Abstract: Provided is a method of constructing a trapezoidal-shaped opening type steel composite U girder, which synthesizes high-strength concrete at an upper flange of positive and negative moment region per construction step, and suitably introduces partial prestressing with PS tendon to decrease a stress applied to the steel by means of the synthesized cross-section of the concrete and the partial prestressing so that the amount of steel used can be saved and a long span bridge can be implemented with a low cost.
Description

OPENING STEEL COMPOSITE U GIRDER CONSTRUCTION METHOD

Technical Field

The present invention relates to a method of constructing an opening steel composite U girder, and in particular, to a method of constructing a trapezoid-shaped opening type steel composite U girder, which utilizes advantages of concrete and steel by introducing synthesis of the concrete and steel and partial prestressing to raise economical efficiency and implement a bridge with a low girder height and a long span.

Background Art

According to the conventional trapezoid-shaped opening type steel girder, it can save the amount of the steel used for an upper flange as compared to the box-type steel girder, so that economical efficiency is secured and construction becomes simple.

However, the conventional trapezoid-shaped opening type steel girder requires a significant increase in amount of steel used per unit due to a common nature of the steel bridge when implementing a long span bridge, which results in an uneconomic waste compared to a concrete girder.

Accordingly, in order to save the amount of high-cost steel used, composite technology development is desperately required which can synthesize the steel and concrete that relatively less costs to implement an economical long span bridge.

Disclosure of Invention

Technical Problem

Accordingly, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a method of constructing a trapezoid-shaped opening type steel composite U girder, which synthesizes high-strength concrete at an upper flange of positive and negative moment region per construction step, and suitably introduces partial prestressing with PS tendon to decrease a stress applied to the steel by means of the synthesized cross-section of the concrete and the partial prestressing so that the amount of steel used can be saved and a long span bridge can be implemented with a low cost.

Technical Solution

To achieve the above object, the present invention provides a method of constructing an opening steel composite U girder, which includes: pre-assembling the U girder at an assembly spot; casting and synthesizing a high-strength concrete on an upper flange of positive moment region of the U girder; placing and coupling the U girder on an
abutment and a pier; casting and synthesizing a high-strength concrete on a bottom plate of a lower flange of negative moment region of the U girder; placing a sheath for inserting tendon on a bottom plate slab and an upper flange of negative moment region of the U girder; blocking-out a steel anchorage of the upper flange of negative moment region of the U girder, and casting and synthesizing a concrete over the entire upper flange of negative moment region and bottom plate slab; introducing prestressing by inserting and prestressing a prestressed (PS) tendon into the upper flange of negative moment region of the U girder, and casting a non-shrinkage concrete on the blocked-out portion for charge; and introducing prestressing to the bottom plate slab concrete of negative moment region by inserting and prestressing the PS tendon at a lower anchorage of the internal slab of the U girder, and finishing an anchorage for maintenance.

Advantageous Effects

According to a method of constructing a trapezoid-shaped opening type steel composite U girder of the present invention, the following effects can be obtained.

First, when a trapezoid-shaped opening type steel composite U girder is constructed, a method of relatively decreasing the amount of steel used by the steel girder bridge introduces synthesis of concrete and steel and partial prestressing to utilize advantages of the concrete and the steel, so that economical efficiency can be raised and a bridge with a low girder height and a long span can be implemented.

That is, the present invention might be considered a little complicated in terms of synthesis order of concrete and steel and introducing order of partial prestressing and so forth per construction step, however, which can be overcome by accurate construction, since the construction cost can be saved and low girder height and long span can be implemented with a low cost.

Second, when a conventional trapezoid-shaped opening type steel composite U girder is constructed, high-strength concrete is synthesized at an upper flange of positive moment region and a lower flange of negative moment region per construction step, and partial prestressing is suitably introduced on the upper flange of negative moment region and a bottom plate slab of negative moment region with PS tendon to decrease a stress applied to the steel by means of the synthesized cross-section of the concrete and the partial prestressing so that the amount of steel used can be saved and a long span bridge can be implemented with a low cost.

