6b and a nut 5b from downside and fixed to the concrete placing portion 2a by driving these nuts 5a and 5b from both sides so that the bolt 3 functions as a shear connector. Fixing of the high-strength bolt 3 is not limited to the above mentioned manner but may be conducted, for example, by inserting the bolt 3 from downside of the concrete placing portion 2a to the bolt hole 9 and driving a nut 5c from upside, as shown in Fig. 6 in which numeral symbols 6c and 6d designate washers. In either case, predetermined axial force is added to the high-strength bolt 3 to stock the frictional resistance required. Height of the high-strength bolt 3 is preferably within a range from a neutral axis level to an upper covering thickness of concrete to be placed.

Reinforcing bars 7 and 8 are then arranged above the steel plate 2 while side forms are assembled, followed by placing concrete 10 thereon. The forms are assembled to leave the jointing portions 2b at both sides of the steel plates 2 to the axial direction of a bridge for connecting neighboring precast floor slabs 1, a single jointing portion being left at one side of the steel plate in case of an outmost panel. The forms are removed after the concrete is placed.

In this manner, there is prepared the precast floor slab 1 composed of a steel plate and concrete.

Joint structure for connecting precast floor slabs each other is shown in Figs. 3 and 4.

In order to provide the joint structure, first of all, the

steel plate jointing portions 2b of the above mentioned precast floor slabs 1 are opposingly faced each other, while reinforcing bars 8 directed to the bridge axis are overlapped (the bars 8 are conventionally arranged in advance to overlap each other).

After a splice plate 4, which has high-strength bolt holes 9 corresponding to those high-strength bolts formed on the jointing portions 2b, is attached on the undersurface of the portions 2b, the headed high-strength bolts 3 fitted with a washer 6a and a nut 5a at downward portion are inserted in holes 9 from upper side thereof, the high-strength bolt holes 9 being invisible because of the inserted bolts 3 in Figs. 3 and 4. A washer 6b and a nut 5b are then fitted to the high-strength bolts 9 from underside of the auxiliary plate 4 and driven to fasten thereof from both sides together with the nut 5a. The high-strength bolts 3 are thus fixed as a shear connector to the jointing portions 2a, thereby both portions 2a of the precast floor slabs 1 to be connected being friction-jointed each other. As a matter of course, the high-strength bolts 3 may be fixed in any other manner, for example, by way of fixing described in Fig. 4. Preferably, height of the high-strength bolts 3 is within a range from the neutral axis level to the upper covering thickness.

After reinforcing bars 7 are arranged, concrete is placed on the jointing portions 2b to complete the joint structure. Fig. 3 shows a situation where concrete is not placed.



THIS SHEET HAS BEEN
REPLACED

What is claimed is:

1. A precast floor slab composed of a steel plate and concrete, characterized in that high-strength bolt holes are formed on the steel plate at predetermined intervals, high-strength bolts are inserted in the high-strength bolt holes and fitted with nuts to form shear connectors, and then concrete is placed thereon.
2. Joint structure of a precast floor slab composed of a steel plate and concrete as claimed in Claim 1, characterized in that jointing portions of precast floor slabs to be connected are opposingly faced each other, a splice plate, which has high-strength bolt holes corresponding to those high-strength bolt holes formed on the jointing portions, is attached on an undersurface of the jointing portions, high-strength bolts are inserted in the high-strength bolt holes and fitted with nuts to form shear connectors, precast floor slabs to be jointed are connected each other, and then concrete is placed thereon.

