Parts of Steel Bridge

contents

Bearings

They are made from cast iron for small roadway bridges or cast steel; they distribute the reaction over a sufficient area of the abutment.

We have:-

a - Boll bearing.

Free rotation and free expansion in all direction except vertical movement

b- Movable or expansion bearing.

One rotation and one horizontal movement

M c- Hinged bearing.

One rotation only

Horizontal and transversal wind bracing

There will be:-

a- Lateral bracing.(9.3.2.1(p146))

Whenever possible, two system of lateral bracing (upper wind bracing and lower wind bracing) may be used.

b- transverse bracing (9.3.2.2(p146))

End and intermediate portal frames (for through bridge) .

End and intermediate cross frames (for deck bridge).

To transmit the horizontal reactions (of upper lateral bracing) to the bearing

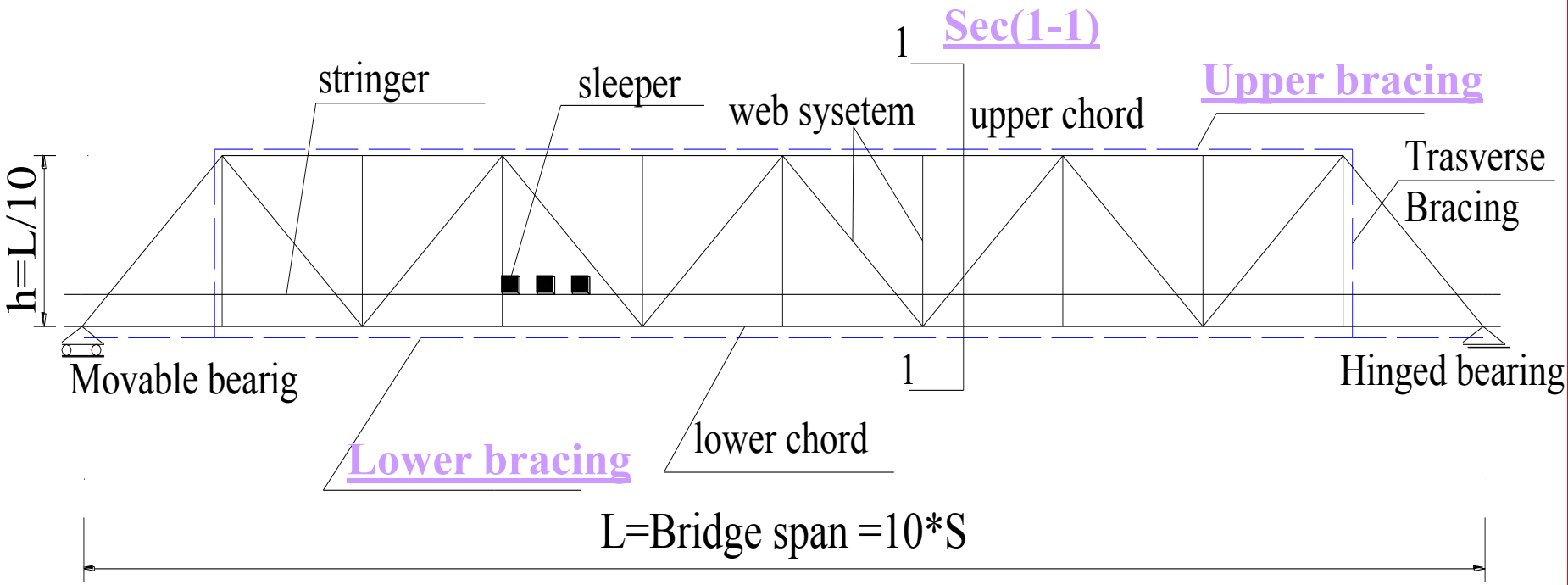
c- Stringer bracing (for Railway Bridge). (9.3.2.4(p147))

To carry the lateral shock of the train

D-Braking force bracing (for Railway Bridge). (9.3.2.4(p147))

To carry the braking force of the train

They transmit the wind pressure, the centrifugal forces and other horizontal forces to the abutments. They reduce the buckling length of the compression chord