Brief Description of Drawings

FIGS. 1 to 29 are process diagrams illustrating an order of constructing a trapezoid-shaped opening type steel composite U girder according to the present invention.

FIG. 30 is a side diagram illustrating a trapezoid-shaped opening type steel
composite U girder according to a first embodiment of the present invention.

FIG. 31 is an enlarged lateral cross-section illustrating the portion A of FIG. 30.
FIG. 32 is an enlarged cross-section illustrating the portion A of FIG. 30.
FIG. 33 is an enlarged lateral cross-section illustrating the portion B of FIG. 30.
FIG. 34 is an enlarged cross-section illustrating the portion B of FIG. 30.
FIG. 35 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder according to a second embodiment of the present invention.
FIG. 36 is an enlarged lateral cross-section illustrating the portion C of FIG. 35.
FIG. 37 is an enlarged cross-section illustrating the portion C of FIG. 35.
FIG. 38 is an enlarged lateral cross-section illustrating the portion D of FIG. 35.
FIG. 39 is an enlarged cross-section illustrating the portion D of FIG. 35.
FIG. 40 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder according to a third embodiment of the present invention.
FIG. 41 is an enlarged lateral cross-section illustrating the portion E of FIG. 40.
FIG. 42 is an enlarged cross-section illustrating the portion E of FIG. 40.
FIG. 43 is an enlarged lateral cross-section illustrating the portion F of FIG. 40.
FIG. 44 is an enlarged cross-section illustrating the portion F of FIG. 40.
FIG. 45 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder according to a fourth embodiment of the present invention.
FIG. 46 is an enlarged lateral cross-section illustrating the portion G of FIG. 45.
FIG. 47 is an enlarged cross-section illustrating the portion G of FIG. 45.
FIG. 48 is an enlarged lateral cross-section illustrating the portion H of FIG. 45.
FIG. 49 is an enlarged cross-section illustrating the portion H of FIG. 45.
FIG. 50 is a detailed lateral cross-section illustrating a web of negative moment region synthesized with high-strength concrete according to a trapezoid-shaped opening type steel composite U girder of the present invention.
FIG. 51 is a detailed side diagram illustrating a web of negative moment region synthesized with high-strength concrete according to a trapezoid-shaped opening type steel composite U girder of the present invention.
FIG. 52 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder using a corrugated steel web for a web of negative moment region according to the present invention.
FIG. 53 is an enlarged and detailed diagram illustrating the portion A of FIG. 52.
FIG. 54 is an enlarged and detailed diagram illustrating the portion B of FIG. 52.
FIG. 55 is a side diagram illustrating a steel composite complex diaphragm 1 of a trapezoid-shaped opening type steel composite U girder according to the present invention.
FIG. 56 is an enlarged and detailed diagram illustrating the portion A of FIG. 55.
FIG. 57 is an enlarged and detailed diagram illustrating the portion B of FIG. 55.

FIG. 58 is a side diagram illustrating a steel composite complex diaphragm 2 of a trapezoid-shaped opening type steel composite U girder according to the present invention.

FIG. 59 is an enlarged and detailed diagram illustrating the portion A of FIG. 58.

FIG. 60 is an enlarged and detailed diagram illustrating the portion B of FIG. 58.

Best Mode for Carrying out the Invention

Hereinafter, the present invention will be described in detail with reference to accompanying drawings.

