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A-Bridge crossover story: Opportunities from cooperative multi-cultural exchange

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Abstract

In parallel to the Panama Canal Expansion, the Third Bridge over the Panama Canal is currently under construction 3.5 kilometers north of the Third Set of Locks on the Atlantic side. Designed by a Chinese-US consortium and contracted as a Design-Bid-Build project, both the design and technical specifications for the Atlantic Bridge, including those relevant to concrete works, are mainly based on AASHTO, ACI and ASTM criteria. As the Atlantic Bridge is located in a high-salinity maritime environment, the major structures of the bridge, other than those for the cable-stay system, are to be built with reinforced concrete. The durability of such structures is of a paramount importance for the project. Therefore, hybrids of both, prescriptive and performance-based technical specifications were put together to ensure that service-life requirements would be fulfilled. Per the Contract, the development of the different concrete mixes was the full and exclusive responsibility of the French construction Contractor. Compliance with both durability requirements and constructability was a significant technical challenge for the Contractor. After the Owner organized a cooperative series of workshops, a feasible technical solution was achieved by means of incorporating certain provisions from European Standards into the Contract. As a result of these collaborative efforts, the Contractor was able to commence the works for the foundations of the project. This paper highlights the challenges, pitfalls, benefits and opportunities derived from international cooperative collaboration with a multi-cultural and multi-standard perspective.

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Keywords: specifications; standards; international; cooperative; multi-cultural

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1. Background

When the existing Panama Canal was opened to traffic in August 15th, 1914, the maritime industry changed. The East Coast of North America was now connected by the shortest maritime route to both the West Coast of North America and Asia. As new maritime routes developed with the inauguration of the Panama Canal, the terrestrial bridge linking North and South America across the Isthmus of Panama was broken.

Previously, the East and West banks of the Panama Canal were only connected by swing bridges over the Panama Canal structures and ferry services at both Pacific and Atlantic sides of the Canal. It was not until October, 1962 when the first bridge over the Panama Canal, the Bridge of the Americas, was inaugurated. Over forty years passed and it was not until year 2004 when the Centennial Bridge was opened to traffic as the second fixed link between North and South America. Both the steel-arch Bridge of the Americas and concrete cable-stayed Centennial Bridge lie on the Pacific entrance of the Panama Canal, where the country's capital, Panama City, and its satellite cities are developing.

At the present time, there is not yet a fixed link between East and West banks at the Atlantic side of the Panama Canal. The vehicular traffic is being currently handled by the swing bridge over Gatún Locks and by means of a ferry boat connection which is owned and operated by the Panama Canal Authority.

However, after the completion of the Panama Canal Expansion Program, which will enable the expanded Panama Canal to handle through the new-Panamax vessels, such vehicular traffic management will not be sustainable.

Hence, pursuant to article 3 in Law 28 of July 17th, 2006, the Panama Canal Authority committed to undertake all necessary studies for a fixed vehicular crossing, either bridge or tunnel, at the Atlantic side of the expanded Panama Canal. The construction of such link had to start immediately after the completion of the Third Set of Locks Project. The Panama Canal Authority shall pay the costs for the project.

The feasibility study revealed that a cable-stayed bridge was the most viable option, and it recommended the project to be conceived and executed under a Design-Bid-Build scheme. It is noteworthy that the location for the Third Bridge over the Panama Canal at the Atlantic side is deemed as having one of the most aggressive environmental impacts with regard to steel corrosion in the atmosphere (ASTM, 1968).

Accordingly, the feasibility study also recommended that –other than the components of the cable-stay system – the new structure should be built with steel-reinforced concrete. Hence, since the very onset of the project, durability of concrete has been of a paramount importance for the Owner and most likely the future operator of the new bridge, the Panama Canal Authority.

The design of the project was awarded in year 2011 to a Chinese-US consortium, and the baseline design was delivered by first quarter of 2012. The Owner had specified a required service life set as 100-year for the main cable-stayed bridge and 50-year for the approach viaducts.

The construction contract was awarded in the last quarter of year 2012 to the winning French Contractor. The Panama Canal Authority –the Owner – issued the order to proceed on January 2013 for the project to be completed in a three-and-half year construction schedule.

2. The technical problem

The designer substantially based the technical specifications for major concrete structures –including but not limited to deep foundations – on relevant codes, standards and guidelines from American Association of State Highway and Transportation Officials (AASHTO), American Concrete Institute (ACI) and ASTM International (formerly known as American Society for Testing and Materials). The construction contract also specified that it is the Contractor´s obligation and responsibility to design and furnish concrete mixes fully compliant with the technical specifications (ACP, 2012).

Hence, for the more than 400 drilled shafts of the project, the contract prescribed a concrete class with a minimum binder content of 410 kilograms per cubic meter of concrete, a maximum water to cementitious material ratio of 0.4 and, compressive strength of 28MPa at 28 days (ACP, 2012). The contract explicitly specified that binder shall consist of cement, pulverized fly ash (PFA), ground granulated blast-furnace slag (GGBS) and/or silica fume. Complementarily, the contract also specified that only fly ash and calcined natural pozzolans (i.e., implicitly