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Fig. 2

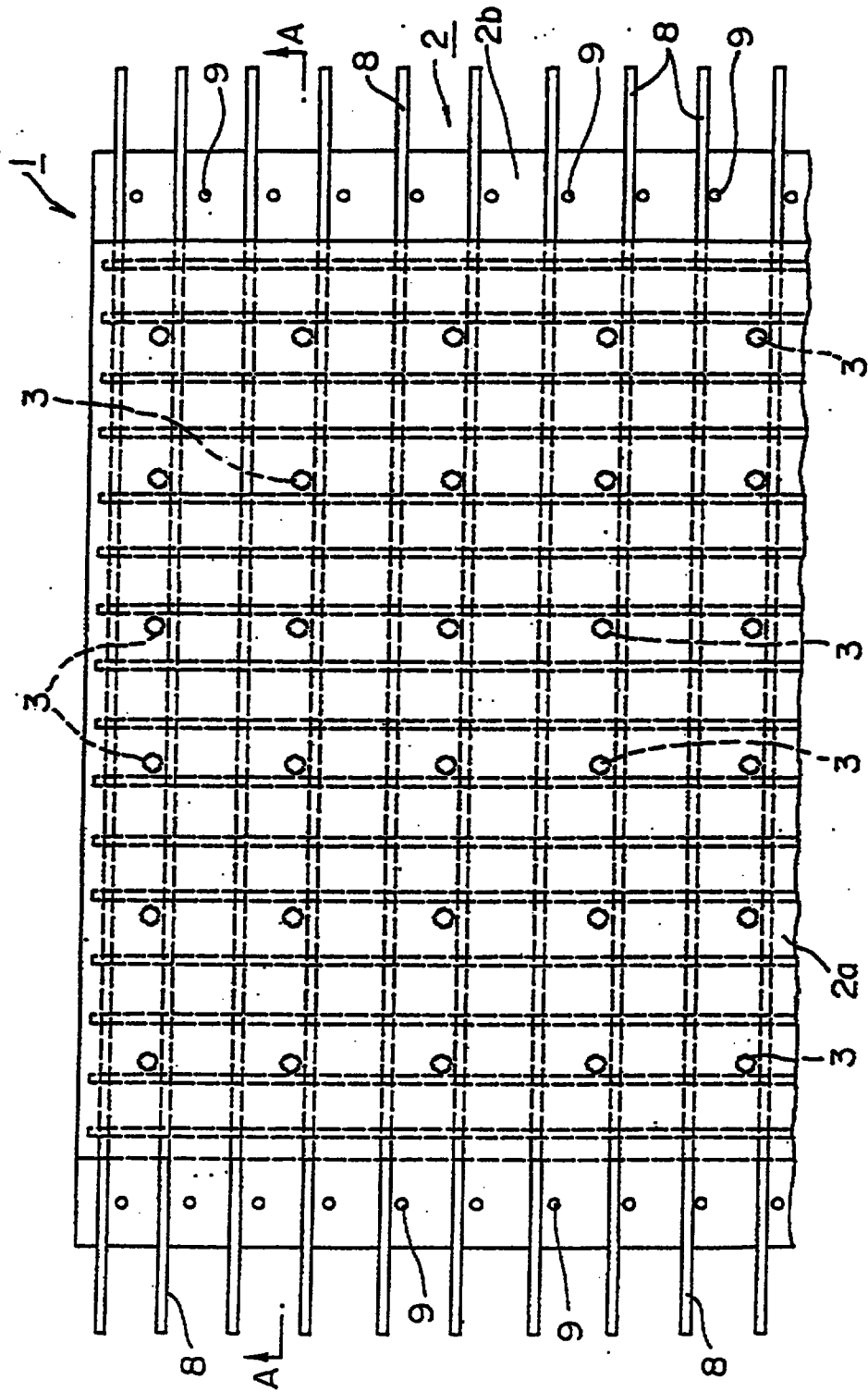


Fig. 3

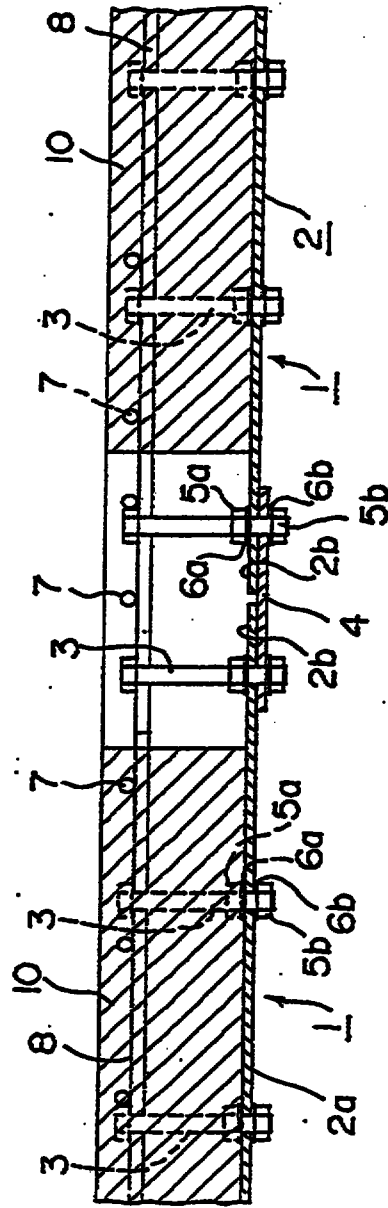


Fig. 4

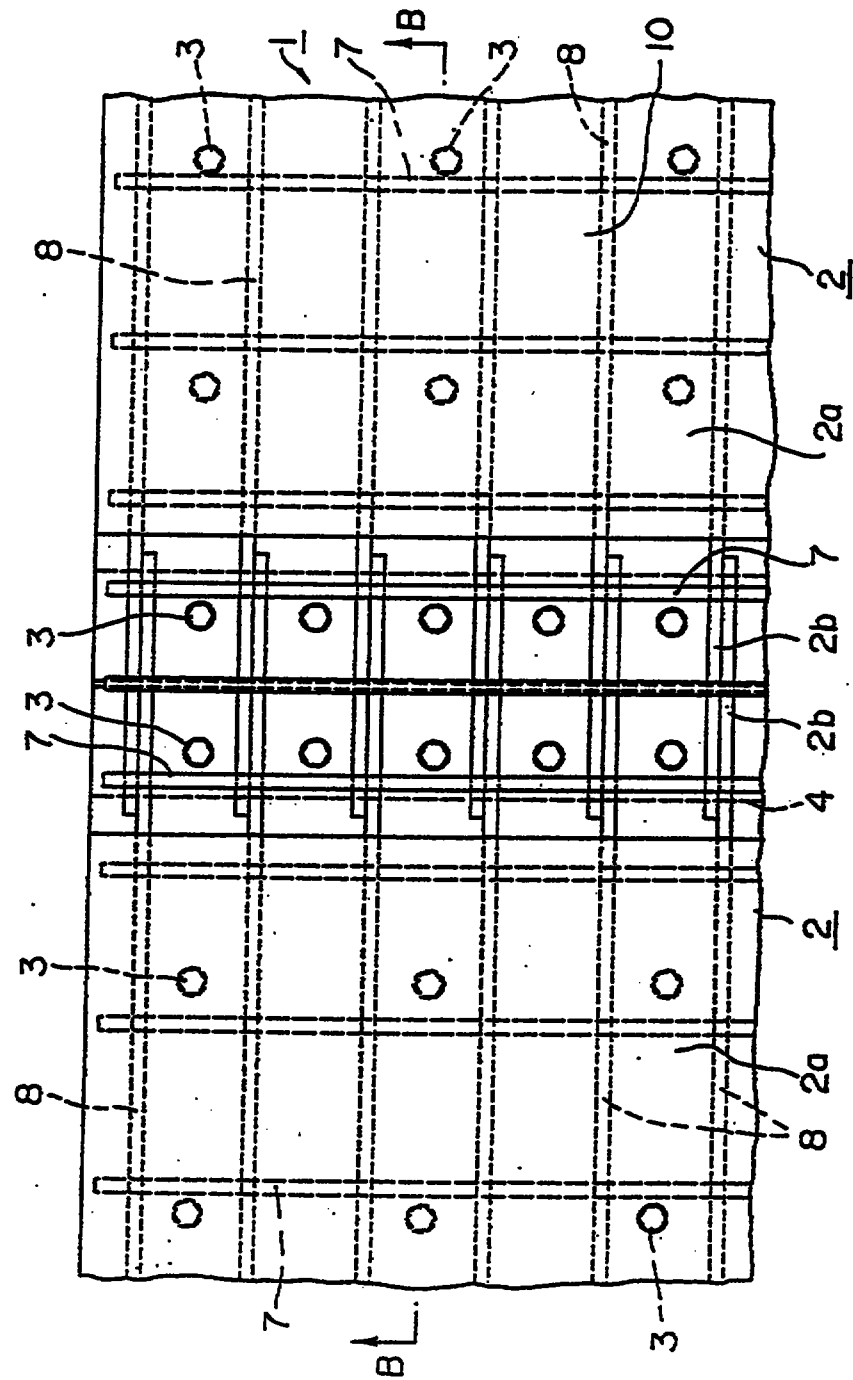


Fig. 5

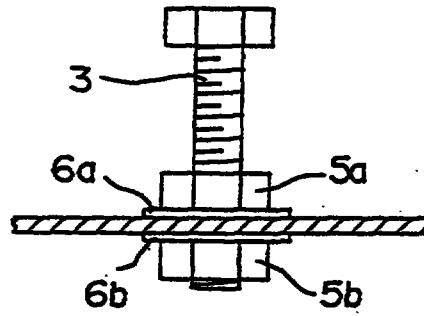


Fig. 6

