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Employment of Local Engineers and Workers for the Construction of the Second Mandaue Mactan Bridge in the Republic of the Philippines

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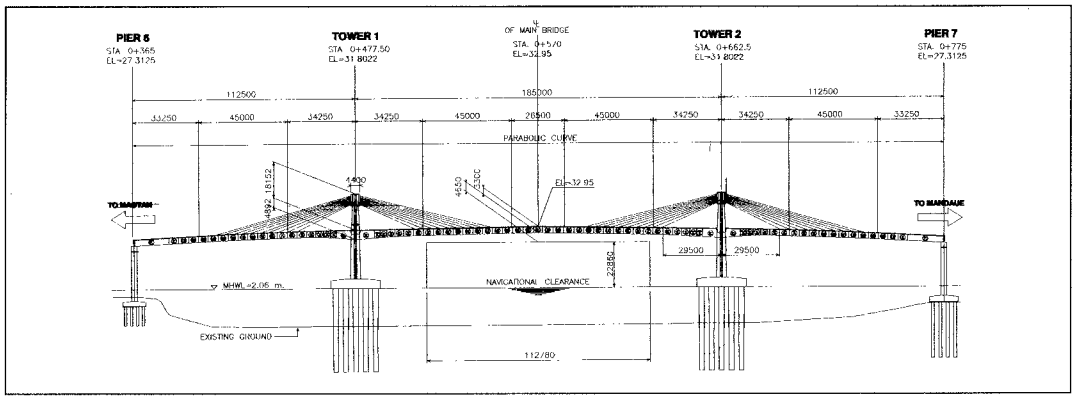
This paper introduces a case of hiring local engineers and workers for construction of a long span bridge in the Philippines where such a bridge was never built in the past.

The project is a construction of a 3 span continuous extradosed prestressed concrete bridge with the total length of 410m and approach viaducts and roads. The project was divided into two, the main bridge and the approach. The main bridge was given to a Japanese contractor. The other package, the approach viaducts and roads were given to a local contractor. The author engaged in the construction of the main bridge as an engineer from the contractor and discusses mainly on the construction of the superstructure of the main bridge. The main bridge is characterized its special features: 185m center span, a saddle structure for stay cable anchorage at the towers, 48 epoxy coated strands for one stay cable and a large three box cross section. The construction period given to the contractor was 33months and when the staging for the pier head table was started, only 16 months were left. The girder was constructed by an in-situ concrete cantilever method, using 4 sets of form travelers. The length of the typical segment is 5m and the cycle time for each segment was 9 days.

In this project, 6 Japanese engineers from the contractor and 2 supervisors from a Japanese subcontractor which specializes in bridge construction in Japan supervised construction of the superstructure, with occasional and short visits of supervisors for specialties such as assembly of form travelers and prestressing of stay cables. About 300 local people including 21 engineers and 4 foremen were hired directly by the project office and also one local subcontractor was employed which supplied about 50 local workers. Workers were divided into groups of 8 to 20 members according to their type of jobs and location assigned. Each group has a leader, called leadman or assistant leadman. In the beginning of the project, small size local subcontractors were hired, but these subcontractors had their own systems and limited capabilities, and we experienced difficulties in controlling workers. For instance, they could not supply human resources the contractor requested. Few workers came to work after a payday and the decision on when to pay was beyond the main contractor's control. Since the construction period was relatively short for this type of work, there was a need for flexible arrangement of manpower to cope with the schedule. Site instructions sometimes didn't reach lower level workers in the organization. There was a tendency that the subcontractors prioritized their profit. Thus, we switched from the subcontractors to direct hiring later.

Engineers and workers were hired through the processes as follows. First, advertisements were placed on local newspapers. Applicants submitted curriculum vitae and took examinations and interviews. Engineers and office workers took a written examination, which consisted of basic mathematics, English readings and analysis, etc. For engineers an additional examination was given to check whether he could make out drawings. Workers showed practical skills on site. To be an engineer, he or she must have a college degree, which usually requires total of 15years of study, 6 years for elementary school, 4 years for high school and 5years for college. For either case, an engineer or worker, a successful applicant was hired temporary for 6 months for a trial and if he showed a good performance during that period, the contract became permanent. Around the project site, there had been several construction activities carried out in the past, such as, a foundation for oil storage and high raise buildings. Thus, we could hire workers with a certain



