Construction of the Lao-Nippon Bridge and Technology Transfer in Laos

Shimizu Corporation, Member, ○Hiroshi KIKUCHI
Shimizu Corporation, Member, Tomoki NAKAMURA

1 Pakse Bridge Project

The world's eighth longest Mekong River flows through six countries in Southeast Asia. Outside of China, prior to the present bridge construction at Pakse in southern Laos, there had been only two other bridges in operation across the Mekong. The first (Friendship Bridge) is at the Lao-Thai border. The second (My Thuan Bridge) is in Vietnam, spanning the lower reaches of the Mekong. Now there is a third bridge, the Lao-Nippon Bridge, commonly known as the Pakse Bridge, constructed with Japanese grant aid. A further bridge (Kampong Cham Bridge) is currently being constructed in Cambodia, and is expected to open in 2002. (***Fig. 1***)

Pakse, the regional capital of southern Laos, lies 130km north of the world's widest waterfalls (12km wide), the Khone Falls at the Cambodian border. The falls are a formidable obstacle on the mighty Mekong to navigation between Laos and the South China Sea. Since Laos has no railway system, transportation greatly relies on its road networks. Until completion of the bridge, the only way for road traffic to cross the Mekong at Pakse had been by means of its limited number of ferries, and then only during the daytime.

The purpose behind the construction of the Lao-Nippon Bridge is: firstly to further open this part of southern Laos to tourism; secondly to stimulate agricultural development in the nearby Bolovens Plateau, which is one of the country's most fertile areas; and thirdly to create an integrated road network within the region and with Lao's neighbouring countries. Roads from Pakse to Thailand, Cambodia and Vietnam have been recently upgraded with the help of loans from the Asian Development Bank. The combined result of these developments is to open up vast new opportunities for the region.

On 23 May 1997, the Lao and Japanese governments signed the Exchange of Notes for the Pakse Bridge Project. The project contract was awarded to the joint venture of Shimizu Corporation and Hazama Corporation on 12 September 1997. The successfully completed bridge was opened for traffic three months ahead of schedule on 2 August 2000. (***Fig. 2***)

Fig. 1 *Project locations*

Fig. 2 *Lao-Nippon Bridge on a postcard*

2 Segmental Bridge

The Lao-Nippon Bridge is spanned by a single prestressed concrete box girder, 11.5 or 14.3m wide at the top and 6.5m at the bottom, and varying in depth between 3.0 and 6.5m. Spans are mainly composed of 384 precast segments of 2.5 or 3.5m in length. The bridge is designed to a live load of 125% of HS20 (AASHTO). Structurally, there are four continuous rigid frame bridges including an extradosed (cable-stayed with small pylons) bridge separated by hinges at mid-span, allowing for longitudinal displacement and rotation. (***Fig. 3***)

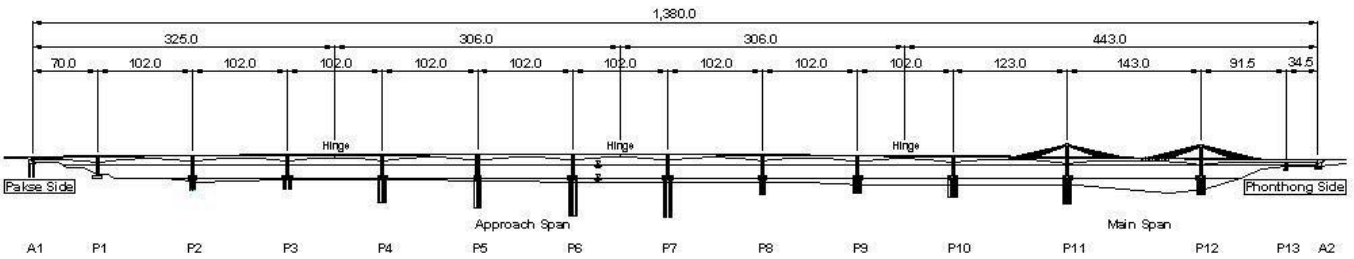

Fig. 3 *Lao-Nippon Bridge*

Keywords: Lao-Nippon Bridge, Mekong River, Extradosed bridge, Technology transfer
Address: Seavance South, 1-2-3 Shibaura, Minato-ku, Tokyo 105-8007 Tel. (03)5441-0596, Fax. (03)5441-0543

2.1 Substructure Construction

Laos has two seasons, a dry season and a wet season. Water levels of the Mekong at Pakse vary by up to 12m through the year. The construction of the bridge substructure was undertaken only in the dry season.