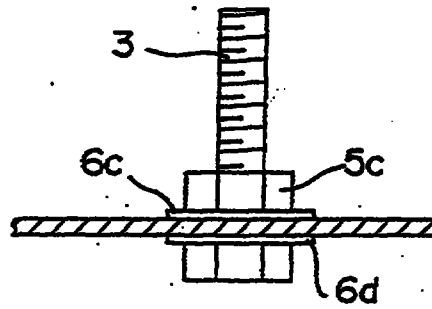
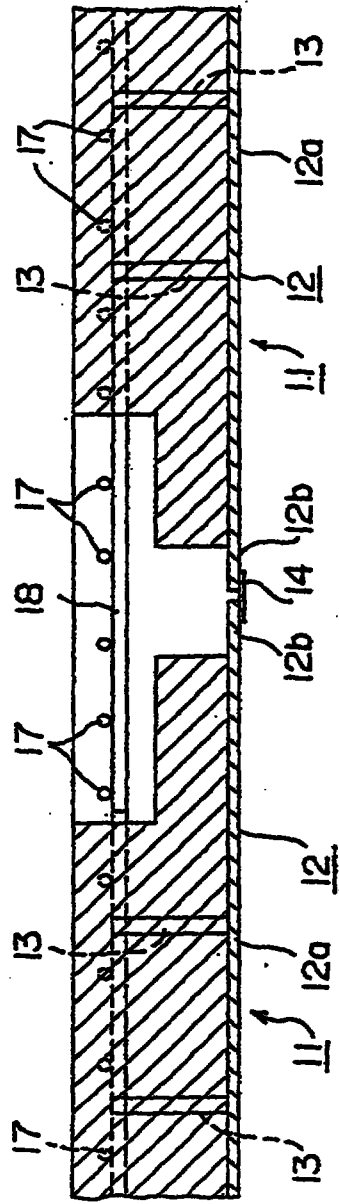


Fig. 7



ABSTRACT

PRECAST FLOOR SLAB COMPOSED OF A STEEL PLATE
AND CONCRETE AND JOINT STRUCTURE THEREOF

A precast floor slab composed of a steel plate and concrete and joint structure thereof in which friction-jointed high-strength bolts are used as shear connectors, while a splice plate is attached to jointing portions of precast floor slabs to be connected and is friction-jointed with the high-strength bolts, the high-strength bolts playing a roll of shear connectors.

