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THE GOLDEN BRIDGE – A FOOTBRIDGE OVER THE SARAWAK RIVER

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Summary

This paper highlights the design and construction challenges faced during the planning and execution phase of the Golden Bridge with a focus on the primary steelwork and cable installation. With a total length of 300m and a maximum clear span of 120m, this unique cable-stayed pedestrian footbridge features two inclined towers and a S-shaped walkway which are made using steel. The Golden Bridge highlights the collaborative effort among the state government, architect, engineers and builders to create an iconic landmark in the city of Kuching. The design of this iconic bridge incorporates various key aesthetic features that are local and unique to the city of Kuching. These features add to the complexity of the bridge in terms of design and construction which brings about various challenges that had to be overcome. Some of the challenges faced are mitigation of the dynamic response of the bridge under pedestrian induced vibrations, site constraints, working over a river, access for workers, cable tensioning and the required precision of steel fabrication. The construction of the Golden Bridge made use of an efficient project execution plan that minimizes construction risks of working on the Sarawak River. The entire construction sequence was analysed to ensure the integrity of the execution plan and to identify potential critical members that require temporary reinforcements during installation. From the initial conceptual design, the Golden Bridge has evolved to what it is today which is evidence of a successful collaborative work among various disciplines.

Keywords: aesthetics; inclined towers; cable-stayed bridge; S-shaped walkway; construction analysis; temporary works; construction over river; construction challenges; splice connections

1. Introduction

In the year 2009, Tuan Yang Terutama (TYT) Abdul Taib Mahmud, who is the ceremonial head of state of the Malaysian State of Sarawak, had conceptualized the idea of the Golden Bridge as an opportunity to rejuvenate the city of Kuching and to connect the traditional Malay villages at the North of Kuching with the urban district located at the South.

2. Features of the Bridge

The design of the Golden Bridge (Figure 1) was inspired by the local heritage as well as the native flora and fauna such as the traditional Bidayuh bamboo bridge and the Rhinoceros Hornbill which is the state bird of Sarawak. The main feature of this cable-stayed bridge is a pair of inclined towers facing in opposite directions which supports an S-shaped walkway via 14 pairs of stayed cables. The bridge was designed as a Class 1 footbridge which is fitted with Tuned Mass Dampers (TMDs) to reduce the amplitude of pedestrian-induced vibrations. Lying directly opposite these towers are viewing platforms which are shaded by a fabric roof. These platforms played an important role as counter-weights during the installation of the inclined tower



Figure 1. Aerial View of the Golden Bridge

3. Key Stakeholders

Being an iconic bridge in Kuching, the Golden Bridge has seen the involvement of various parties including the Sarawak Economic Development Corporation (SEDC) as the Sarawak government body and client, KTA Sarawak as the local bridge designers, PPES Works and NAIM Engineering as joint venture main contractors, Sediabena as the nominated steel subcontractor, Schlaich Bergemann and Partner (SBP) as an independent third party design reviewer, Universiti Sains Malaysia (USM) and the Ministry of Tourism. Throughout the life cycle of the project, various decisions had to be made to fulfil the needs of each party. There are two main phases to the life cycle which are the pre-construction and construction phase.

4. Pre-Construction Stage – Design and Construction Challenges

From the initial conceptual design, the Golden Bridge has evolved to what it is today after several improvements and modification of the initial design. Through a collaboration between Sediabena, KTA and SBP, the dynamic performance of the bridge was improved by integrating diagonal bracings, TMDs and increasing the overall mass of the bridge. Several construction challenges had to be overcome including working over rapid currents along the Sarawak River, daily river traffic and the accuracy of steel fabrication to ensure that the cable system length is within an acceptable tolerance limit given the complexity of the bridge geometry.

5. Construction Phase – Planning and Project Execution Plan

The focus of the construction planning was to develop a feasible and safe execution plan for the project which takes into account the expected construction challenges. Due to the daily river traffic underneath the bridge, temporary works along the Sarawak River was restricted. Hence, the cables themselves became the primary supports for the walkway segments during the construction of the bridge. A 200 Tonne crawler crane on top of a modified landing craft was the primary setup used for the erection works for the entire bridge, including the towers, walkways and viewing platforms.

Self-supporting splice connections consisting of bolts were used to facilitate installation works and the bridge was constructed primarily using these connections to minimize lifting time required by the crane. Temporary works such as cables, elevated working platform and cantilevered steel supports were used throughout the construction to provide access and stress relief for critical members identified during the construction analysis by SBP.

6. Conclusion

The construction of the Golden Bridge presented various challenges which needed to be overcome. Through a collaboration among engineers, bridge builders and the state government, the primary steel works for the bridge was successfully constructed after erection works began in October 2016 and ended in May 2017.