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Title: COMPOSITE GIRDER WITH STEEL TRUSS WEB HAVING HINGE CONNECTING, AND CONNECTION STRUCTURE THEREOF

Abstract: A composite web truss girder includes an upper flange, a lower flange and a web, in which the upper and lower flanges include concrete, and the web has a truss structure of a diagonal member formed of steel. In forming a connection structure of a panel point at which steel member and the upper and lower flanges are combined, diagonal members are connected with a hinge so that the diagonal members are rotatable, and combined with each other. Then, the diagonal members are buried in the upper or lower flanges, and concrete flows into the diagonal members. Thus, assemblability of the diagonal member and the upper or lower flanges in the field may be enhanced, secure connection structure may be attained, and buckling of the diagonal member may be prevented.
Description

COMPOSITE GIRDER WITH STEEL TRUSS WEB HAVING HINGE CONNECTING, AND CONNECTION STRUCTURE THEREOF

Technical Field

The present invention relates to a composite girder with truss web including upper and lower flanges formed of concrete and a web which has a truss structure with a diagonal member formed of steel, and a connection structure of a panel point at which the steel member and the upper and lower flanges are combined.

Background Art

FIG. 1 is a schematic perspective view illustrating a bridge using a conventional composite web truss girder. As illustrated in the figure, a composite web truss girder 100 includes a web between an upper flange 101 and a lower flange 102, in which the web has a truss structure of a diagonal member 103 formed of steel. In such a composite web truss girder, it is very important how to configure a connection structure of a panel point portion at which the diagonal member 103 and the upper flange 101 or the lower flange 102 are combined.

FIG. 2 is a schematic partial side view illustrating the connection structure of the panel point portion at which the diagonal member 103 and the lower flange 102 are combined with each other in the conventional composite web truss girder. FIG. 3 is a cross-sectional view taken along a line C-C in FIG. 2. Conventionally, a steel typed connection structure using a gusset plate 110 and shear studs 120 is used as the connection structure of diagonal members 103 at the panel point. As shown in FIGS. 2 and 3, the diagonal members 103 formed of steel and obliquely disposed at both sides are bolt-combined with the gusset plate 110 in a rigid joint type manner at the panel point portion.

Thus, in the conventional composite web truss girder, before the web having a truss structure is combined with the upper and lower flanges, the diagonal member 103 is combined with the gusset plate 110 in a rigid joint type, in which the diagonal member 103 is not rotatable and vertically and horizontally displaced with respect to the gusset plate 110. Thus, the connection structure of the rigid joint type incurs some troubles in construction as follows.

When the precut diagonal member 103 is connected to the gusset plate 110, the case where the angle of an inclined face of an end portion of the diagonal member 103 does not coincide with a bolt-coupling hole formed at the gusset plate 110 occurs frequently. In this case, it is impossible to bolt-combine the end portion of the diagonal member
103 with the gusset plate 110.

Also, there are cases where a plurality of diagonal members 103 are connected to the gusset plate 110 in advance, so that bellies are formed in a unit type having a pre-determined length and moved to the filed. In the field, the pluralities of web units are vertically assembled to form a proper girder for an entire bridge. When the web unit manufactured at the plant is moved to the field, a stress is concentrated at a joint between the diagonal member 103 and the gusset plate 110, so that a connection at a rigid joint between the preconnected diagonal members 103 and the gusset plate 110 is damaged. Thus, it is frequently required that the gusset plate should be repaired in the field, a bolt should be changed, or a connection method should be changed to welding.

In addition, the end of the diagonal member 103 may be welded to the gusset plate 110. In this case, welding in the field is troublesome, and much cost and many efforts are required in welding. Also, because the welding is performed at high height, it is dangerous. Furthermore, welding in the field incurs thermal transformation of the diagonal member 103.

In the above-described prior arts, the diagonal members 103 are connected in a rigid joint type through the gusset plate 110, and the gusset plate 110 is integrally shear-connected to the upper and lower flanges. Thus, the web of a truss structure using the diagonal member 103 is joined with the upper and lower flanges. Hence, the gusset plate 110 is required to be integrally shear-connected to concrete of the upper and lower flanges, and a shear stud 120 has been installed at an outer surface of the conventional gusset plate 110 to attain the shear-connection.

