

The Layout and Design of the Urban Irregular Bridge

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ABSTRACT

The layout and design of the urban irregular overpass that crosses the railway passenger dedicated lines, the common passenger station, the comprehensive hub of the first urban main tract and many urban facilities is introduced in a medium-sized city. We study the design of the bridge type on the projected traffic flow, the design of the cross section of the structure on the requirements of lane, the various measures on the conception of safety and environmental protection, the structure optimization on the different functional requirements. The design characteristics of the above is of great reference value for the bridge builders that design the urban bridges of complex geomorphic.

PREFACE

With the development of bridge technology, the shape of the bridge structure is more flexible. In order to make the bridge and the surrounding environment to be combinative perfectly and meet the requirements of the bridge landscape, many cities begin to use profiled component in designing bridges.

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This paper introduces the irregular bridge structure of a medium-sized city in the central plains. As shown in figure 1 two irregular bridges in the east and in the west respectively by the left ramp and right ramp connects the high-speed railway station. Two irregular bridges across the tracks in the east and in the west. At the same time the south of the city and north of the city are also closely linked together. It is convenient for the passengers in the station. It solved the problem that a city is broken up by the Longhai railway for many years. It is not inconvenient for the urban residents. It restricts the development of the urban economy. The new high-speed rail station is two floors of the system of the frame structure. The second floor is the waiting area and the parking lot. The urban passengers in the north directly arrive at the waiting area on the second floor of the high-speed rail station by two irregular bridges in the left and in the right of the north square (as shown in figure 1, 2). The vehicles are parked in the parking lots of the second floor and leave on its own after sending the passengers. The passengers of the south city can arrive directly to the waiting area of the high-speed rail station on the second floor. By the western irregular bridge (as shown in figure 3) the vehicles are parked in a parking lot. They can choose two routes (route as shown in figure 4) to leave after sending passengers. One route leads to the south of the city through the programmed into the east irregular bridge and other route is leading to the north of the city. Each transport hub is closely linked together by the reasonable layout of the irregular bridge. It is convenient for people to travel. The Concorde curve used in design linear of the bridges linear can make the bridge more beautiful and stretching.

The irregular bridges of the city are designed on two-way six lanes across the Longhai railway, zhengxu guest, the shanghe guest. Non-motor vehicles span the railway by the framework and u-shaped slot channels. The system of the ground transportation is formed by the main girder, the ground and underground passage (as shown in figure 2).

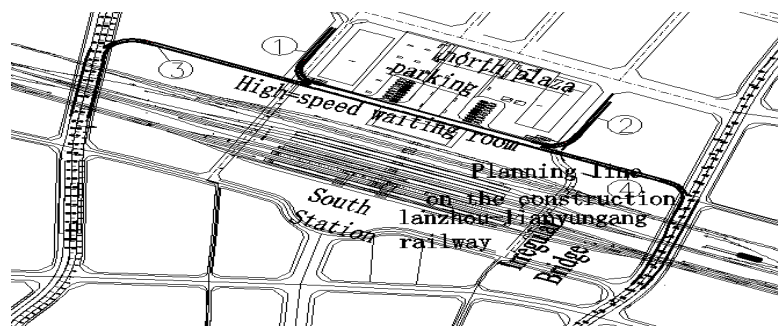


Figure 1. The planar graph of the overpass.

THE STRUCTURE DESIGN

The overpass with six lanes is located in the easement curve line. The fourth united overpass is formed the section of a single box 3 rooms and straight girder cross as shown in figure 3. The straight girder cross section for the construction is very simple and easy to control the quality of the construction. Variable cross-section is set to direct web. If fixed up into inclined web, in order to meet the requirements of the reinforcement. The web is kept in the same plane, so the width of the bottom plate of the high cross section of is too small. It is not helpful to the arrangement of bearing. The first triple located at the circular curve and easement curve. The inclined web section of a single box 3 rooms is used as shown in figure 4. The web and the flange plate, base plate and outer contour transition are in circular arc transition. The inclined web can increase the torsional performance and reduced the bottom width, so the width of the pier top is effectively reduced. The top and bottom of the bridge looks more harmonious and beautiful. The design of the upper structure of the bridge is very reasonable.