FIGS. 1 to 29 are process diagrams illustrating an order of constructing a trapezoid-shaped opening type steel composite U girder according to the present invention, wherein FIG. 1 is a side diagram illustrating the pre-engaged U girder, FIG. 2 is a cross-sectional diagram taken along the A-A line of FIG. 1, FIG. 3 is a side diagram illustrating caisson concrete cast on the upper flange of positive moment region, FIG. 4 is a cross-sectional diagram taken along the A-A line of FIG. 3, FIG. 5 is a cross-sectional diagram taken along the B-B line of FIG. 3, FIG. 6 is a side diagram illustrating the U girder placed on abutment and pier, FIG. 7 is a cross-sectional diagram taken along the A-A line of FIG. 6, FIG. 8 is a cross-sectional diagram taken along the B-B line of FIG. 6, FIG. 9 is an exemplary diagram illustrating high-strength concrete cast on the lower flange of negative moment region, FIG. 10 is a cross-sectional diagram taken along the A-A line of FIG. 9, FIG. 11 is a cross-sectional diagram taken along the B-B line of FIG. 9, FIG. 12 is a cross-sectional diagram taken along the C-C line of FIG. 9, FIG. 13 is an exemplary diagram illustrating tendon placed on the negative moment region, FIG. 14 is a cross-sectional diagram taken along the A-A line of FIG. 13, FIG. 15 is a cross-sectional diagram taken along the B-B line of FIG. 13, FIG. 16 is a cross-sectional diagram taken along the C-C line of FIG. 13, FIG. 17 is an exemplary diagram illustrating a cast state of bottom plate concrete slab, FIG. 18 is a cross-sectional diagram taken along the A-A line of FIG. 17, FIG. 19 is a cross-sectional diagram taken along the B-B line of FIG. 17, FIG. 20 is a cross-sectional diagram taken along the C-C line of FIG. 17, FIG. 21 is an exemplary diagram illustrating prestressing introduced on the upper flange concrete of negative moment region, FIG. 22 is a cross-sectional diagram taken along the A-A line of FIG. 21, FIG. 23 is a cross-sectional diagram taken along the B-B line of FIG. 21, FIG. 24 is a cross-sectional diagram taken along the C-C line of FIG. 21, FIG. 25 is an exemplary diagram illustrating prestressing introduced on the bottom plate slab of negative moment region, FIG. 26 is a cross-sectional diagram taken along the A-A line of FIG. 25, FIG. 27 is a cross-sectional diagram taken along the B-B line of FIG. 25, FIG. 28 is
an exemplary diagram illustrating installed pavement and guardrail, and FIG. 29 is a
cross-sectional diagram taken along the A-A line of FIG. 28.

As shown in these drawings, a method of constructing a trapezoid-shaped opening
type steel composite U girder according to the present invention includes: pre-
assembling the U girder 10 at an assembly spot; casting and synthesizing a high-
strength concrete 14 on an upper flange of positive moment region 12 of the U girder
10; placing and coupling the U girder 10 on an abutment 16 and a pier 18; casting and
synthesizing a high-strength concrete 14 on a bottom plate 22 of a lower flange of
negative moment region 20 of the U girder 10; placing a sheath for inserting tendon 24
on a bottom plate slab 26 and an upper flange of negative moment region 28 of the U
girder 10; blocking-out a steel anchorage 30 of the upper flange of negative moment
region 28 of the U girder 10, and casting and synthesizing a concrete over the entire
upper flange of negative moment region 28 and bottom plate slab 26; introducing pre-
stressing by inserting and prestressing a prestressed (PS) tendon 34 into the upper
flange of negative moment region 28 of the U girder 10, and casting a non-shrinkage
concrete on the blocked-out portion 32 for charge; and introducing prestressing to the
bottom plate slab 26 concrete of negative moment region by inserting and prestressing
the PS tendon 34 at a lower anchorage 36 of the internal slab of the U girder 10, and
finishing an anchorage for maintenance 38.

That is, in the method of constructing the trapezoid-shaped opening type steel
composite U girder according to the present invention,

1) The trapezoid-shaped opening type steel composite U girder 10 is manufactured at
a factory, carried into an assembly spot, and assembled by a displaceable unit.

2) The high-strength concrete 14 is cast and synthesized on the upper flange of
positive moment region 12 of the assembled trapezoid-shaped opening type steel
composite U girder 10, which is then placed on the abutment 16 and the pier 18 to
cause the steel composite upper flange to absorb a compressive stress occurring from
the upper flange of positive moment region 12.

In this case, the high-strength concrete 14 synthesized on the upper flange of positive
moment region 12 is synthesized with a constant cross-section having a predetermined
thickness, or is synthesized to be thicker on the maximum positive moment region 40
of central span with a variable cross-section.

Here, in the case of the variable cross-section synthesis, adjustment of the concrete
thickness can more effectively control the compressive stress occurring on the upper
flange 12.

