Exploration of a New Rigid-Frame Arch Bridge Constructed by Vertical Downrotation

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Summary

A new rigid-frame arch bridge structure spanning over deep valley and river in mountainous areas was proposed based on the advantages of both above. Then its structural characteristics, downrotating vertically construction technology and techno-economic benefits were analyzed. The researches and engineering application show that the rigid-frame arch bridge is simple, safe and efficient in construction without broad constructing yards, and behaves good mechanical properties, structural integrity and aseismatic ductility.

Keywords: rigid frame arch bridge; rotating down vertically construction; structural property.

1. Introduction

In western China, there are many high mountains and deep valleys. With rapid progress in China's Western Development Program, high-grade highways extend to these mountainous areas at present. So many bridges will be constructed spanning over the deep valleys and rivers. And they control the construction duration and cost of whole highway to a great extend. Western China is developing slowly in economy. Existing low-grade highways limit large constructing equipments into the mountainous areas. And there are limited constructing yards. So it is important for safe and economical bridges to choose optimum structures and their construction methods. In this paper, a new rigid-frame arch bridge was proposed with downrotating vertically construction.

2. The new rigid-frame arch bridge

2.1 The structural characteristics

The conventional arch bridge and continuous rigid frame bridge have different advantages and disadvantages respectively. A new rigid-frame arch bridge structure combines their advantages

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together, which has three linear segments of the arch rib under combined pressure and bending [1]. The spandrel structures and substructures are the same as the conventional arch bridge. To bear the moments and its induced tensile stress, there are some post-tensioned steel strands bedded in the inclined and horizontal arch ribs. This bridge is between the conventional concrete arch bridge and continuous rigid frame bridge in structural form, span and mechanical performance.

2.2 Downrotating vertically construction technology

Fig. 1 shows the construction technology of vertical downrotation for the rigid-frame arch bridge. At first, half the arch ribs are constructed in pillar on two banks respectively, and then rotated down vertically, close up and form two whole arch ribs finally [2].

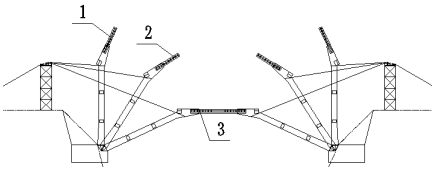

Fig. 1: Downrotating vertically construction technology of the rigid-frame arch bridge

Fig. 2: The Gulu Middle School Overpass Bridge with the rigid-frame arch structure

2.3 Application

The rigid-frame arch structure has been successfully applied in Gulu Middle School Overpass Bridge over Chongqing Yulin highway shown in Fig. 2 [2,3]. This overpass bridge is designed with span of 40m and loading of automobile-20ton and trailer-100ton in China National Standard.

This application shows that the rigid-frame arch bridge and its vertical downrotation are simple in technology, economical in assistant equipments, safe and efficient with short duration and limited constructing yards. These obvious techno-economic advantages make it possible for this bridge to be widely applied in mountainous areas. And there is much hope of increasing its span to above 100m.

3. Conclusions

The new rigid-frame arch bridge proposed is between the concrete arch bridge and continuous rigid frame bridge in structural form, span and mechanical properties. It's half the arch rib is constructed in pillar respectively at first, and then two halves are rotated down vertically and close up. This bridge structure and its downrotating vertically construction have obvious techno-economic advantages in mountainous areas with deep U-shaped and V-shaped valleys. The rigid-frame arch structure has been successfully applied in Gulu Middle School Overpass Bridge with span of 40m.

4. Acknowledgements

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