Truss Bridge

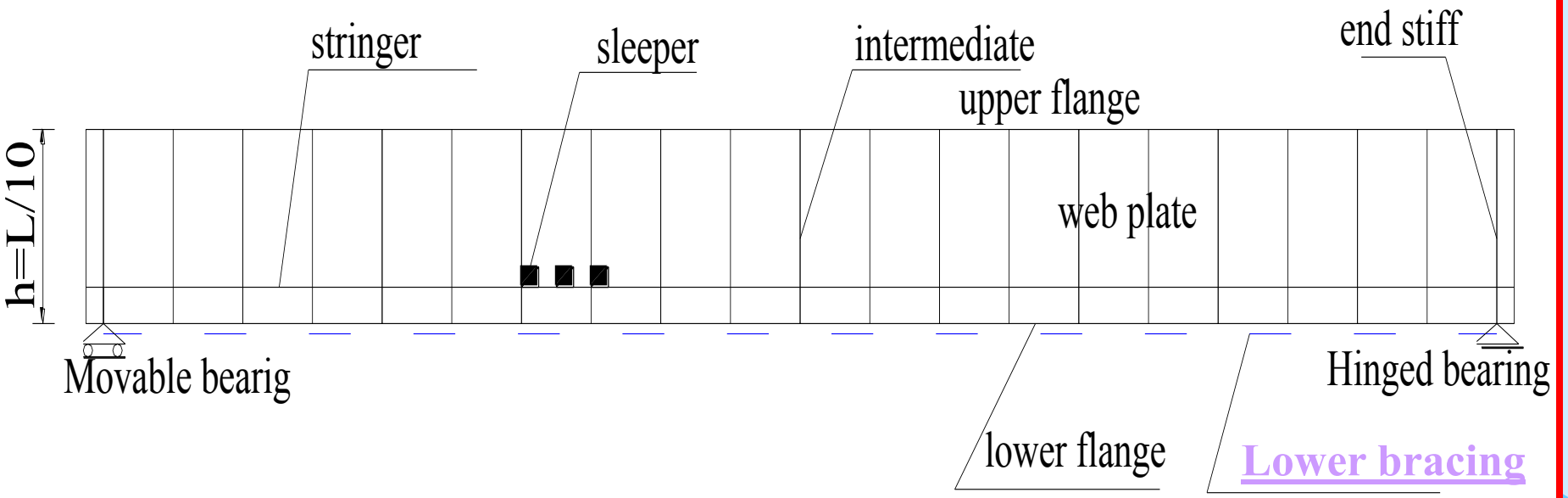
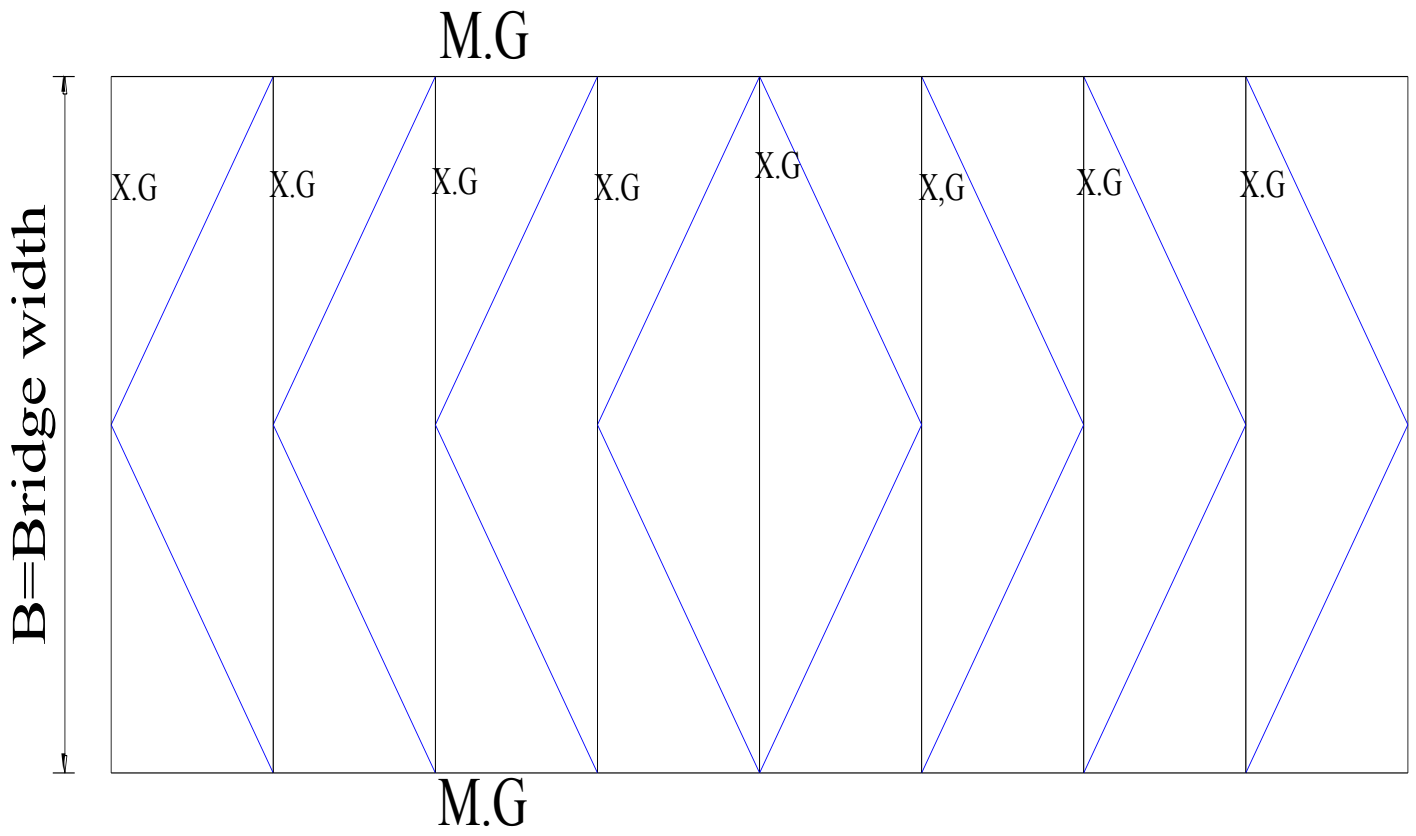


Plate Girder Bridge



Lower Bracing

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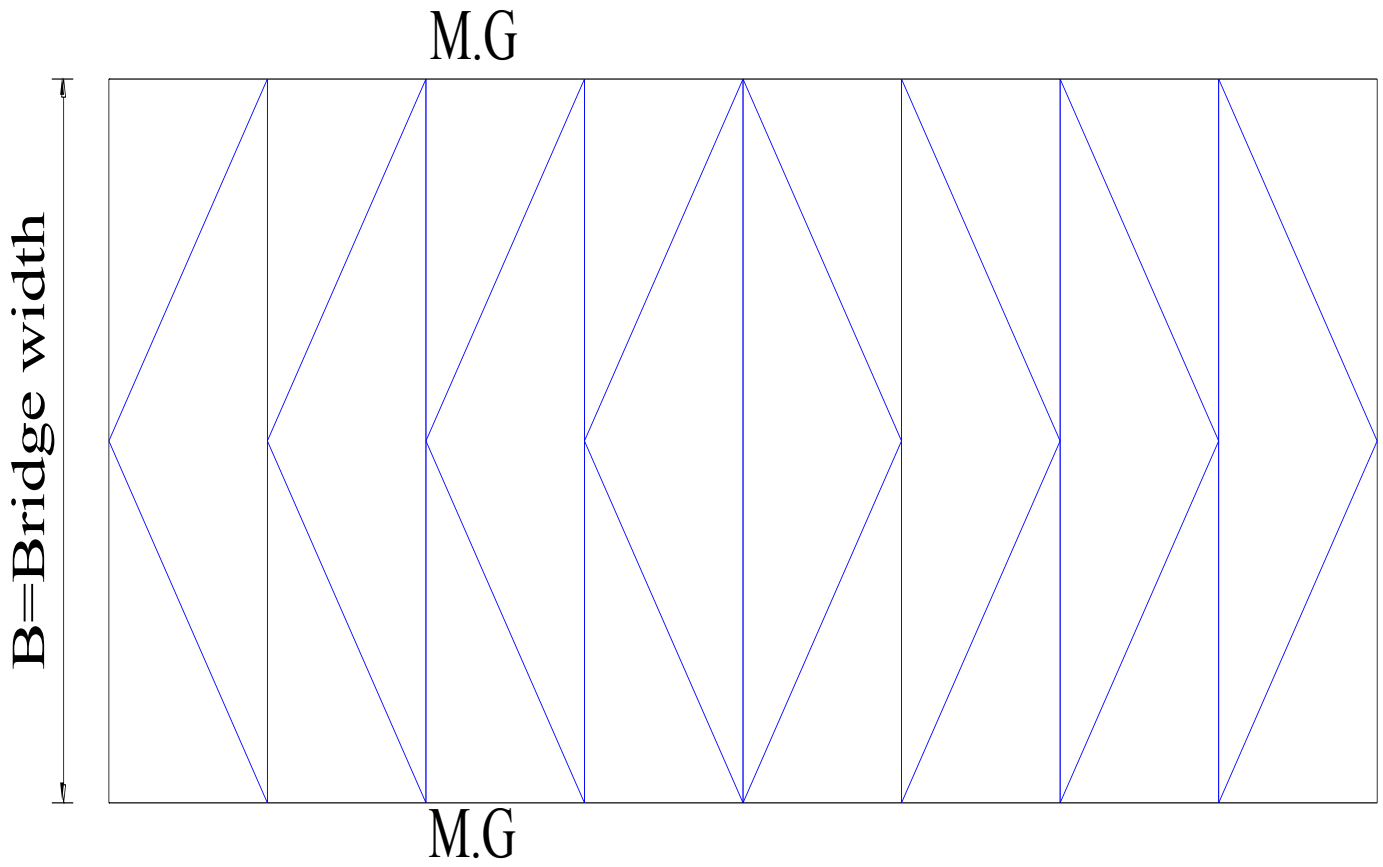