(Figure 3)

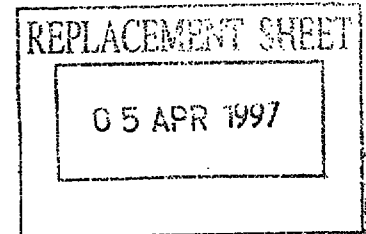
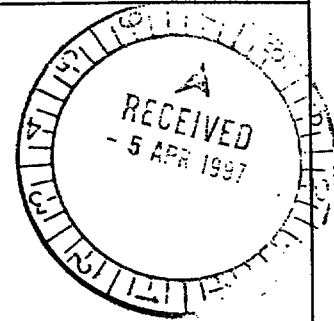


Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

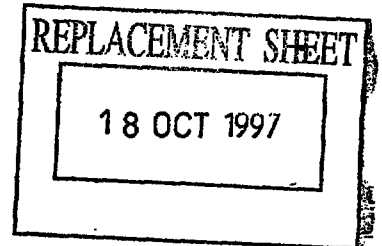
ABSTRACT

PRECAST FLOOR SLAB COMPOSED OF A STEEL PLATE
AND CONCRETE AND JOINT STRUCTURE THEREOF

A precast floor slab (1) composed of a steel plate (2) and concrete (10) and joint structure thereof in which friction-jointed high-strength bolts (3) are used as shear connectors, while a splice plate (4) is attached to jointing portions of precast floor slabs to be connected and is friction-jointed with the high-strength bolts (3) the high-strength bolts (3) playing a roll of shear connectors.



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FLOOR SLAB ASSEMBLY

The present invention relates to a floor slab assembly using precast floor slabs made of steel plate and concrete.

Bridge floor slabs include a cast-in-place slab for which form assembling, reinforcing and concrete placing processes are conducted in the field, and a precast floor slab in which such processes are carried out in advance in the shop and then brought into the field.

Conventionally, as shown in Fig. 7, a precast floor slab composed of a steel plate and concrete is prepared by welding shear connectors 13 of stud type, pipe type and the like at predetermined intervals on a concrete placing portion 12a of a steel plate 12 of predetermined size comprising the concrete placing portion and a

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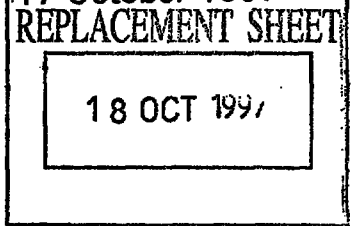
joint portion, and then placing concrete on the concrete placing portion 12a. Two panels are connected by opposingly facing the joint portions 12b, welding an attaching plate 14 on an undersurface of the joint portions 12b and then placing concrete thereon so as to keep continuity of the steel plate 12. In Fig. 7, there is shown a situation where concrete is not placed on the joint portions, numerals 17 and 18 designating reinforcing bars.

Operation of welding considerably depends on welder's skill and is easily influenced by operating environment including wind and ambient temperature around the site in the case of field welding. Such disadvantages make deck welding less reliable. Further, distortion (internal stress) and change in hardness derived from welding would decrease the resistance to fatigue of decks.

On the other hand, structural continuity of jointed decks is weakened because of difference between structure of main body and that of joint portions.

Accordingly, it is an object of the present invention to solve these conventional problems by providing a floor slab assembly in which fixture of shear connectors to a steel plate and connection of steel plates are conducted without welding.