3) In the concrete cast to be thicker with a variable cross-section on the maximum
positive moment region 40 of a central span of the positive moment region, penetrating
holes 44 for arranging reinforced bars of the bottom plate slab 26 are formed in a
direction perpendicular to a bridge by means of a pipe formed of resin, thereby facilitating the arrangement of reinforced bars.

4) The high-strength concrete 14 is cast and synthesized on the lower flange of inner support to cause the steel composite lower flange to absorb the compressive stress occurring at the lower flange of negative moment region 20.

5) In this case, the high-strength concrete 14 cast and attached to the lower flange of negative moment region 20 is cast and synthesized with a constant cross-section having a predetermined thickness, or is cast and synthesized to be thicker with a variable cross-section on the maximum negative moment region 2 close to the inner support.

Here, in the case of the variable cross-section synthesis, the compressive stress occurring at the inner support can be more effectively controlled by adjusting the concrete thickness.

6) In addition to the constant cross-section synthesis or the variable cross-section synthesis on the lower flange of negative moment region 20 of the inner support, a concrete diaphragm 48 may be additionally synthesized on a lower portion of the neutral axis of a steel diaphragm 46 of the inner support to move downward the centroid axis of negative moment region and increase the eccentricity efficiency.

6) After the high-strength concrete 14 is cast and synthesized on the lower flange of negative moment region 20 of the inner support, the concrete is cast simultaneously on the upper flange of negative moment region 28 and the bottom plate slab 26

In this case, the PS tendon 34 anchorage 36, the sheath 24, and the PS tendon 34 for introducing the partial prestressing are buried in the upper flange of negative moment region 28 in advance, and the portion of the PS tendon 34 anchorage 36 is made to be blocked-out.

The sheath 24, the PS tendon 34 and the anchorage 36 including the anchorage for maintenance 38 are displaced below the bottom plate slab 26 of the U girder 10 in order to introduce the partial prestressing on the bottom plate slab of negative moment region 26.

7) The partial prestressing is introduced on the upper flange of negative moment region 28 by prestressing the PS tendon 34 at the blocked-out portion 32 of the upper flange of negative moment region 28, the blocked-out portion 32 is charged with a non-shrinkage concrete or the like by means of casting, and the partial prestressing is introduced on the bottom plate slab of negative moment region 26 by prestressing the PS tendon 34 to control tensile cracking above the support.

The anchorage for maintenance 38 allows the sheath 24 only to be buried in order to make the PS tendon 34 and the steel anchorage 30 integrated and inserted at the time of future maintenance, and the portion where the steel anchorage 30 is to be installed is
molded in the form of steel anchorage 30 to save the initial installation cost of the maintenance system.

[61] 8) The high-strength concrete 14 having a predetermined thickness is additionally cast and synthesized on the steel web of negative moment region to cause the steel composite concrete web to absorb the shear stress occurring at the web near the support.

[62] In the meantime, the high-strength concrete 14 is primarily cast and synthesized on the upper flange of positive moment region 12 of the U girder 10 and is placed along with the U girder 10 of negative moment region, the high-strength concrete 14 is secondarily cast and synthesized on the inner lower flange of negative moment region 20 of inner support, a high-strength concrete or normal-strength concrete is then cast and synthesized on the entire span of the bottom plate slab 26 and the upper flange of negative moment region 28, and partial prestressing is sequentially introduced on the upper flange of negative moment region 28 concrete and the bottom plate slab 26 concrete of negative moment region.

[63] In addition, the high-strength concrete 14 is primarily cast and synthesized on the upper flange of positive moment region 12 of the U girder 10 while the high-strength concrete 14 is cast and synthesized to be thicker on a maximum positive moment region 40 to change a cross-section, and is placed along with the U girder 10 of negative moment region on the abutment 16 and the pier 18, the high-strength concrete 14 is secondarily cast and synthesized on the lower flange of negative moment region of inner support while the high-strength concrete 14 is cast and synthesized to be thicker on a maximum negative moment region 42 to change a cross-section, a high-strength concrete or normal-strength concrete is then cast and synthesized on the entire span of the bottom plate slab 26 and the upper flange of negative moment region 28, and partial prestressing is sequentially introduced on the upper flange of negative moment region 28 concrete and the bottom plate slab 26 concrete of negative moment region.

