Measures to expand the use of new technologies in civil engineering: From the perspective of the solutions side

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Why civil engineering does not produce smartphones

In the technology of 50 years ago, telephones were already widely used but faxing still seemed like a distant dream. In today's technology, from mobile phones and email to smartphones, the pace of progress is so rapid that it's hard to even keep up. Media is being accessed differently, and I sometimes notice that I am the only one reading a newspaper when I look around in a train. Meanwhile, amazing technological achievements were being made 50 years ago in the field of civil engineering, including the Honshu-Shikoku Bridge, Seikan Tunnel, and Kurobe Dam, and civil engineering became an attractive field for academic studies. During the period of rapid economic growth that followed, civil engineers created a variety of new technologies to meet the needs of infrastructure development. However, in recent years, civil engineering is no longer producing new technologies that people seem to find as impressive as the smartphone. Producing the infrastructure that underlies the nation's economy, civil engineers tend to work in the background without a great deal of external recognition. Many of our members may be wondering how this situation came about.

Needs and solutions of new technologies

Necessity is said to be the mother of invention, and needs are an important driving force in the creation of new technologies. Electric light bulbs were invented when people wanted to have light without the work of cleaning lamps, and washing machines were invented to free people from the labor of doing laundry by hand. Soil improvement technologies were developed to

make it possible to build structures on soft ground, and tunneling shield technologies were developed to allow underground structures to be built without disturbing land use on the surface. However, the smartphone was not invented in response to needs. It had not yet occurred to people to want a device that would let them access information by sliding their fingertips, but a genius named Steve Jobs conceived of this, and his product exploded in popularity because it matched the potential needs of users. A new technology had grown out of the solutions side.

How orderers decide to use new technologies

The topic of expanding the use of new technologies will be examined in terms of public works projects, which account for 80% of all civil engineering projects on a monetary basis in Japan. Fig. 1 shows the typical progression of a public works project. As this figure indicates, public works are built according to design documents specified by the orderer. If new technologies are to be used in this process, that decision will be made either at the stage of design based on design documents prepared by the orderer (documents expressing the orderer's intention, including specifications, drawings, and site explanations), or at the stage of construction. At the design stage, this decision would be made by the orderer, since it is the orderer who decides whether to incorporate new technologies at the design stage. In general contracts for public works, the contractor is responsible for the construction methods used;[(1)] so it is quite possible for a contractor to include the use of new construction technologies, and this takes place on a frequent basis. Meanwhile, orderers have undergone staffing reductions in recent years, and it requires a great deal of work for them to coordinate with related institutions and handle complicated bid contract procedures, etc. The fact is that they simply cannot manage to incorporate new technologies into their design documents. Because civil engineering projects are subject to different conditions depending on the site, it would be ideal to carefully survey each site and design each project based on the technologies that are best suited to the site; however, without the necessary resources, there has been a shift toward depending on standardization and manuals with regard to the use of technologies. As the standards become increasingly detailed, ordering engineers tend to focus their energies on fitting the standards, instead of technological considerations. Of course, there are cases in which new technologies have been incorporated due to efforts on the part of an orderer, and there have been organizational initiatives for the use of new technologies, including the use of NETIS (New Technology Information System, MLITT) and bid acceptance based on comprehensive assessment with evaluation of technical proposals. However, the basic structure is that the use of new technologies depends on whether this is specified in the order documents by the orderer in question, and this is an obstacle that cannot be easily overcome. In many cases, in order to be successful, efforts to go beyond the framework of existing technologies and incorporate highly innovative new technologies must begin further upstream in the process, at the stage of design.