The bridge is founded on 126 steel-cased bored piles with a diameter of 1.5m. Application of an appropriate drilling rig to the different soil conditions was a way to the early completion of piling work. Three drilling rigs, a rotary-powered casing jack with grab hammer, an earth drill, and a reverse-circulating drill mounted on a self-elevating platform, were used in the work. In total, 426 precast panels, forming the soffit and the sides of the pile caps, allowed for rapid construction of the pile caps. All of the piles, pile caps and lower 10m of piers were completed in the first dry season of the construction period.

2.2 Segment Production

Space is not at a premium in Laos. Precast segments were produced on a longline bed on site. Each new segment was match-cast against the preceding old segment to ensure as near perfect fit as possible. The bridge has curved spans at both ends with straight spans in between. A total of 48 segments of curved spans and 336 segments of straight spans were made by the shortline and longline methods, respectively. In the conventional longline method, the formwork is moved and the old segment remains stationary on the longline bed. For the curved span segments, a shortline application to the longline bed was adopted, whereby the formwork is moved and the old segment is rotated in place on a transfer cart.

Two rebar cages were prefabricated per day, using four sets of rebar assembly jigs. Two sets of formwork moulds produced two segments a day. The match-cast face with multiple shear keys was coated with a novel mixture of talcum powder, household detergent and water as the bond-breaking agent.

2.3 Segment Erection

After the construction of cast-in-situ pier heads, precast segments were placed by the balanced-cantilever method using a launching girder. Approach spans have 15 pairs of segments each. The shortest completion time for a single span was 14 days.

Main span pier has 21 pairs of segments including 9 pairs of stayed segments. For the main span erection, the launching girder was extended from 141.75m to 156.75m and its structure was changed from a two- to three-point supported one. A temporary pier, composed of four 30m long steel pipes with a diameter of 1.5m, was constructed midway between P11 and P12. It provided a front support to the launching girder during P11 erection. (***Fig. 4***) It also, together with a hydraulic connection, stabilised the cantilever tip of P11 during the erection of P12.

Fig. 4 *Main span erection at P11*

3 Technology Transfer

In Laos, even though there are few new graduates in civil engineering, it is still difficult for them to find jobs. Some road projects offer a limited amount of work for civil engineers, but normally only in the dry season. This situation makes career advancement difficult. On the Pakse Bridge Project, the contractor made every attempt to offer opportunities for local engineers to develop their technological skills. They were also encouraged to show initiative and, after discussion of the available options, to take decisions for themselves.

More than ten different nationalities were involved in the many specialised tasks carried out during the bridge construction. In such circumstances, a clear definition of each person's role helped reduce any potential friction among the people. The atmosphere on site, with its wide variety of languages, was very much a multinational one. Everybody worked in harmony based on a mutual understanding. Laotians are friendly towards foreigners and the foreigners themselves, in this instance, made an effort to adapt to the Lao culture and to respect the local people.

4 Conclusions

A monument segment, an extra bridge segment, was erected on a hill overlooking the bridge. (***Fig. 5***) The message on it reads "For the Peaceful and Prosperous Future of Greater Mekong." All the people involved in the project endorse this sentiment. There is a saying in Southeast Asia to describe the three nationalities in the region "The Vietnamese grow the rice, the Cambodians watch it grow, while the Laotians listen to it grow." Indeed, whilst it is true that most Laotians tend to be of quiet and passive nature, they are also a peaceful and warm-hearted people. It is inevitable that the completion of the Lao-Nippon Bridge will bring further development to Laos. Nonetheless, may the Laotian spirit remain unchanged.

Fig. 5 *Monument segment*