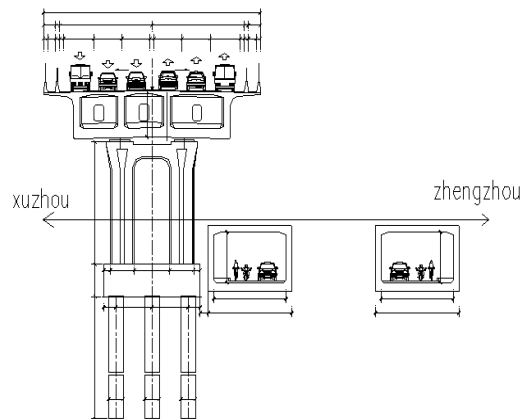


Figure 2. The system of the traffic.

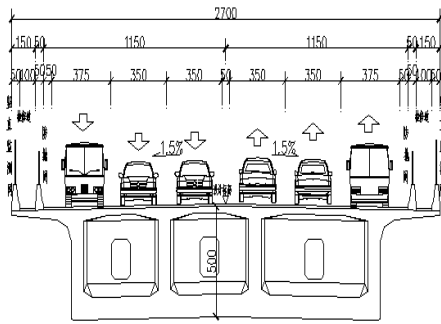


Figure 3. Vertical web section

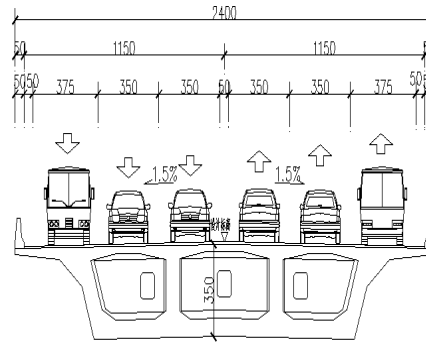


Figure 4. Inclined vertical web section.

The 15th pier as shown in figure 5 is located in the transition zone where the main line of the bridge and the ramp of the elevated bridge are connected. The section size of pier top is 3.7*2.3. The section size of pier bottom is 2.7*1. The Vase pier is used in the design of the bridge pier. It meets the stress and safety of structure, it is also very beautiful.

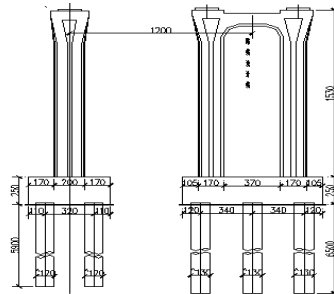


Figure 5. The fifteenth pier.

SAFEY AND ENVIRONMENTAL PROTECTION

The wide of the overpass standard section with the two-way six lanes is 24 m. The overpass spans the Longhai railway and the planning shanghe guest. The two sides of bridge are set the wall every 1 meter for the safety of railway operation. The midst of wall is set up 1 m buffer period and check channel. The main purpose is to prevent vehicles on the irregular bridge damaging the train and the train tracks. The cast net is set in the 9th to the thirteenth holes of the bridge. The setting range of the hole is extended outward to the rail. It can prevent passengers in the vehicles discarding the waste. It avoids damaging the train. The wire and other ancillary facilities. The 252.75 m web is set on both sides of bridge to prevent the damage of

the special railway line and the train. It prohibits the pedestrians and non-motor vehicle from passing through the bridge.

In the process of the bridge construction, the things of the bridge deck and the hanging basket (including water) do not fall into the catenary. For avoiding the railway outage and causing the major events, so the protection trellis is set on the railway. The lightning-proof grounding device of the hang basket must be set and reserved enough safe distance (50 cm) with contacted net lines. The scope of the cable within 3 m column and vertical and horizontal beam all needs to be used the insulated adhesive for safety as shown in figure 6. Strictly according to the railway construction period, the segmental schedule must be arranged in advance and reported to relevant railway departments. The key parts of the bridge are constructed by the time that the railway arranges as the movement of the hanging basket, the pouring of the concrete. Before the construction it should be reported to railways and approved by the leader of the relevant railway .We should check and reinforce insulation in the power grid of the construction for safety.



Figure 6. Protective measures.

THE COMBINATION OF DESIGN AND CONSTRUCTION

The difficulties that the Longhai railway bring should be considered for the bridge construction in the process of designing bridge .Therefore the across is not designed in the Longhai railway. When it crossing the Longhai railway, the section of the bridge is designed the same width of the section for the convenience of the construction. The hanging basket is used in the construction, rather than the full space support. If the variable section of the bridge is designed in the stage of the Longhai railway. It brings great difficulties for the construction. When do not across the Longhai railway. The section is designed the unequal width of the section, used cast-in-place construction. The wide stage of the section is not designed in the Longhai railway.