[64] Moreover, the casting and synthesis of the concrete on the upper flange of negative moment region 28 allows the high-strength concrete 14 to be collectively cast at the same time that the high-strength concrete 14 is cast and synthesized on the positive moment region, and partial prestressing is introduced in advance on the upper flange of negative moment region 28 concrete by means of the PS tendon 34 to place the girder along with the U girder 10 of positive moment region on the abutment 16 and the pier 18.

[65] In addition, penetrating holes 44 for arranging reinforced bars are formed in the high-strength concrete 14 cast to be thicker on the upper flange 12 of the maximum positive moment region 40 at a constant interval in order to laterally arrange reinforced bars of
the bottom plate slab 26 in a direction perpendicular to a bridge.

The PS tendon anchorage 36 for introducing partial prestressing on the bottom plate slab 26 concrete of negative moment region is integrated with the anchorage for maintenance 38 and displaced below the bottom plate slab 26, the anchorage for maintenance 38 only has a sheath 24, the steel anchorage 30 is molded with concrete by a mold, and the steel anchorage 30 and the PS tendon 34 are inserted for maintenance if required.

In addition, the high-strength concrete 14 is further cast and synthesized on an inner steel web of the negative moment region 50.

The U girder 10 is applied to a trapezoid-shaped opening type steel web U girder or a trapezoid-shaped opening type corrugated steel web.

In addition, the synthesis of the high-strength concrete 14 on the upper flange of positive moment region 12, the synthesis of the high-strength concrete 14 on the lower flange of negative moment region 20, and the introduction of sequential prestressing on the upper flange 28 concrete of negative moment region and the bottom plate slab 26 concrete of negative moment region are applied to a steel I-type girder and a truss girder.

A plate steel web is used for the positive moment region and a corrugated steel web is used for the negative moment region of the U girder 10, or the corrugated steel web is used for the positive moment region and the plate steel web is used for the negative moment region of the U girder 10.

In addition, a diaphragm displaced in an inner support of the U girder 10 is composed of a concrete diaphragm 48 with a predetermined height below a neutral axis, and a steel diaphragm 46 is disposed above the concrete diaphragm 48.

Mode for the Invention

Hereinafter, various embodiments of the present invention will be described in detail.

First embodiment

FIG. 30 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder according to a first embodiment of the present invention, FIG. 31 is an enlarged lateral cross-section illustrating the portion A of FIG. 30, FIG. 32 is an enlarged cross-section illustrating the portion A of FIG. 30, FIG. 33 is an enlarged lateral cross-section illustrating the portion B of FIG. 30, and FIG. 34 is an enlarged cross-section illustrating the portion B of FIG. 30.

As shown in these drawings, according to the method of constructing the trapezoid-shaped opening type steel composite U girder of the present invention, the high-strength concrete 14 is cast and synthesized on the upper flange of positive moment region 12 and is placed on the abutment 16 and the pier 18, the high-strength concrete
14 is then cast and synthesized on the lower flange 20 of negative moment region, the concrete is collectively cast on the upper flange of negative moment region 28 when the concrete is case on the bottom plate slab 26, and prestressing is introduced on the upper flange of negative moment region 28 and the bottom plate slab 26 of negative moment region.

Here, the high-strength concrete 14 is cast and synthesized with a constant cross-section for thickness on the upper flange of positive moment region 12 and the lower flange of negative moment region 20.

**Second embodiment**

FIG. 35 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder according to a second embodiment of the present invention, FIG. 36 is an enlarged lateral cross-section illustrating the portion C of FIG. 35, FIG. 37 is an enlarged cross-section illustrating the portion C of FIG. 35, FIG. 38 is an enlarged lateral cross-section illustrating the portion D of FIG. 35, and FIG. 39 is an enlarged cross-section illustrating the portion D of FIG. 35.