Upper Bracing

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2.2 Types of Bridges

2.2.1 Introduction

In designing the different parts of a bridge we must investigate carefully how the loads are transmitted from one member to the next. We must follow the loads from the point of application up to the abutment. All members and all connections should have the same factor of safety. The strength of the whole structure depends on the weak part. The design of the details is just as important as the design of the main members; failure is generally caused by a weak or wrong detail. For the computation and design of the different parts of a steel bridge, the same method is used as for the corresponding members of steel buildings

But on account of the bigger spans and greater loads, much bigger cross section is required. Bridges can be classified according to many factors like purpose of the bridge, system of main girders, considering the position of the bridge floor, square or skew bridge, and fixed or movable bridges. In the following section we can see these different classifications.

Classification of bridges

1. Classification according to purpose of the bridge

a. Railway Bridge.

b. Roadway Bridge.

c. Foot bridge.

d. Combined bridge as Embaba Bridge.

2. Classification according to system of Main Girder

a-Simple Bridge.

The main girders are resting on two supports only. They may be: - beams, plate

girders or trusses. One of the supports is hinged while the other is movable and thus these bridges are externally statically determinate. But internally they may be either determinate or indeterminate.

b-Continuous Bridge.

The main girders are continuous trusses or plate girders on three or more supports. One bearing only of each girder is hinged, while all the other must be movable to avoid

temperature stresses. Vertical loads acting on a continuous girder give also vertical reactions, but the bridge is statically indeterminate. A settlement of one of the piers produces additional stresses; therefore continuous bridges should be built in places where we have firm soils.

c- Cantilever Bridge.

The main girders extended over several spans but they have many intermediate hinges that the reactions are statically determine. For n supports we have to odd n-2 hinges. In a cantilever bridge the settlement of support does not affect the stresses. When foundation is not firm enough, either simple bridges or cantilever bridges should be used.

D- Arch Bridges.

An arch is a structure which under vertical loads produces inclined reactions at both supports.

We have 3-hinged, 2-hinged and fixed arches.

1-Three-hinged arches are statically determinate; hence, horizontal displacement of the abutments does not produce any additional stresses on the structural system.

2- Two-hinged arches and the fixed arches are statically indeterminate; hence, displacement of the abutments produces additional stresses in the structural system. Furthermore, foundations of such arches should be on rock or on very solid gravel.

e- Suspension Bridges.

Cables of suspension bridges are made from very high tensile steel. The allowable deflection is about 10 cm.

The floor is hung by vertical suspenders from cables. These cables are carried by vertical steel towers A-Q, B-V over which it posses and are anchored at P and V.

A saddle top of each tower is provided to relieve the tower from B.M. The reaction at top of tower is nearly vertical. Stiffening, girders must be used to reduce the deflection and vibration of the bridge due to the moving loads. Suspension bridges are of good appearance but they are economical only for long spans (> 300 m).

f- Three Chord System Bridges.

The arch trusses with a tie bow-string are simply supported. They are externally statically determinate, and once internally statically indeterminate. They are good appearance but rather expansive than trusses with two chords.

3. Classification according to position of bridge floor

Fig(2-7)

a- Deck Bridge.

In which the floor is or near the top chord or flange of the main girders.

b- Through Bridge.

In which the floor is or near the bottom chord or flange of the main girders. The distance (h) is called the height of construction, it is the height between the top of rails or road way and the lowest line of the bracing.

If there is a sufficient height of construction a deck bridge should always be arranged as it is more economical stiffer, and of better appearance than through bridge.

In a railway deck bridge the distance between the two main girders can be made less than in a through bridge therefore the weight of the cross-girder and wind bracing would be less.In Roadway bridge, the reinforced concrete floor may rest on several main girders.

4-Classification according to the layout of the bridge (square or skew bridges)

The centerline of the square bridge is perpendicular to centerline of the canal, while in skew bridge they are at oblique angle. Fig(2-8)

5-Fixed bridges and Movable bridges.

Movable spans are required in bridges crossing navigable streams if the height below the bridge is not sufficient for the passage of ships.

Three major types of movable bridges are in common use:-

a- The vertical lift bridge.

b- The bascule bridge.

c-The swing bridge.