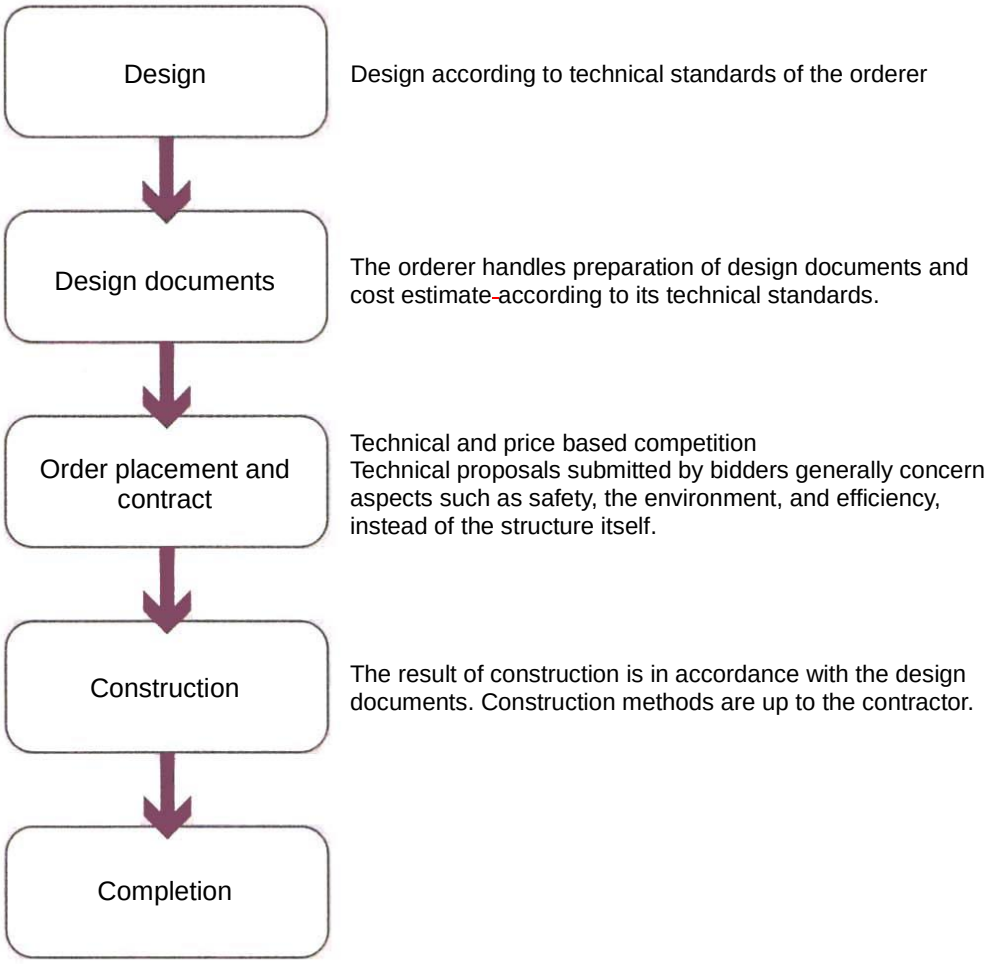

Fig. 1. Stages in the execution of general public works projects

Incorporating new technologies from the solutions side into public works

To overcome this situation, the private sector side could push for the use of their own new technologies as solutions. The assumed progression in this case is shown in Fig. 2. Here, the orderer first asks for technical proposals, including new technologies, for a specific project. To request unrestricted technical proposals that are not limited by existing technical standards, instead of the conventional approach of prescribing the specifications, the orderer needs to indicate the performance requirements, stating the desired functions of the structure they want to build, along with the constraints. It would be inconvenient for performance to be specified differently for different projects or by different orderers, so all orderers should be aware of common requirements concerning their performance specifications in advance. Then orderers could evaluate and compare the submitted technical proposals in terms of technologies and price, selecting the best proposal. If necessary, the orderer can refer to the results of evaluation of the proposed technologies by public institutions and consult with experts.

