HEAVY LIFTING AND TRANSPORT EQUIPMENT PLUS PREFABRICATION FOR RAPID INSTALLATION OF BRIDGE SUPERSTRUCTURE SYSTEMS

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ABSTRACT

Bridge owners are increasingly choosing prefabrication to address a number of design and construction challenges, but available prefabrication techniques are often constrained by what can be hauled and lifted into place. However, new technology associated with heavy lifting and transport equipment facilitates the use of prefabrication, as demonstrated by a number of projects built over the past decade.

Keywords: Prefabrication, Lifting, Hauling, Transport, Superstructure.

INTRODUCTION

Bridge owners are increasingly choosing prefabrication to address a number of design and construction challenges: minimizing the effect that bridge construction has on traffic, improving safety in the work-zone, reducing the impact of bridge construction on the environment, generally improving constructibility, and improving the quality and durability of structures.

Available prefabrication techniques to employ in bridge design and construction are often constrained by what can be hauled and lifted into place. Understanding both practical and real limits, engineers balance use of prefabrication against what can be moved into place affordably. In the absence of published standards, engineers apply limits based on their experience or what they can learn by talking to others in their offices or to local contractors. They often assume that very heavy lifting and moving is either impossible or prohibitively expensive. However, new technology associated with heavy lifting and transport equipment facilitates the use of prefabrication, as demonstrated by a number of projects built over the past decade.

WATER CROSSINGS

Bridges that cross major bodies of water often offer the opportunity of transporting bridges or bridge parts by water. In some cases, the tide can be used to raise parts into place. Bridges over land present more challenges for moving large parts around.

SEVEN MILE BRIDGE, FLORIDA

In the early 1980's, the Seven Mile Bridge connecting the Florida Keys was replaced with a precast segmental bridge. The 135-foot spans were preassembled and lifted into place as a unit. Precast segmental piers were constructed, including the superstructure cap elements, and then a crane was assembled on the pier. The crane lifted the preassembled segmental superstructure into place.

CONFEDERATION BRIDGE, NORTHUMBERLAND STRAIT, CANADA

All superstructure and substructure parts of this eight-mile long bridge were prefabricated and erected in twelve months. The large part of the superstructure was comprised of preassembled "T-type" balanced-cantilever segmental main girders weighing 75 mega-newtons each. They were lifted into place by an ocean-going crane. These parts were set in place during warm months that allowed water access to the bridge; the parts were in place by the time the strait iced over, allowing superstructure work to continue to close the spans.

ROBERT MOSES CAUSEWAY APPROACH REPLACEMENTS

The 50-year-old approaches on the southbound side of the Robert Moses Causeway were scheduled to be replaced with a traditional prestressed beam/cast-in-place deck superstructure. However, the contractor, Weeks Marine, proposed a value-engineering alternative based on a prestressed precast “quad” unit that would take advantage of Weeks’ unique marine capacity and heavy lifting equipment. The units were fabricated in Bayshore, MD, and then loaded on barges in two stacks, six panels high. Barge-mounted cranes lifted the units into place.

LAND CROSSINGS: SELF-PROPELLED MODULAR TRAILERS

Self-propelled modular trailers (SPMTs) significantly expand the possibilities for lifting and moving heavy bridge elements and systems over land. Two SPMT types are available: those having four or six axle lines. The units have engines of variable power, and being modular, they can be coupled to realize many different transport configurations.

A4-A5 BRIDGE AT HOOFDDORP, NETHERLANDS

This 120-meter fly-over that weighed over 3,300 tons was prefabricated and lifted into place using SPMTs.

E34 HIGHWAY BRIDGES NEAR ANTWERP, BELGIUM

Conventional bridge replacement techniques, which would have required four months construction time, were avoided to minimize the impact on traffic. Potential losses to the traveling public were estimated at $302,000 per day – about $24 million. Prefabricated “N-shape” bridges were estimated to be installable within 82 hours: actual construction time was even shorter. One bridge required two new N-spans of 140 ½ feet and 148 ½ feet; the other bridge required two new N-spans of 104 ¾ feet. Modular SPMTs were combined into a transport system that was reused for each span, with additional SPMTs added as needed. For the largest bridge, weighing 2,100 tonnes, two lines of 24 units and 18 units were combined to be used on each side of the bridge.