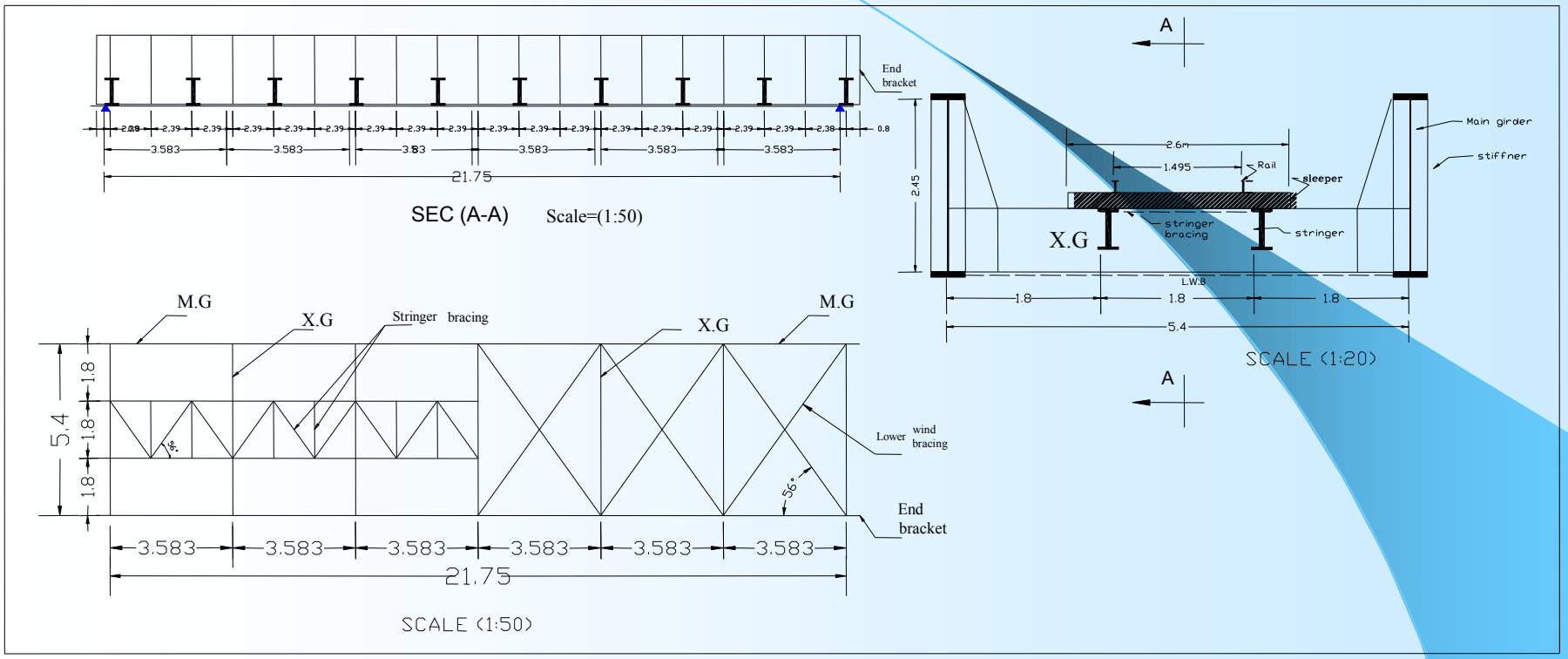
End bracket
2.39
3.583
21.75
0.8
SEC (A-A)
Scale=(1:50)
A
Main girder
stiffner
2.6m
1.495
Rail
sleeper
2.45
X.G
stringer bracing
stringer
LW.B
1.8
5.4
SCALE (1:20)
M.G
X.G
Stringer bracing
Lower wind bracing
56°
End bracket
SCALE (1:50)

