Application of BIM to a Cable-stayed Bridge Construction

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Summary

3D modeling and BIM technology are being used more and more in the construction industry. The scope of this paper arose as we wondered how the general contractor can benefit from the use of 3D models. Presented herewith is the application of BIM to an actual bridge now under construction in Cheongpoong, Choongcheongbuk-Do. This constitutes the first application of BIM in Korea. Virtual construction of the cable-stayed bridge was performed to visualize design and analyze constructability and coordination problems and to integrate the bridge's visualization, cost, and schedule under location-based conditions with industry-specific solutions for 3D modeling. Two hundred and ninety-two main 3D objects constituted the cable-stayed bridge, which is 442m long with a main span of 327m. BIM application benefits such as clash detection, interdisciplinary communication, and method-statement simulation have been confirmed. In addition, integration of a 3D model, cost, and schedule is shown by comparing the measurements of different structures at a specific time using 2 different construction sequencing scenarios and work breakdown structures (WBS). It is possible to create dynamic graphics and effects and explore complete projects under real-world conditions before they are constructed.

Keywords: building information modeling (BIM), 3D modeling, cable-stayed bridge, clash detection, simulation, visualization, virtual construction

Case Study

The BIM application methods were applied to a cable-stayed bridge, Cheongpoong Bridge, now under construction by Daelim. It is located in Chooncheongbuk-Do, Korea, crossing the Chung Ju Lake. This bridge is the first steel-concrete hybrid cable-stayed bridge in Korea. It is 442m long with a main span of 327m. Because the bridge is being built across an in-land lake with a depth of over 40m, and because its variation throughout the year is high due to unpredictable rainfall, the main span is supposed to be constructed by the member erection method and the free cantilever method (FCM). All pieces of the main span are delivered through the side span, with a derrick crane lifting and installing each component of the edge girder, cross beam, stringer, and PC slab. Since this method is being tried for the first time, construction know-how is insufficient, and a series of bottlenecks are expected. BIM application prior to actual construction is expected to be helpful.

General contractor BIM users are generally divided into two groups: (1) workers at the construction site, and (2) the project management team at the head office.

1. This experiment performed clash detection, analyzed constructability, provided decision-making and coordination support, and simulated the construction sequence by applying BIM's 3D visualization and simulation function at the construction site. Consequently, contractors can cut construction costs by direct and ripple effects, as well as secure construction safety.

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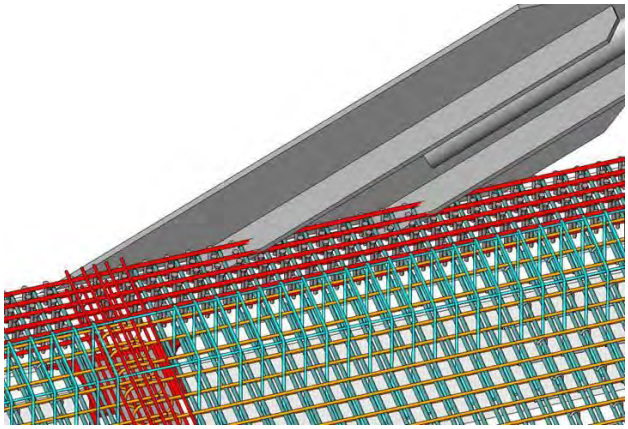


Fig. 1 : Clash Detection

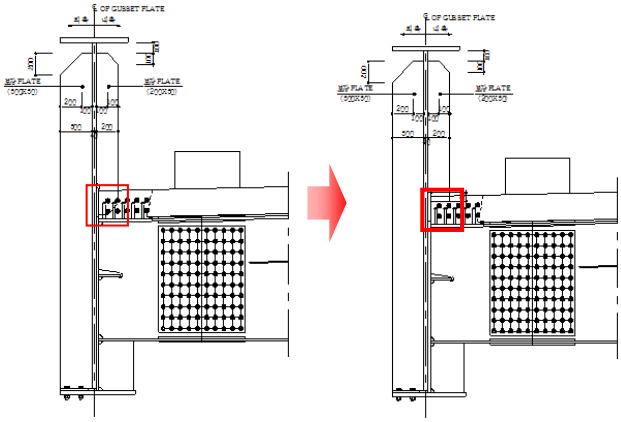
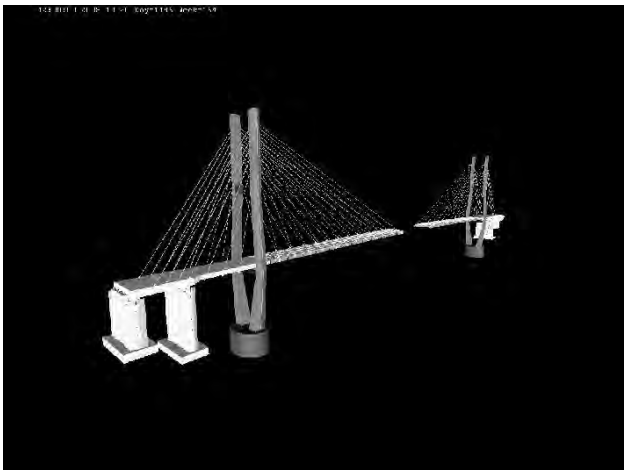
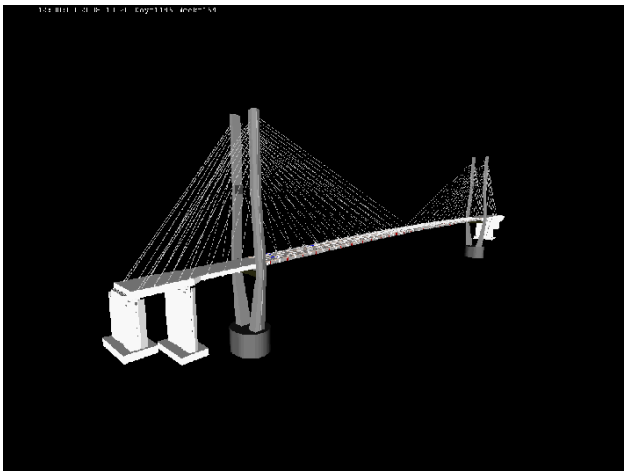


Fig. 2 : 2D dwg. Adjustment

2. Project management teams can improve the accuracy of earned value management and their understanding of the current situation with visual connecting schedules and cost and visual information together, which also contribute to the project performance.

Table 1: Synchronization of Schedule, Cost and Visual Information

Case 1 : Member Erection Method	Case 2 : Prefabrication Method
	
- Data Date : October 20th, 2008 - Cumulative Rate of Progress : 92.60% - Earned Value : $20,757,000 - Expected Completion Date : July 8th, 2009	- Data Date : October 20th, 2008 - Cumulative Rate of Progress : 95.97% - Earned Value : $21,511,000 - Expected Completion Date : June 10th, 2009

In conclusion, we obtained the desired result from the case study of the Cheongpoong Bridge, but the construction industry's working environment and education system are not yet set up to apply BIM technology entirely. Since this research was carried out under the assumption of those constraints mentioned above, the results are also limited.

As IT development grows faster and faster, it is clear that the working environment of construction keep pace with it. Every party in the construction industry should be concerned about the newest technology trends and make a constant effort to change and improve the process. Hereafter, based on the research of BIM application throughout the life cycle of construction projects, BIM should be systemized, with related education and environmental conditions continuously expanded.