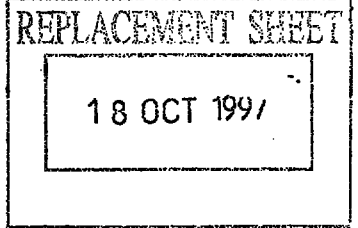
According to the present invention, there is provided a floor slab assembly comprising first and second precast floor slabs each comprising: a steel plate having bolt holes at predetermined intervals; high-strength bolts inserted in the bolt holes and fitted with nuts to form shear connectors; and a concrete layer into which the bolts project; wherein: edge portions of the steel plates of the floor slabs are side by side; and a splice plate which has bolt holes is attached to the undersurfaces of the edge portions of the steel plates by high-strength bolts which are inserted through bolt holes in the splice plate and the edge portions, are fitted with nuts to form shear connectors, and project into a concrete infill strip between the concrete layers of the floor slabs.



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As the high-strength bolts are friction-jointed, each bolt functions as a reliable shear connector structure of the floor slab without decreasing the resistance to fatigue which has been inevitable with conventionally welded shear connectors because of distortion and change in hardness thereof. Also, fabrication of the floor slab assembly is not reliant on a welder's skill and it is possible to avoid conventional problems arising from field welding conditions such as wind, ambient temperature, etc. as well as other inconveniences which accompany welding.

Because the structures of the concrete layers and the concrete infill strip are about the same, this improves the continuity of the structure as a whole and, because of the common shear connector structure, improves the reliability.



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A non-limiting embodiment of a floor slab assembly in accordance with the present invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a section taken on line A-A in Fig. 2, showing a precast floor slab of the floor slab assembly;

Fig. 2 is a plan view of the precast floor slab;

Fig. 3 is a section taken on line B-B in Fig. 4, showing the floor slab assembly;

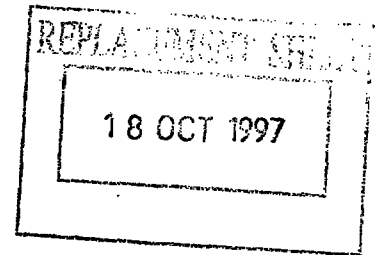
Fig. 4 is a plan view of the floor slab assembly;

Fig. 5 is a section showing how to fix a high-strength bolt;

Fig. 6 is a section of an another example of how to fix a high-strength bolt; and

Fig. 7 is a section of a conventional floor slab assembly.

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In Fig. 1, only outlines of placed concrete are drawn and inside thereof is shown as if concrete is not placed for convenience.

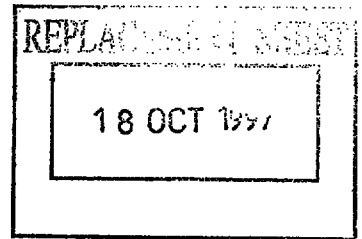
An embodiment of a precast floor slab 1 is shown in Figs. 1 and 2. A steel plate 2 is consisted of a concrete placing portion 2a and a jointing portion 2b and may have arbitrary size decided by considering conditions of a bridge where floor slabs thereon are replaced and effective conveyance of the panel.

Bolt holes 9 for high-strength bolts 3 are formed on the steel plate at predetermined intervals. In Fig. 2, the high-strength bolt holes 9 formed on the concrete placing portion 2a are invisible because the high-strength bolts 3 are inserted therein. Distances of the high-strength bolt holes 9 are different between the concrete placing portion 2a and the joint portion 2b in Fig. 2.

The high-strength bolt 3 is fitted with a washer 6a and a nut 5a at a downward portion thereof and inserted from upside of the



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CLAIMS

1. A floor slab assembly comprising first and second precast floor slabs each comprising:
a steel plate having bolt holes at predetermined intervals;
- 5 high-strength bolts inserted in the bolt holes and fitted with nuts to form shear connectors; and
a concrete layer into which the bolts project;
wherein:
edge portions of the steel plates of the floor slabs are side by side; and
- 10 a splice plate which has bolt holes is attached to the undersurfaces of the edge portions of the steel plates by high-strength bolts which are inserted through bolt holes in the splice plate and the edge portions, are fitted with nuts to form shear connectors, and project into a concrete infill strip between the concrete layers of the floor slabs.