Fig 2-1

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Systems of Main Girder

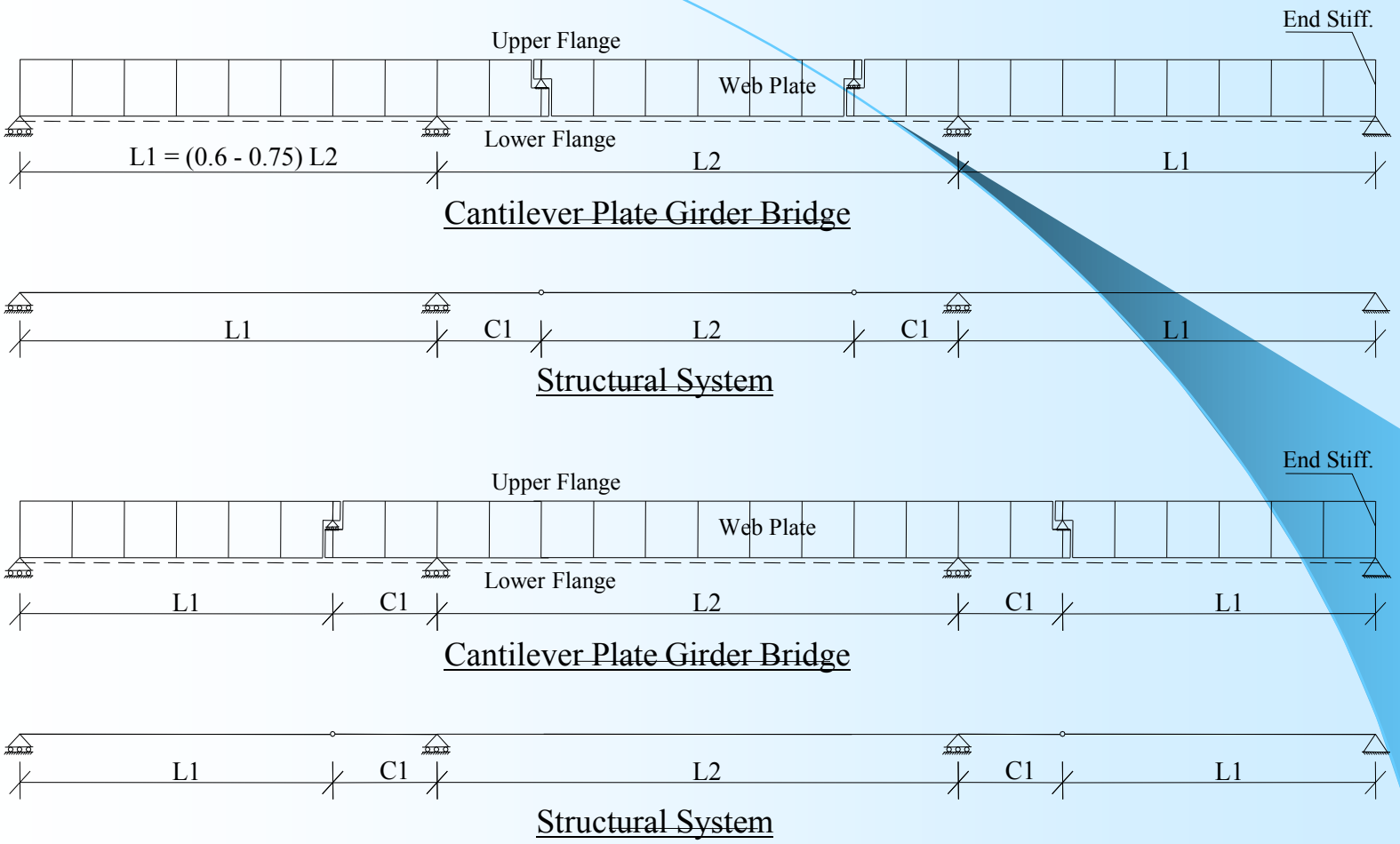

Fig 2-2

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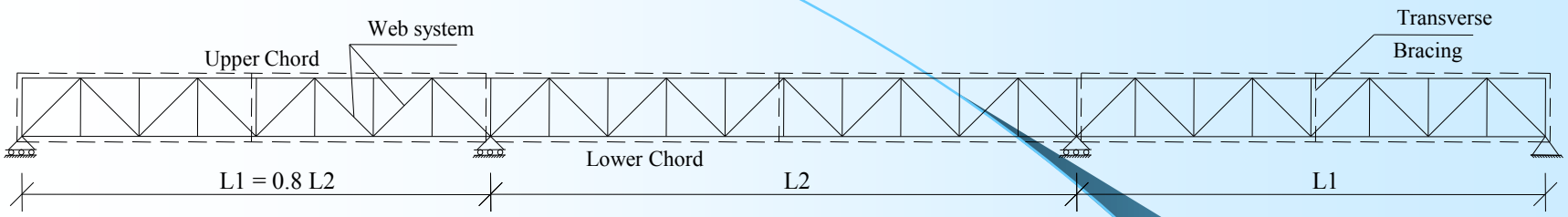
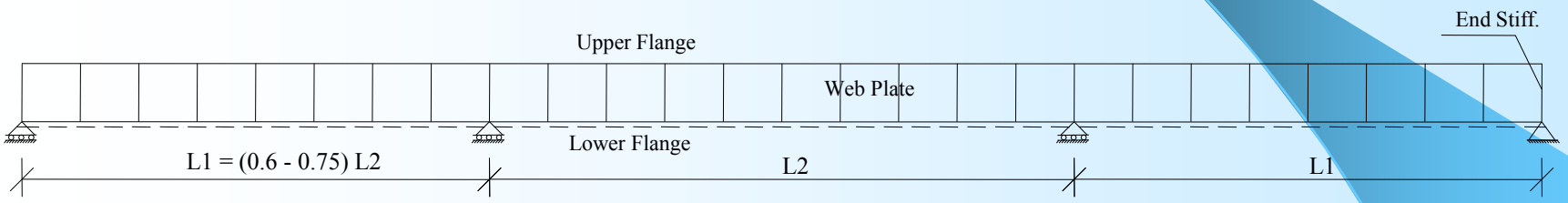
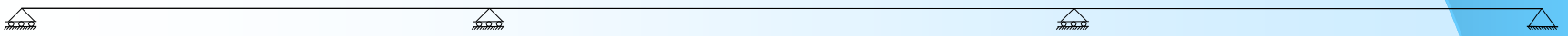
Systems of Main Girder