Generally, reinforcing bars are disposed densely in the upper and lower flanges. When the gusset plate 110 is shear-connected to the upper and lower flanges with the shear studs 120, the shear studs 120 are required to be put into the space between the reinforcing bars densely disposed in the upper and lower flanges. Thus, when concrete is poured to form the upper and lower flanges, concrete may not be filled very well in the space between the reinforcing bars and in the space between the shear studs 120 and the reinforcing bars.

In order to prevent the above problems, it may be required to use high flow concrete or non-contraction mortar at the portion in which the gusset plate 110 is installed. For this purpose, predetermined portions are required to be blocked out or concrete is required to be doubly placed. This is an inefficiency process.

In the composite web truss girder, one of the diagonal members at both sides connected to each other supports a tensile force, and another of the diagonal members supports a compressive force. Thus, only some of the shear studs 120 installed on an upper surface of the gusset plate connected in a rigid joint type serve as a shear-connector. That is, in the prior art, in which shear studs 120 are installed so as to
connect the gusset plate 110 to the upper flange or the lower flange, only some of the
shear studs 120 exert their own function, and others do not exert their own function.
This is inefficient.

[12] In addition, the above-mentioned prior arts employ many steel parts such as the
shear stud 120, the gusset plate 110, etc., so that material cost is increased.

Disclosure of Invention

Technical Problem

[13] The present invention has been made to solve the above mentioned problems
associated with the prior art. Thus, the present invention is devised to prevent decrease
in efficiency of assembly work in the field, thermal transformation of the diagonal
member due to welding in the field, low constructibility, and increase in construction
cost and construction period, which are attained by a connection structure of a rigid
joint type between diagonal members, the connection structure being formed by a
gusset plate at a panel point at which diagonal members of a composite web truss
girder and an upper flange or a lower flange are combined.

[14] The present invention is also devised to solve the problems incurred from the fact
that a gusset plate and an upper flange or a lower flange are combined with shear studs
in the prior art, i.e., the problem that a predetermined portion is required to be blocked
out so as to use high flow concrete or non-contraction mortar and the high flow
concrete or concrete is required to be doubly poured, and the problem of the shear stud
failing to serve as shear connector.

[15] The present invention is also devised to solve the problems that structural limitation
of the conventional shear studs, i.e., only some of the shear studs serve as shear
connector and the remainder thereof do not serve as shear connector.

Technical Solution

[16] In order to achieve the above objects, there is provided a composite web truss girder
comprising an upper flange, a lower flange and a web having a truss structure of a
diagonal member formed of steel, wherein a hinge plate is disposed at a connection
end of the diagonal member at a panel point at which connection ends of diagonal
members at both sides connected to each other and the upper flange or the lower flange
are combined; the hinge plates of the diagonal members are disposed overlappingly
and a hinge pin pierces through the overlapped hinge plates, such that the diagonal
members are rotatable with respect to each other before the connection ends of the
diagonal members are buried in the upper flange or the lower flange; an inner finish
plate is disposed at an end of lower portion of the hinge plate and in the diagonal
member to close the cross-section of the diagonal member; and concrete forming the
upper flange or the lower flange flows into the diagonal member to fill in the diagonal
member up to the inner finish plate when the connection ends of the diagonal members are buried in concrete forming the upper flange or the lower flange.

In particular, a cutoff portion is formed at the connection end of the diagonal member, and the end of the hinge plate is inserted into the cutoff portion and joined to the circumference thereof.

In addition, there is provided a connection structure of a panel point of a composite web truss girder, the composite web truss girder comprising an upper flange, a lower flange and a web having a truss structure of a diagonal member formed of steel, ends of diagonal members connected to each other being combined with the upper flange or the lower flange at the panel point, wherein connection ends of the diagonal members at both sides connected to each other are directly buried in concrete of the upper flange or the lower flange to be combined with the concrete, hinge plates are respectively disposed at the connection ends of the diagonal members; the hinge plates of the diagonal members are disposed overlappingly and a hinge pin pierces through the overlapped hinge plates, such that the diagonal members are rotatable with respect to each other before the connection ends of the diagonal members are buried in the upper flange or the lower flange; an inner finish plate is disposed at an end of lower portion of the hinge plate and in the diagonal member to close the cross-section of the diagonal member; and concrete forming the upper flange or the lower flange flows into the diagonal member to fill in the diagonal member up to the inner finish plate when the connection ends of the diagonal members are buried in concrete forming the upper flange or the lower flange.

