

The Reinstatement of Tengcun Rotary Bridge



Background

Due to a once-in-a-century deluge in 2016, 11 bridges in Wangdong Village, Rongshui Miao Autonomous County, Guangxi Zhuang Autonomous District were damaged. The government planned to rebuild bridges to reconnect the main roads. However, bridges like the Tengcun Bridge did not receive any funding from the provincial government. Project Mingde therefore offered to help the villagers.

Resulting damage



Figure 1: Damaged Tengcun Bridge

Figure 1: 3 out of 8 piers were damaged. Tengcun Bridge was accessible only to pedestrians but vehicles were not allowed to cross the damaged bridge.

Solutions considered

After visiting the site and holding numerous meetings for many times, we suggested 3 different possible remedies to reinstate the bridge.

Solution 1 – 3 piers with 4 spans (reinforced concrete)

The original configuration and appearance of the bridge are maintained using new piers and decks with each at a span of 12 meters (Figure 3). Foundations of the piers are connected and strengthened with gabion wrap (rock put in wired steel cages (Figure 2)) to prevent scouring (soil below foundation being washed away). Filler of the gabion wrap is to be rocks gathered from the nearby river.



Figure 2: Gabion wrap

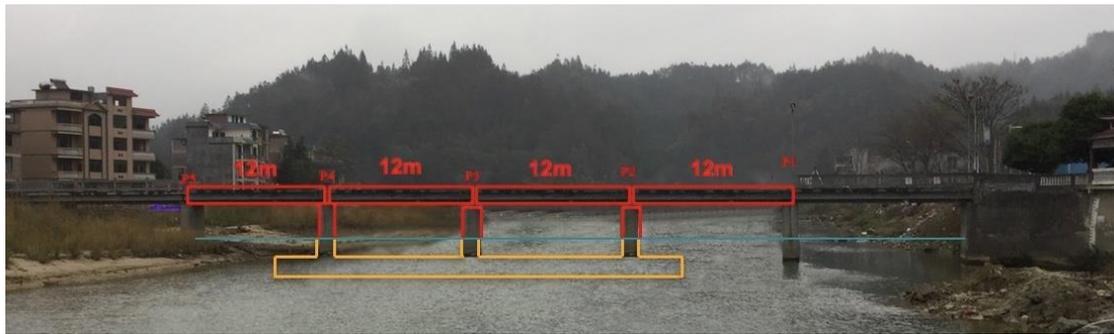


Figure 3: Solution 1

Solution 2 – 2 piers with 3 spans (reinforced concrete)

This solution consisted of 2 piers only. The span length is adjusted to 12 meter, 24 meters and 12 meters (Figure 4). The 12-meters spans are same as that in Solution 1. However, depth of the 24-meters-span needs to be increased as the length is increased. The foundations are the same as in Solution 1 except not being connected in this case.

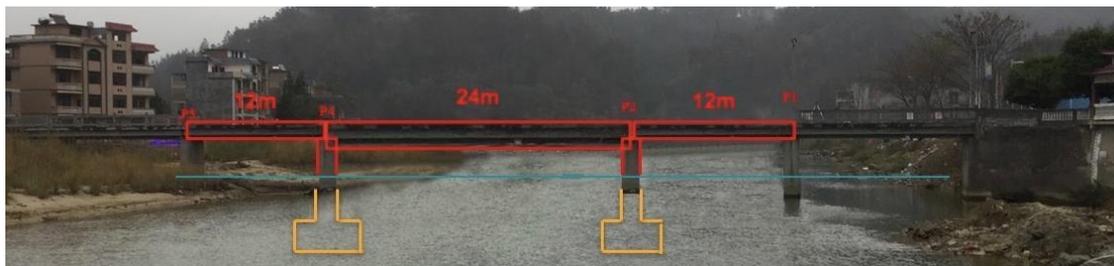


Figure 4: Solution 2 & 3

Solution 3 – 2 piers with 3 spans (steel)

This solution is similar to Solution 2 except that structural steel is used for the 24-meter span. For purpose of maintenance steel beams however need to be repainted every 2-3 years to prevent corrosion.

Solution adopted

However, with closer evaluation, all 3 solutions were considered to be too expensive and not cost-effective. After much deliberation with the villagers, concerned parties decided on a practice frequently applied for bridge repairs in the Mainland which cost much less than the RMB2million estimated for any of the 3 suggested solutions. The structure of the bridge was accordingly restored and realigned to its original position by methods of jacking and subsequently strengthening its foundations. The solution consisted of 3 separate stages.

1. To begin with, rocks and sand nearby were used to divert temporarily the flow of the river so as to provide a dry working platform for the restoration work.



Figure 5: Bridge with River Course Temporary Diverted

2. Afterwards two temporary mass concrete supports (Figure 6) were built to realign the structure and jack up the bridge decks. To reduce the overall cost sand and rock from the river bed were used for the temporary mass supports.



Figure 6: Temporary Concrete Support

Workers used jacks to push the bridge decks back to its original level. Timber wedges were jammed in at steps as temporary support while the decks were being slowly raised. By repeating this process, the bridge decks were restored to their original positions. Four structural steel metal cylinders were finally installed to support and stabilize the overall bridge deck.



Figure 7: Bridge Restored to Original Level

3. Finally, foundations of the piers were connected together with reinforced concrete to provide stronger stability. Pipes were installed between piers to ensure water can still flow through freely.

A Reinstated crossing

After months of repair the bridge was completed and re-opened on 24th August 2018. The village held a celebration ceremony on 22nd October 2017 and renamed it Tengcun Rotary Bridge (Figure 8).



Figure 8: The Tengcun Rotary Bridge

Conclusion

The damaged Tengcun Bridge was successfully restored and reinstated with the collaborative wisdom and effort of Project Mingde and the villagers at a much reduced cost of RMB600K - jointly funded by the Rotary Club of Kowloon, the local government and contribution from villagers. The project was a valuable and practical out-of-classroom lesson to students with little and limited resources. The remedial method might not be the best one in terms of what we learnt from books and theories, but it was no doubt a cost-effective and optimal solution under prevailing circumstances.

Acknowledgement

We would like to express our deepest gratitude to the Rotary Club of Kowloon and its members for supporting and funding the repair and reinstatement of the Tengcun Bridge as well as to villagers of Tengcun for their assistance and cooperation.

We would thank our professors and tutors for their guidance and encouragement, and to our fellow Project Mingde students for their participation, hard work and contribution all at the same time.

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For and on behalf of

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