ContinuousTruss Bridge



ContinuousTruss Bridge



Structural System

Fig 2-3

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Systems of Main Girder

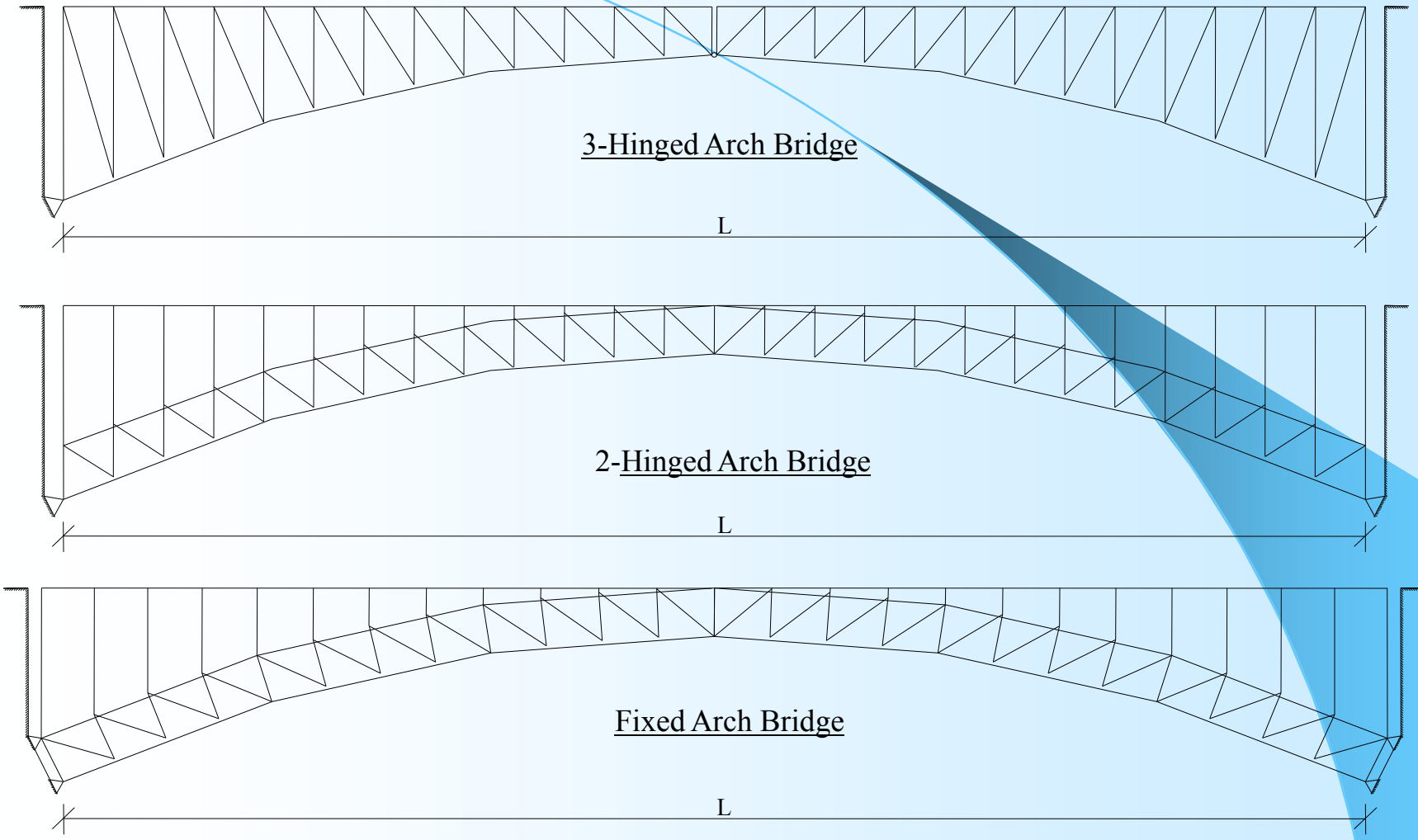

Figure 2.4

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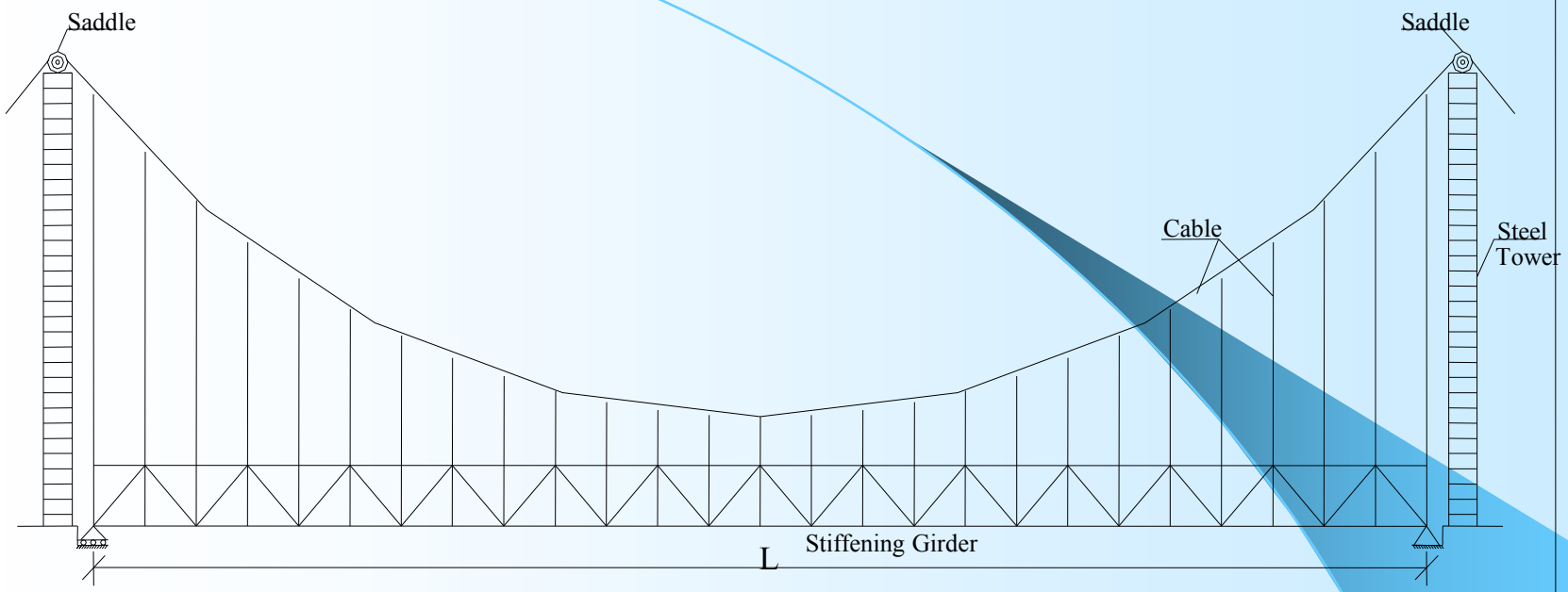
Systems of Main Girder



Suspension Bridge

Figure 2.5

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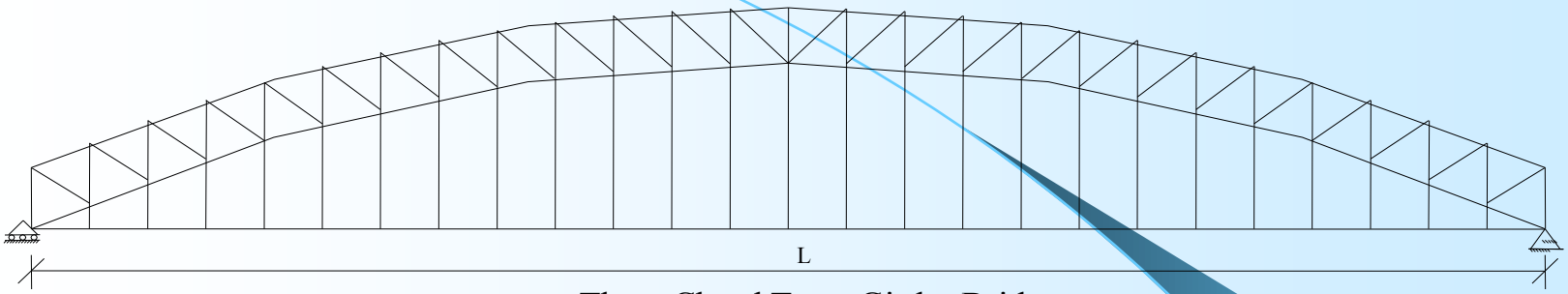
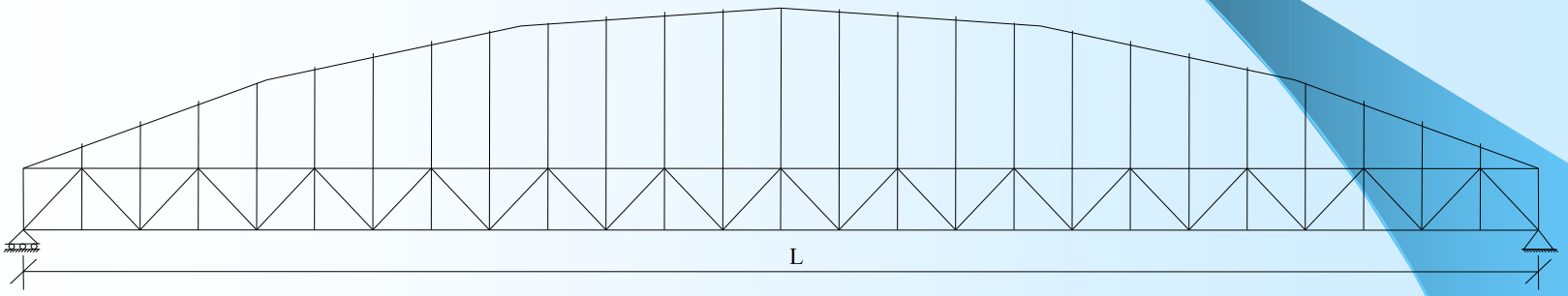
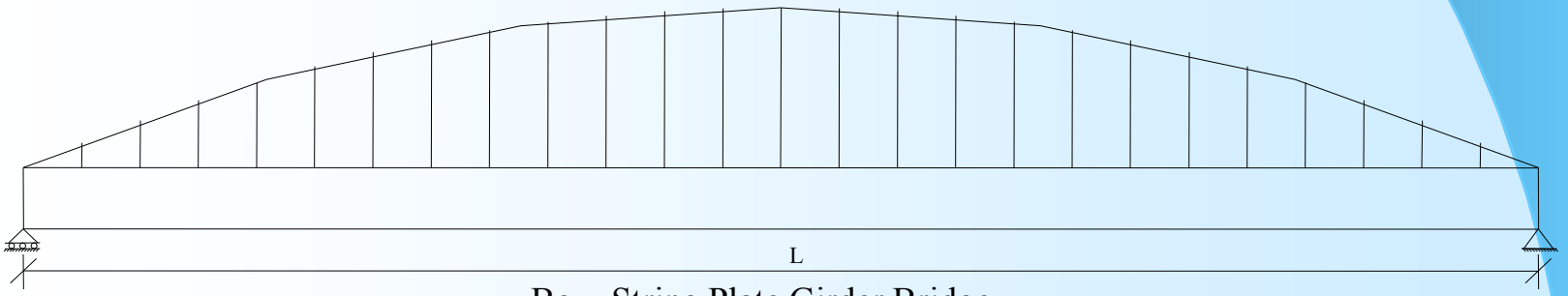
Systems of Main Girder