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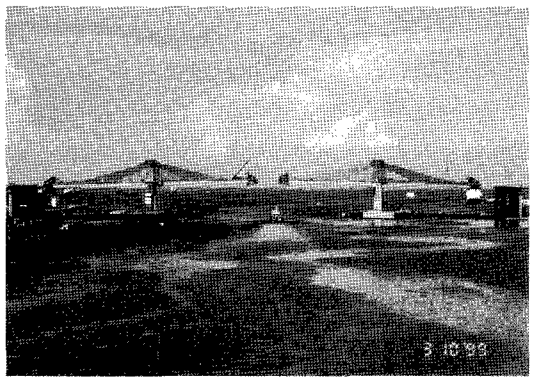
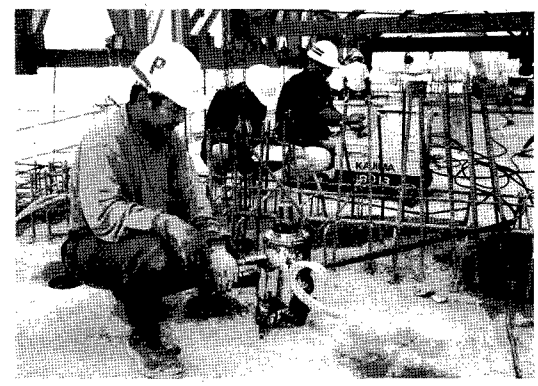


General View



Prestressing Vertical Bar

level of skills.

Some activities in this project were new to local workers as well as local engineers. For example, even though relatively small composite concrete girder bridges with post-tensioning concrete beams have been constructed in the Philippines, most of workers didn't have an experience on prestressed concrete. Thus, at first, Japanese engineers and supervisors taught local workers and engineers from installation of sheaths to operation of a jack for prestressing. In fact, in the beginning, the Japanese engineers and supervisors operated prestressing jacks in person. Then gradually local engineers and workers took the place of Japanese staffs. A control chart of prestressing for strands was also plotted by a local engineer from a middle point of the project. There are particular aspects for prestressed concrete compared to ordinary reinforced concrete construction. A severer criterion is applied in layout of prestressing steels than that of reinforcing bars. It was common that steelmen changed a layout of sheaths to install reinforcing bars. Welding shall be avoided near prestressing steels. A high-tension force is introduced to a prestressing steel and it is dangerous to stand behind the jack during the operation. Some workers were not accustomed with certain tools such as steel made scaffoldings, form tie and plastic cone, and as a result, sometimes a minor problem could be seen. It is often observed that a form is deformed around plastic cones due to over tightening of form ties in developing countries and it was so in the Philippines. It took for a while to let all workers know these things and overcome problems.

There is some learning from the project.

As we could imagine, there was a cultural difference. In Japan, sometimes field engineers are required to do physical work or survey. In the Philippines, basically engineers don't do jobs, which make their hands dirty. Survey is normally done by surveyors. In the project, we required local engineers to do physical activities such as operation of a jack and pump for prestressing, and installation of sheaths and prestressing steels so that they would be able to teach how to do to workers who never work on prestressing before. Some local engineers showed unwillingness and it was important to confirm this matter before hiring the ones.

There is a large variance in ability of individuals. Despite all engineers graduated from a college, some of them had a poor understanding of drawings. A relatively high correlation was observed between the written examination mentioned above and performance on site. Similarly some workers learned new things quickly and others didn't. The key was to evaluate one's ability fast and to assign one to an appropriate job.

Lifetime employment is uncommon and usually engineers change employers from one project to another. Due to peculiarity of the project in terms of technology, local engineers and workers will have a rare chance to practice what they learned from the project. From contractors' point of view, even though they train engineers and workers they scarcely find a similar project nearby and it makes difficult for the contractors to utilize human resources cultivated.

Monetary incentive was offered for meeting a monthly target, perfect attendance and good performance. It was a fixed amount equivalent to 2 to 3 days salary for a typical worker and seemed to be effective with relatively small expenditure.

Instead of hiring local people, there were other options to carry out this project. We could bring more engineers and skilled workers from Japan or other counties instead of hiring local engineers and workers. A large portion of the project could be given to a special subcontractor that was capable to do the work. But first, if we look at the costs, the difference in wage level for Japanese and Filipinos is enormous. Also moving human resources from other countries accompanies with extra costs such as transportation and miscellaneous allowances. Second, there was a regulation on importing laborers and it made difficult to hire foreign workers. Thus, We tried to do the entire work with local manpower aiming at saving labor cost and indirect cost. Whether a project can be finished with mainly local manpower is highly depends on availability of human resources and it is certainly not always applicable to any project. In the Philippines relatively good workers were available. As described above, even though it was not easy to transfer skills to local people, in this case, the trial seemed to be successful, and hopefully, it could offer hints for other project in the future.