Further, a cutoff portion is formed at the connection end of the diagonal member, and the end of the hinge plate is inserted into the cutoff portion and joined to the circumference thereof.

Advantageous Effects

According to a composite web truss girder of the present invention, connection ends of diagonal members 1 at both sides have a hinge connection structure through a hinge pin 3 and buried in concrete of an upper flange 101 or a lower flange 102 at a panel point, at which a diagonal member 1 and the upper flange or the lower flange are combined.

Since the connection ends of the diagonal members 1 have a hinge connection structure in which the diagonal members 1 are rotatable before the connection ends of the diagonal members 1 are buried in concrete of the upper and lower flanges 101 and 102, when the diagonal members 1 at both sides are combined so that each diagonal member 1 is combined in the field or a web unit with a truss structure is connected to each other in the field, the angle of the diagonal member 1 is easily adjustable, and
thus the diagonal members 1 between neighboring web units are easy to connect to each other in the field.

Also, since troublesome welding is not required when the diagonal members 1 are connected to each other, prevention of thermal transformation of the diagonal member, decrease in task risk, simplified work in the field, cost reduction and decrease in construction period may be obtained.

In addition, since a sufficient space between the diagonal member 1 and a reinforcing bar 130 of the upper or lower flanges 101 and 102 may be secured to fill concrete, various problems in the prior art may be solved at the panel point, when pouring concrete of the upper and lower flanges.

Additionally, the upper and lower flanges may be strengthened through the hinge pin 3 serving as a horizontal reinforcing bar, and when the hinge pin 3 is horizontally extended, the hinge pin 3 may serve as a horizontal bracing member between composite web truss girders.

Especially, since concrete is filled at an upper end portion of the diagonal member 1 by a predetermined depth, the end of the diagonal member 1 may be strengthened more to prevent buckling thereof.

**Brief Description of the Drawings**

FIG. 1 is a schematic perspective view illustrating a bridge using a conventional composite web truss girder.

FIG. 2 is a schematic partial side view illustrating the connection structure of the panel point at which the diagonal member and the lower flange are combined with each other in the conventional composite web truss girder.

FIG. 3 is a cross-sectional view by a line C-C in FIG. 2.

FIG. 4 is a schematic perspective view illustrating a truss structure of the diagonal member with a reinforcing bar for the upper and lower flanges being assembled so as to manufacture a composite web truss girder of the present invention.

FIG. 5 is a detailed perspective view illustrating a hinge connection structure of the diagonal member according to the present invention.

FIG. 6 is a perspective view illustrating a hinge plate hinge-connected of the present invention.

FIG. 7 is a schematic side view illustrating the composite web truss girder of the present invention.

**Best Mode for Carrying Out the Invention**

Although constitutions and features of the present invention have been described with reference to exemplary embodiments of the present invention, it is understood that the present invention should not be limited to these exemplary embodiments but
various changes and modifications can be made within the spirit of the present invention.

Hereinafter, constitution and effect of a composite web truss girder according to an exemplary embodiment of the present invention will be described with reference to the attached drawings.

FIG. 4 is a schematic perspective view illustrating a truss structure of the diagonal member 1 to form a web, with a reinforcing bar 130 for the upper and lower flanges being assembled so as to manufacture a composite web truss girder of the present invention. FIG. 5 is a detailed perspective view illustrating a hinge connection structure of the diagonal member 1 of the present invention. FIG. 6 is a perspective view illustrating a hinge plate hinge-connected according to the present invention.

FIG. 7 is a schematic side view illustrating the composite web truss girder of the present invention.