As shown in these drawings, according to the method of constructing the trapezoid-shaped opening type steel composite U girder of the present invention, the high-strength concrete 14 is cast and synthesized on the upper flange of positive moment region 12 and is placed on the abutment 16 and the pier 18, the high-strength concrete 14 is then cast and synthesized on the lower flange 20 of negative moment region, the concrete is collectively cast on the upper flange of negative moment region 28 when the concrete is case on the bottom plate slab 26, and prestressing is introduced on the upper flange of negative moment region 28 and the bottom plate slab 26 of negative moment region.

Here, the high-strength concrete 14 is cast and synthesized with a variable cross-section for thickness on the upper flange of positive moment region 12 and the lower flange of negative moment region 22.

**Third embodiment**

FIG. 40 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder according to a third embodiment of the present invention, FIG. 41 is an enlarged lateral cross-section illustrating the portion E of FIG. 40, FIG. 42 is an enlarged cross-section illustrating the portion E of FIG. 40, FIG. 43 is an enlarged lateral cross-section illustrating the portion F of FIG. 40, and FIG. 44 is an enlarged cross-section illustrating the portion F of FIG. 40.

As shown in these drawings, according to the method of constructing the trapezoid-shaped opening type steel composite U girder of the present invention, after the high-strength concrete 14 is cast and synthesized on the upper flange of positive and negative moment regions 12 and 28, prestressing is introduced on the upper flange of
negative moment region 28 by means of PS tendon 34 in advance, which is then placed on the abutment 16 and the pier 18, the high-strength concrete 14 is then cast and synthesized on the lower flange of negative moment region 20, the bottom plate slab 26 concrete is cast and synthesized, and prestressing is introduced on the bottom plate slab 26 of negative moment region 26.

Here, the high-strength concrete 14 is cast and synthesized with a constant cross-section for thickness on the upper flange of positive moment region 12 and the lower flange of negative moment region 22.

**Fourth embodiment**

FIG. 45 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder according to a fourth embodiment of the present invention, FIG. 46 is an enlarged lateral cross-section illustrating the portion G of FIG. 45, FIG. 47 is an enlarged cross-section illustrating the portion G of FIG. 45, FIG. 48 is an enlarged lateral cross-section illustrating the portion H of FIG. 45, and FIG. 49 is an enlarged cross-section illustrating the portion H of FIG. 45.

As shown in these drawings, according to the method of constructing the trapezoid-shaped opening type steel composite U girder of the present invention, after the high-strength concrete 14 is cast and synthesized on the upper flange of positive and negative moment regions 12 and 28, prestressing is introduced on the upper flange of negative moment region 28 by means of PS tendon 34 in advance, which is then placed on the abutment 16 and the pier 18, the high-strength concrete 14 is then cast and synthesized on the lower flange of negative moment region 20, the bottom plate slab 26 concrete is cast and synthesized, and prestressing is introduced on the bottom plate slab 26 of negative moment region 26.

Here, the high-strength concrete 14 is cast and synthesized with a variable cross-section for thickness on the upper flange of positive moment region 12 and the lower flange of negative moment region 20.

In the meantime, FIG. 50 is a detailed lateral cross-section illustrating a web of negative moment region synthesized with high-strength concrete 14 according to a trapezoid-shaped opening type steel composite U girder of the present invention, and FIG. 51 is a detailed side diagram illustrating a web of negative moment region synthesized with high-strength concrete according to a trapezoid-shaped opening type steel composite U girder 10 of the present invention.

As shown in these drawings, the method of constructing the trapezoid-shaped opening type steel composite U girder of the present invention includes additionally casting the high-strength concrete 14 on the steel web of negative moment region 50.

FIG. 52 is a side diagram illustrating a trapezoid-shaped opening type steel composite U girder using a corrugated steel web for a web of negative moment region
according to the present invention, FIG. 53 is an enlarged and detailed diagram illustrating the portion A of FIG. 52, and FIG. 54 is an enlarged and detailed diagram illustrating the portion B of FIG. 52.

[92] As shown in these drawings, according to the method of constructing the trapezoid-shaped opening type steel composite U girder of the present invention, the U girder 10 is applied to a trapezoid-shaped opening type steel composite U girder or a trapezoid-shaped opening type corrugated steel web U girder.