Three Chord Truss Girder Bridge



Bow-String Truss Girder Bridge



Bow-String Plate Girder Bridge

Fig 2-6

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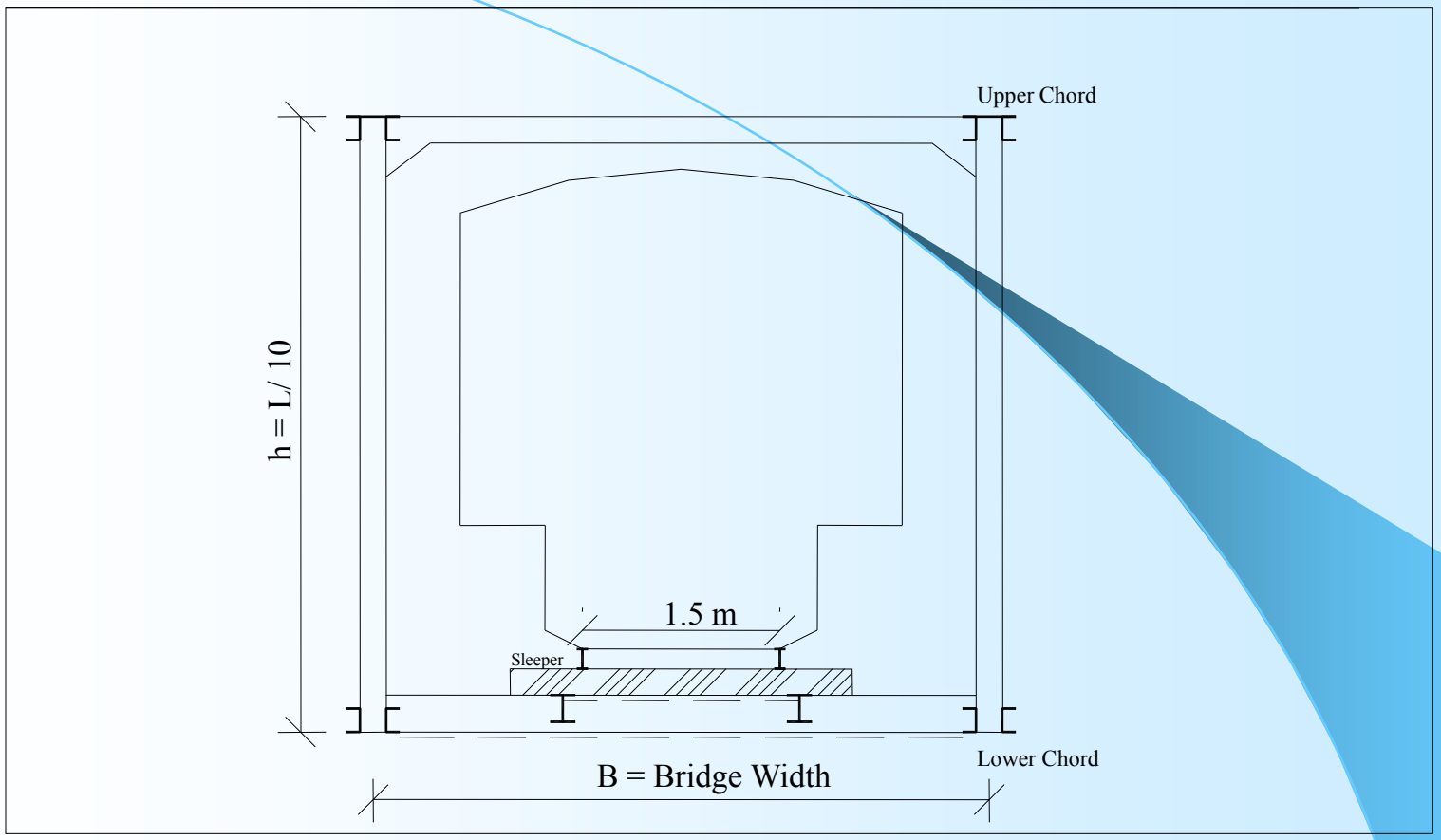