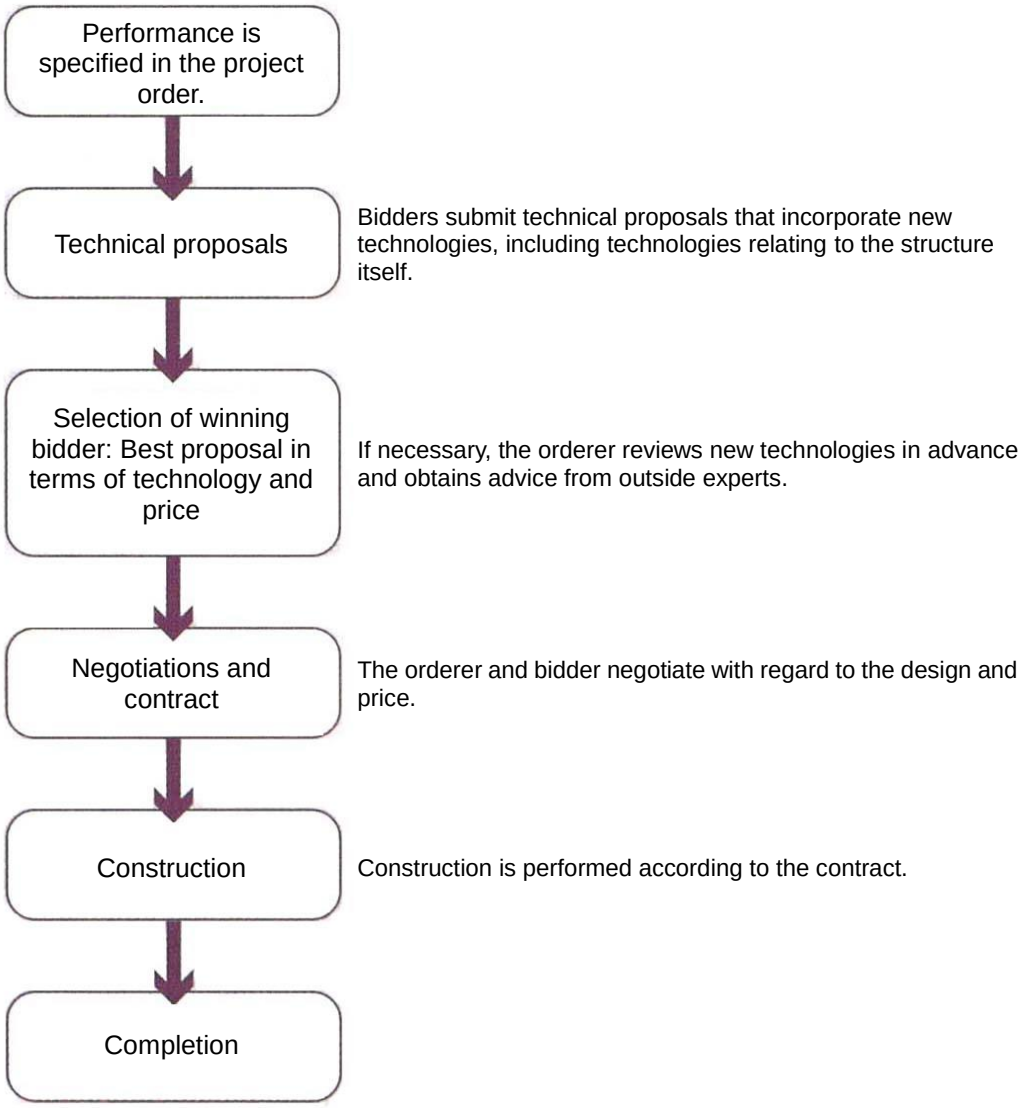

Fig. 2. Stages in project execution emphasizing new technologies (proposed)

I would like to emphasize that in this approach, it would be necessary to seek technical proposals for each individual project. In civil engineering, every project is unique. The conditions are different at every site, and companies would be expected to compete to offer the technologies that are best suited to the respective conditions. This means that even if two projects appear similar at a glance, there is still a possibility of using different technologies in each; and this would give rise to diligent competition with regard to technology for each individual project. The technologies to be proposed will not be limited to civil engineering technologies, and we are hoping for participation from all technical fields.

Future development of SIP

Many outstanding technologies have been proposed in the SIP Infrastructure Maintenance, Renovation and Management Program, including technologies from fields other than civil engineering. These are being developed with the goal of practical application, and efforts for regional implementation are making particular progress. Through SIP, new technologies are

already being put to use in several cases. For this to become established as a sustainable process for all public works, it is essential for orderers, who are in the position of buying technologies, to adopt a contract system that is more technology-oriented. In this way, SIP will be able to leave a legacy for the future by establishing a process for the development and implementation of new technologies for infrastructure maintenance and other areas.

Reference

(1) For example, see Article 1, Paragraph 3 of the standard construction contract agreement of the Ministry of Land, Infrastructure, Transport and Tourism.

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