[93] In addition, the synthesis of the high-strength concrete 14 on the upper flange of positive moment region 12, the synthesis of the high-strength concrete 14 on the lower flange of negative moment region 20, and the introduction of sequential prestressing on the upper flange 28 concrete of negative moment region and the bottom plate slab 26 concrete of negative moment region are applied to a steel I-type girder and a truss girder.

[94] A plate steel web is used for the positive moment region and a corrugated steel web is used for the negative moment region of the U girder 10, or the corrugated steel web is used for the positive moment region and the plate steel web is used for the negative moment region of the U girder 10.

[95] FIG. 55 is a side diagram illustrating a steel composite complex diaphragm 1 of a trapezoid-shaped opening type steel composite U girder according to the present invention, FIG. 56 is an enlarged and detailed diagram illustrating the portion A of FIG. 55, FIG. 57 is an enlarged and detailed diagram illustrating the portion B of FIG. 55, FIG. 58 is a side diagram illustrating a steel composite complex diaphragm 2 of a trapezoid-shaped opening type steel composite U girder according to the present invention, FIG. 59 is an enlarged and detailed diagram illustrating the portion A of FIG. 58, and FIG. 60 is an enlarged and detailed diagram illustrating the portion B of FIG. 58.

[96] As shown in these drawings, according to the method of constructing the trapezoid-shaped opening type steel composite U girder of the present invention, a diaphragm displaced in an inner support of the U girder 10 is composed of a concrete diaphragm 48 with a predetermined height below a neutral axis, and a steel diaphragm 46 is disposed above the concrete diaphragm 48.

[97] In the method of constructing the trapezoid-shaped opening type steel composite U girder having the steps as described above, a method of relatively decreasing the amount of steel used by the U girder 10 introduces the synthesis of concrete and steel and the partial prestressing to take advantages of the concrete and the steel so that the economical efficiency can be raised, the bridge with a low girder height and a long span can be implemented, and the order of synthesizing the concrete and the steel and the order of introducing the partial prestressing are employed per construction step so
that the construction cost can be saved and the bridge with a low girder height and a long span can be implemented with a low cost.

[98] In addition, the method of constructing a trapezoid-shaped opening type steel composite U girder 10, synthesizes high-strength concrete at an upper flange of positive and negative moment region per construction step, and suitably introduces partial prestressing with PS tendon on the upper flange of negative moment region 28 and the bottom plate slab of negative moment region 26 to decrease a stress applied to the steel by means of the synthesized cross-section of the concrete and the partial prestressing so that the amount of steel used can be saved and a long span bridge can be implemented with a low cost.
Claims

[1] A method of constructing an opening steel composite U girder 10, comprising:
pre-assembling the U girder 10 at an assembly spot;
casting and synthesizing a high-strength concrete 14 on an upper flange of
positive moment region 12 of the U girder 10;
placing and coupling the U girder 10 on an abutment 16 and a pier 18;
casting and synthesizing a high-strength concrete 14 on a bottom plate 22 of a
lower flange of negative moment region 20 of the U girder 10;
placing a sheath for inserting tendon 24 on a bottom plate slab 26 and an upper
flange of negative moment region 28 of the U girder 10;
blocking-out a steel anchorage 30 of the upper flange of negative moment region
28 of the U girder 10, and casting and synthesizing a concrete over the entire
upper flange of negative moment region 28 and bottom plate slab 26;
introducing prestressing by inserting and prestressing a prestressed (PS) tendon
34 into the upper flange of negative moment region 28 of the U girder 10, and
casting a non-shrinkage concrete on the blocked-out portion 32 for charge; and
introducing prestressing to the bottom plate slab 26 concrete of negative moment
region by inserting and prestressing the PS tendon 34 at a lower anchorage 36 of
the internal slab of the U girder 10, and finishing an anchorage for maintenance
38.