The composite web truss girder of the present invention includes a web between an upper flange 101 and a lower flange 102, in which the web has a truss structure of a diagonal member 1 formed of steel. However, before diagonal members 1 are combined with the upper flange 101 or the lower flange 102, the diagonal members 1 are hinge-combined with each other at a panel point portion at which the diagonal members 1 and the upper flange 101 or the lower flange 102 are combined, which is different from the prior art. As shown in FIGS. 5 and 6 illustrating an exemplary embodiment of the present invention, hinge plates 2 are respectively disposed at connection ends of the diagonal members 1, and the hinge plates 2 of the diagonal members 1 at both sides are disposed overlappingly. A hinge pin 3 pierces through the overlapped hinge plates 2, such that the diagonal members 1 are hinge-combined to be rotatable with respect to each other.

A lower portion of the hinge plate 2 is inserted into the diagonal member 1 by a predetermined depth, and an inner finish plate 4 is disposed at the end of the lower portion of the hinge plate 2. And an inner finish plate 4 is disposed in the diagonal member 1 to close the cross-section of the diagonal member 1. As shown in the figures, a cutoff portion 11 is formed at the diagonal member 1 so that an end of the hinge plate 2 is inserted into the cutoff portion 11 and joined at a circumference of the inserted portion, for example, by welding, and thus the hinge plate 2 may be joined with the diagonal member 1.

The diagonal members 1 may be respectively moved to the field and then hinge-combined with each other. Alternatively, a web unit having a predetermined length may be preproduced to have a truss structure with the diagonal members 1, and then web units may be moved to the filed and connected to each other.

As shown in FIG. 7, the hinge-combined connection ends of the diagonal members
I are buried into concrete of the upper flange 101 or the lower flange 102, and the upper flange 101 or the lower flange 102 and the web are integrated. Concrete forming the upper flange 101 or the lower flange 102 flows into the diagonal member 1 to fill up to the inner finish plate 4. Since the concrete is filled in the diagonal member 1 from the connection end of the diagonal member 1 to a predetermined length, the connection end of the diagonal member 1 is reinforced and buckling of the end of the diagonal member 1 is prevented.

As described above, in the present invention, the diagonal members 1 have a hinge connection structure before the web having a truss structure is combined with the upper and lower flanges 101 and 102. Therefore, it is easy for the diagonal members 1 at both sides or the web unit to be connected in the field by adjusting the angle between the diagonal members 1 at the panel point. Conventionally, since a conventional diagonal member has a connection structure of a rigid joint, when the angle of an end portion of the diagonal member and a connection face of a gusset plate do not coincide with each other or angles of the diagonal members of both web units do not coincide with each other, it is very difficult and troublesome to connect the diagonal members and/or the gusset plate in the field. However, in the present invention, the diagonal member 1 has a hinge connection structure to adjust the angle of the diagonal member 1. And therefore, it is very easy to connect to the adjacent diagonal members 1 in the field.

Especially, even though a stress concentration is generated at connected ends between the diagonal members 1 during moving the web unit that is preproduced at the plant to the field, since the diagonal members 1 are hinge-combined to be rotatable, the connected portions of the diagonal members 1 may be free from the risk of breakage due to the stress concentration. Furthermore, in the hinge connection structure, since welding is not required in the field, efficiency of work may be enhanced and thermal transformation of the diagonal member 1 due to the welding may be prevented.

In the hinge connection structure of the diagonal member 1 having the hinge pin 3 inserted therethrough, the diagonal member is easily connected to the upper and lower flanges 101, 102. As shown in FIG. 4, in the present invention, the connection ends of the diagonal members 1 hinge-connected by the hinge pin 3 are directly inserted and installed between the reinforcing bars 130 for the upper and lower flanges 101, 102 to be buried in concrete forming the upper and lower flanges 101, 102. And thereby, the upper and lower flanges 101, 102 and the diagonal member 1 are joined integrally, beyond a shear connection. Thus, differently from the prior art using wherein shear studs are used, the present invention secures a sufficient space for concrete flowing into the connection between the reinforcing bar 130 and the diagonal member 1. Therefore, when concrete forming the upper and lower flanges 101, 102 is poured, the
panel point of the diagonal member 1 may be filled easily with just general-use concrete, not high flow concrete.

