



## Designs of Bridges in the Hirose-gawa Area Determined by Competition

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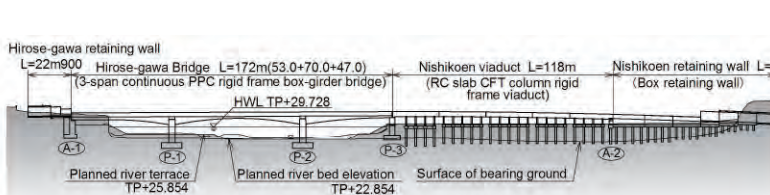
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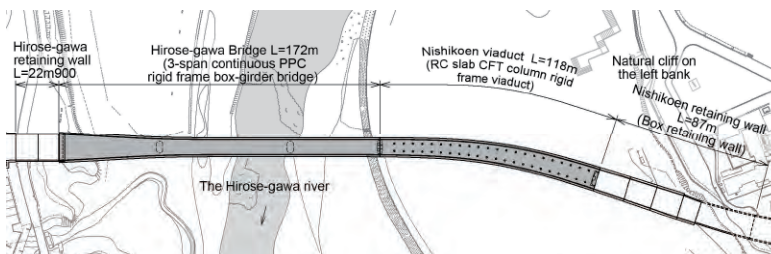
### Summary

The bridges (the Hirose-gawa Bridge and Nishikoen Viaduct) are the structures of the Sendai Subway Tozai Line cross over the Hirose-gawa River and Nishikoen Park. These structures are passes through the scenic Sendai area that is called "Forest city". Sendai City required the two bridges an excellent aesthetic design constructed for such an important area. In 2006, the city held a design competition to select the design. It was the first design competition as railway bridges in Japan. The winners of the competition were consigned the design of the bridges [1], [2]. Construction works, which have been conducted since 2008, are planned to be completed in 2013, and will be followed by installation of rail tracks. The outline of the fully worked-out plan for realization of a very exceptional bridge design and construction will be reported in this paper.

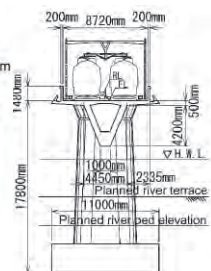
**Keywords:** design competition, structural design, PPC rigid frame bridge, CFT rigid frame viaduct



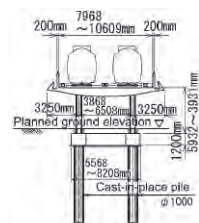
*Fig.1 Cross-sectional view of the plan*



*Fig.2 Plan view of the plan*



*Fig.3  
The Hirose-gawa  
Bridge*



*Fig.4  
The Nishikoen  
Viaduct*

Construction Period : Dec. 2008 – Sep. 2013

Location: Aobayama, Aobaku of Sendai City, Miyagi prefecture, Japan

## 1. Outline of the structures

Fig.1-4,5,6 show the outline of the bridge structures. The notable feature of the bridges is that even though the structures of the river bridge and the viaduct differ clearly, they have continuity and unity in their appearances by the open channels along the outer sides of the both structures. The open channels, working as drainage devices, soften the heavy impression of wall railings. Several modifications were made on the initial plan to formulate a final plan that realized the points proposed at the competition (Fig. 7).



*Fig.5 The shape of the Hirose-gawa Bridge*



*Fig.6 The shape of the Nishikoen Viaduct*



*Fig.7 Wide overhang for the open channel*

## 2. The Hirose-gawa Bridge

### 2.1 Bridge plan

In designing the Hirose-gawa Bridge the arches of the Ohashi Bridge which is located about 200m downstream of the Hirose-gawa Bridge were taken into consideration. The Ohashi Bridge had created the image of the space around it since the early years of the Showa era. The new bridge that was decided to a 3-span continuous concrete bridge with variable section was designed to create a double silhouette with the Ohashi Bridge.

### 2.2 Structural design

This bridge has a PPC structure. The height of pier is 10m, which is low for the maximum span length of 70m. High earthquake resistance, and maintenance and economical efficiencies were provided by the rigid frame structure, which was determined after considering the possibility of decrease in stiffness when cracking occurs in the piers.

## 3. The Nishikoen Viaduct

### 3.1 The RC slab CFT column rigid frame structure

The structure of this bridge is a special rigid frame structure, in which multiple CFT columns connected with the RC underground beams directly support the RC slab. The structural design was achieved by using a frame model that showed the rigid frame structure made up of the slab, the CFT column, and the underground beam. In the modeling of the slab, the effective width of the slab was determined based on the distribution characteristics of normal stress obtained from a 3-D elastic FEM analysis. A beam member that had the resultant effective width replaced the slab.

## 4. Conclusion

At the time of the Great East Japan Earthquake of March 11, 2011, the Hirose-gawa Bridge was under the cantilever processes. Only minor cracks were founded (max. width of 0.3 mm) in the proximities of the heads of P1 and P2 piers in the detailed inspection after the earthquake. They were considered to be caused by the earthquake and repaired in due course.

The construction work was launched after detailed inspection in July 2011. The construction of the bridges was completed in September 2013. The Tozai Line is planned to open in 2015 fiscal year flowing the installation of rail tracks, works for electrical facilities.