[2] The method according to claim 1, wherein the high-strength concrete 14 is
primarily cast and synthesized on the upper flange of positive moment region 12
of the U girder 10 and is placed along with the U girder 10 of negative moment
region, the high-strength concrete 14 is secondarily cast and synthesized on the
inner lower flange of negative moment region 20 of inner support, a high-
strength concrete or normal-strength concrete is then cast and synthesized on the
entire span of the bottom plate slab 26 and the upper flange of negative moment
region 28, and partial prestressing is sequentially introduced on the upper flange
of negative moment region 28 concrete and the bottom plate slab 26 concrete of
negative moment region.

[3] The method according to claim 1, wherein the high-strength concrete 14 is
primarily cast and synthesized on the upper flange of positive moment region 12
of the U girder 10 while the high-strength concrete 14 is cast and synthesized to
be thicker on a maximum positive moment region 40 to change a cross-section,
and is placed along with the U girder 10 of negative moment region on the
abutment 16 and the pier 18, the high-strength concrete 14 is secondarily cast
and synthesized on the lower flange of negative moment region of inner support.
while the high-strength concrete 14 is cast and synthesized to be thicker on a maximum negative moment region 42 to change a cross-section, a high-strength concrete or normal-strength concrete is then cast and synthesized on the entire span of the bottom plate slab 26 and the upper flange of negative moment region 28, and partial prestressing is sequentially introduced on the upper flange of negative moment region 28 concrete and the bottom plate slab 26 concrete of negative moment region.

[4] The method according to any one of claim 1 to claim 3, wherein the casting and synthesis of the concrete on the upper flange of negative moment region 28 allows the high-strength concrete 14 to be collectively cast at the time same time that the high-strength concrete 14 is cast and synthesized on the positive moment region, and partial prestressing is introduced in advance on the upper flange of negative moment region 28 concrete by means of the PS tendon 34 to place the girder along with the U girder 10 of positive moment region on the abutment 16 and the pier 18.

[5] The method according to claim 3, wherein penetrating holes 44 for arranging reinforced bars are formed in the high-strength concrete 14 cast to be thicker on the upper flange 12 of the maximum positive moment region 40 at a constant interval in order to laterally arrange reinforced bars of the bottom plate slab 26 in a direction perpendicular to a bridge.

[6] The method according to any one of claim 1 to claim 3, wherein the PS tendon anchorage 36 for introducing partial prestressing on the bottom plate slab 26 concrete of negative moment region is integrated with the anchorage for maintenance 38 and displaced below the bottom plate slab 26, the anchorage for maintenance 38 only has a sheath 24, the steel anchorage 30 is molded with concrete by a mold, and the steel anchorage 30 and the PS tendon 34 are inserted for maintenance if required.

[7] The method according to any one of claim 1 to claim 3, wherein the high-strength concrete 14 is further cast and synthesized on an inner steel web of the negative moment region 50.

[8] The method according to claim 1 or claim 3, wherein the U girder 10 is applied to a trapezoid-shaped opening type steel web U girder or a trapezoid-shaped opening type corrugated steel web.

[9] The method according to any one of claim 1 to claim 3, wherein the synthesis of the high-strength concrete 14 on the upper flange of positive moment region 12, the synthesis of the high-strength concrete 14 on the lower flange of negative moment region 20, and the introduction of sequential prestressing on the upper flange 28 concrete of negative moment region and the bottom plate slab 26
concrete of negative moment region are applied to a steel I-type girder and a truss girder.

[10] The method according to any one of claim 1 to claim 3, wherein a plate steel web is used for the positive moment region and a corrugated steel web is used for the negative moment region of the U girder 10, or the corrugated steel web is used for the positive moment region and the plate steel web is used for the negative moment region of the U girder 10.

[11] The method according to any one of claim 1 to claim 3, wherein a diaphragm displaced in an inner support of the U girder 10 is composed of a concrete diaphragm 48 with a predetermined height below a neutral axis, and a steel diaphragm 46 is disposed above the concrete diaphragm 48.
A. CLASSIFICATION OF SUBJECT MATTER

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)

IP 8  EO1D 21/00

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) "composite", "girder"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search: 17 JUNE 2009 (17 06 2009)
Date of mailing of the international search report: 18 JUNE 2009 (18.06.2009)

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