[43] Thus, in the present invention, increase in construction cost, block-out, double placement of concrete, etc. associated with the use of high flow concrete in the prior art are removed, and thus, improved efficiency of work, construction cost reduction and decrease in construction period may be obtained. In addition, since the connection end of the diagonal member 1 is directly buried in concrete, shear connection and integral combination between the upper and lower flanges 101, 102 and the diagonal member 1 may be attained without the malfunction of the shear connector at the panel point.

[44] Especially, since the hinge pin 3 is disposed horizontally at the upper and lower flanges 101, 102 to be buried in concrete, the hinge pin 3 may serve as a horizontal reinforcing bar to strengthen the upper and lower flanges. In addition, the hinge pin 3 may be extended by more than the horizontal width of the upper and lower flanges, and the extended hinge pin 3 may serve as a horizontal bracing member of the composite web truss girder.

[45] Also, in the present invention, the connection structure between the diagonal members 1 is simple and steel parts are simplified, and thus it is very advantageous in manufacturing cost.

Industrial Applicability

[46] According to a composite web truss girder of the present invention, assemblability of the diagonal member and the upper or lower flanges in the field may be enhanced, secure connection structure may be attained, and buckling of the diagonal member may be prevented.
Claims

[1] A composite web truss girder comprising an upper flange (101), a lower flange (102) and a web having a truss structure of a diagonal member (1) formed of steel, wherein a hinge plate (2) is disposed at a connection end of the diagonal member (1) at a panel point at which connection ends of diagonal members (1) at both sides connected to each other and the upper flange (101) or the lower flange (102) are combined; the hinge plates (2) of the diagonal members (1) are disposed overlappingly and a hinge pin (3) pierces through the overlapped hinge plates (2), such that the diagonal members (1) are rotatable with respect to each other before the connection ends of the diagonal members (1) are buried in the upper flange (101) or the lower flange (102); an inner finish plate (4) is disposed at an end of lower portion of the hinge plate (2) and in the diagonal member (1) to close the cross-section of the diagonal member (1); and concrete forming the upper flange (101) or the lower flange (102) flows into the diagonal member (1) to fill in the diagonal member (1) up to the inner finish plate (4) when the connection ends of the diagonal members (1) are buried in concrete forming the upper flange (101) or the lower flange (102).

[2] The composite web truss girder of claim 1, wherein a cutoff portion (11) is formed at the connection end of the diagonal member (1), and the end of the hinge plate (2) is inserted into the cutoff portion (11) and joined to the circumference thereof.

[3] A connection structure of a panel point of a composite web truss girder, the composite web truss girder comprising an upper flange (101), a lower flange (102) and a web having a truss structure of a diagonal member (1) formed of steel, ends of diagonal members (1) connected to each other being combined with the upper flange (101) or the lower flange (102) at the panel point, wherein connection ends of the diagonal members (1) at both sides connected to each other are directly buried in concrete of the upper flange (101) or the lower flange (102) to be combined with the concrete, hinge plates (2) are respectively disposed at the connection ends of the diagonal members (1); the hinge plates (2) of the diagonal members (1) are disposed overlappingly and a hinge pin (3) pierces through the overlapped hinge plates (2), such that the diagonal members (1) are rotatable with respect to each other before the
connection ends of the diagonal members (1) are buried in the upper flange (101) or the lower flange (102); an inner finish plate (4) is disposed at an end of lower portion of the hinge plate (2) and in the diagonal member (1) to close the cross-section of the diagonal member (1); and concrete forming the upper flange (101) or the lower flange (102) flows into the diagonal member (1) to fill in the diagonal member (1) up to the inner finish plate (4) when the connection ends of the diagonal members (1) are buried in concrete forming the upper flange (101) or the lower flange (102).

The connection structure of claim 3, wherein a cutoff portion (11) is formed at the connection end of the diagonal member (1), and the end of the hinge plate (2) is inserted into the cutoff portion (11) and joined to the circumference thereof.
[Fig. 4]
A. CLASSIFICATION OF SUBJECT MATTER

E01D 2/00(2006.01)1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 E01D2/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models since 1975

Japanese utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS (KIPO internal) & keywords "composite", "truss", "joint", "beam" and "girder"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 04646379 A (MULLER, JEAN M ) 3 MAR 1987 See column 5, lines 10 - 15 and figure 8</td>
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☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

22 APRIL 2008 (22.04.2008)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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