The section of the irregular bridge is a single box 3 rooms and anon symmetrical section that the size of three rooms is inconsistent. In the wide stage of the section the size of left ventricular width b and middle ventricular width is gradually increasing. But the size of the right ventricular consistently keeps into 790 cm as shown in figure 8. In the whole construction process we only change the left

ventricular and the section location. The arrangement and number of the reinforcement of the floor and roof of web. But the location of the floor of the right section, the arrangement and number of the reinforcement remained the same. The reasonable design of the section not only meets the force of the box girder, but also is convenient for the construction process and speed up the construction progress.

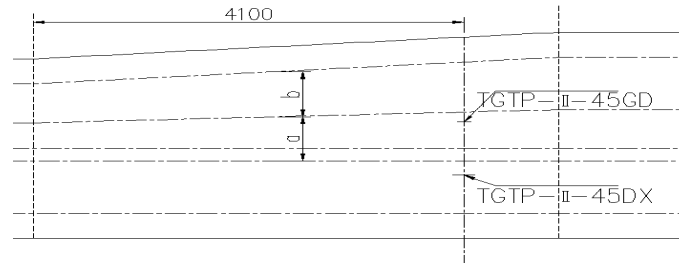


Figure 7. The broaden stage of the section.

THE CALCULATION AND THE DISTRIBUTER CHARACTERISTICS

The calculation of the irregular bridge is used Midas/civil to set up the bridge model as shown in figure 8. Because the force of the variable cross-section is very complex. Such as the wider stage of the section is analyzed the force to ensure that reinforcement course is concise and rational. For the right reinforcement we not only needs to clearly grasp the change of the structure internal force, but it also need to carefully consider the actual construction process. Complex reinforcement tasks can be solved by the elaborate design. The wide stage of the section that analyzed after force shows the web mainly bears the shear. The roof and web of bridge mainly bear the tensile and compressive stress. We arrange the steel by the characteristics of the force. The steel mainly bear tensile stress and the concrete bear compressive stress. They play their respective advantages on the strength. It greatly improves the bearing capacity of the concrete. It can make the structure is safe and reliable, and ensures the durability of components. According to the mechanical characteristics, the bending reinforcement should be configured in the roof mainly bear pull and pressure and floor. The main reinforcement direction should be kept possibly with the direction of the main tensile stress. The concrete is the most advantageous to bear and simplified the reinforcement, also reduces the cost. On the condition of protective layer torsional stirrups and longitudinal reinforcement are decorated around the surface of component, increasing the effect of torsional. The web mainly undertakes the shearing stress. We not only decorate the torsion reinforcement, but also should decorate shear reinforcement. The reinforcement is decorated in the inside of the stirrup. The type of the longitudinal reinforcement in the middle web is $\Phi 12$. The type of the longitudinal reinforcement in the left and right side web is $\Phi 16$. The type of the top and floor plate is $\Phi 16$. The type of the web is $\Phi 16$. The type

of reinforcement is $\Phi 25$ in the upper and lower side of longitudinal reinforcement. According to the mechanical characteristics, the reinforced type of the different location of section is used is different.

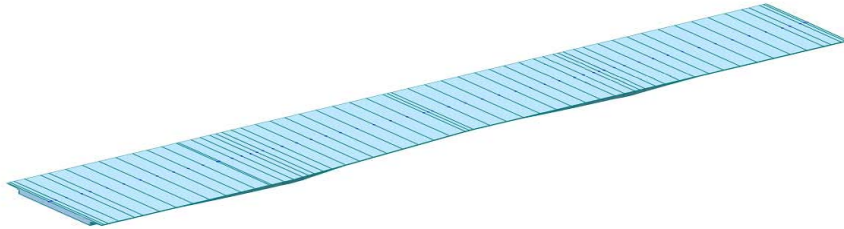


Figure 8. Midas/Civil model.

CONCLUSION

With the vigorous development of the country's infrastructure the scale of the bridge is more and more big, a large number of the Irregular Bridges appear continuously. The traffic organization of the urban bridge is different from the highway Bridges, it should be put important position, especially the urban overpasses. The urban Bridge is not only the important buildings in cities, but also beautifies the environment. It requests the bridge workers to design the bridge by urban planning, urban traffic, environment protection, the aesthetics and coordination of the bridge, the optimization of the bridge. The Irregular Bridges that has built is helpful for the future design and construction of the similar Bridges and provide valuable experience.

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