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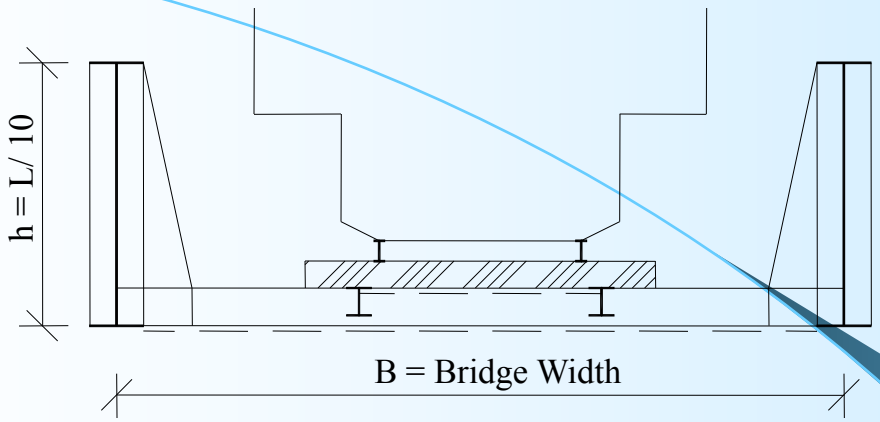
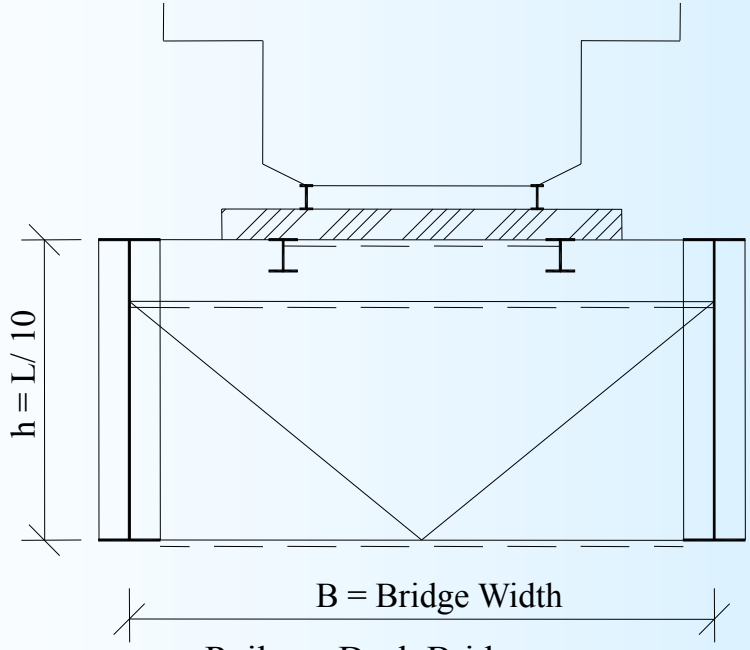


Railway Through Bridge



Railway Deck Bridge

Figure 2.7

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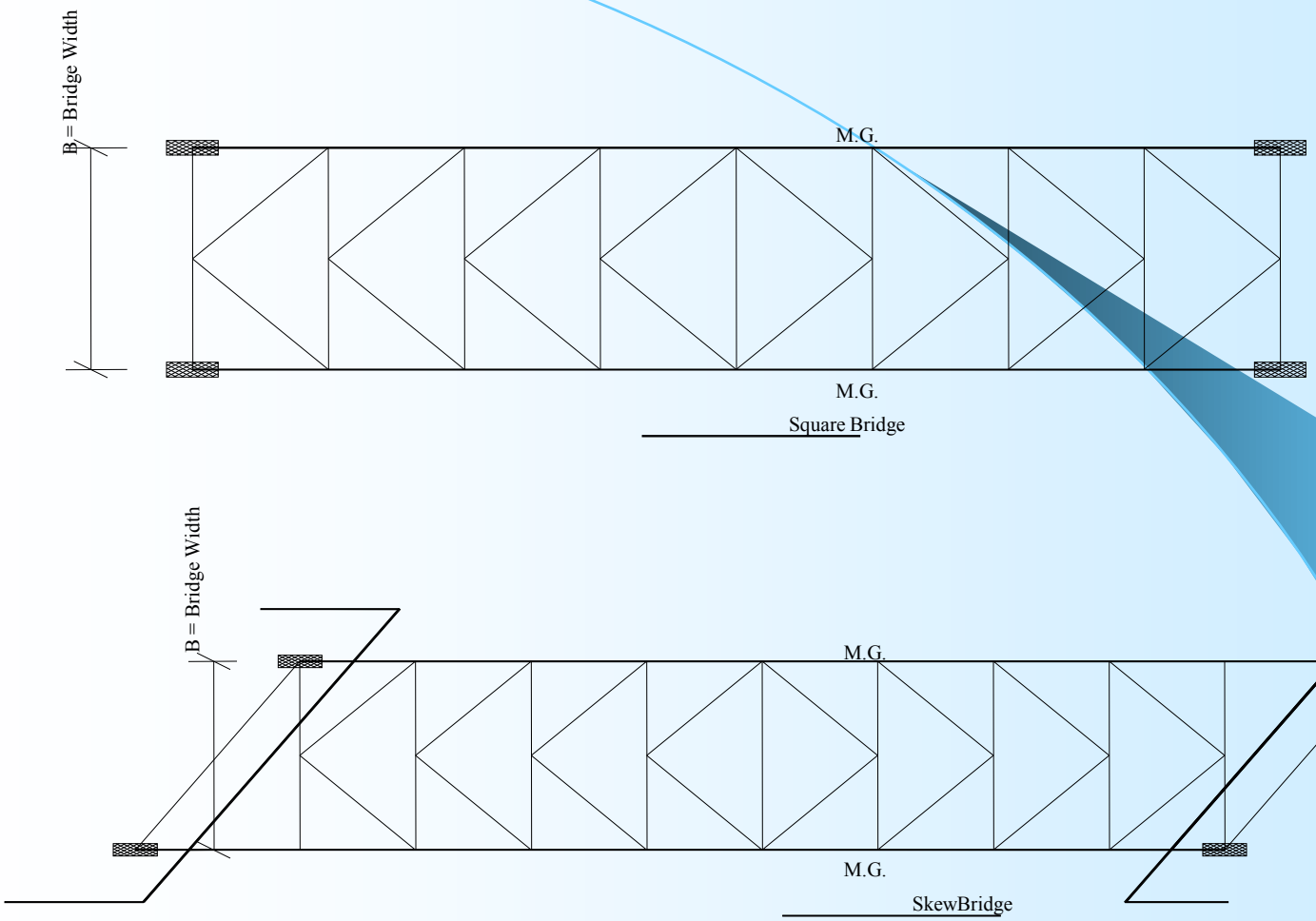
B = Bridge Width
M.G.
M.G.
Square Bridge
B = Bridge Width
M.G.
M.G.
SkewBridge

Fig 2-8

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