CBDG Conference 2008

Modern Precasting Methods in Bridge Construction
by William Paschetta
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Introduction

The four VINCI divisions

VINCI Concessions
Expertise in outsourced public services and concessions going back over a century: infrastructure design, construction, financing and operation

EUROVIA
European leader in roadworks and materials recycling; leading producer of road aggregates

VINCI Construction
World leader in design and construction of major building and infrastructure projects and in civil engineering

VINCI Energies
Market leader in France and a major player in Europe in energy and information technologies

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Introduction
VINCI in UK – Recent Projects

Medway Viaduct for CTRL (JV with Morgan Est)
VINCI in UK – Recent Projects

Thurrock Viaduct for CTRL (JV with Morgan Est)
Introduction

VINCI in UK – Recent Projects

Rainham and Aveley Viaducts for CTRL (JV with Morgan Est)
VINCI in UK – Recent Projects

Kincardine Viaduct – Push launched Bridge over Forth River (JV with Morgan Est)
Main types of Precasting

Precasting in bridges construction can be used through numerous ways. It can be classified into 3 main categories:

1. “Light”: a few tonnes
   Typical examples:
   - precast slabs for decks
   - small RC or PC girders…

2. “Medium”: from 10 to several 100 t
   Typical examples:
   - I or T shape RC or PC girders
   - precast segments
   - precast pier heads…

3. “Heavy”: more than 1000 tons
   Typical examples:
   - foundations
   - full span precasting
Example of a Large-Scale Precasting

Geographical location

[Image of a map showing Prince Edward Island Bridge and surrounding geographical locations such as St. John's, Gulf of St. Lawrence, Prince Edward Island, Charlottetown, Fredericton, Halifax, Quebec, Augusta.]
General longitudinal profile

PRINCE EDWARD ISLAND BRIDGE

WEST APPROACH
(66m+13x93m)
NEW BRUNSWICK

MAIN BRIDGE
(165m+43x250m+165m)
NAVIGATION SPAN

EAST APPROACH
(5x93m+60m+30m)
PRINCE EDWARD ISLAND

1275 11080 555
12910
The reasons for choosing a large-scale precasting

- High repetitiveness of tasks:
  - 43 main spans, 250 m long

- Sequencing of tasks made difficult by uncertain climatic conditions and by exceptionally long winter (strait commonly covered by ice, 1 m thick, from January to April)

- Programme of works very tight: 13 km of bridge to be constructed within 28 months

Use of large-scale precasting with unusual installations and huge precast elements
The main bridge is composed of 22 stable frames connected by 60 m long drop-in expansion spans.
Example of a Large-Scale Precasting

Prefabricated components of main structure and their position in the structure

- Balance cantilever unit (7800 t)
- Fixed drop-in span (1350 t)
- Template (100 t)
- Pier shaft (max 4000 t)
- Pier base foundation (max 5100 t)
- Hinged drop-in span (1560 t)
Main bridge: cross-section at pier
Main sequences of construction: transversal view

1) **Pier base erection**
   - general dredging to competent bedrock
   - dredging of a trench into the bedrock
   - pier base lowered onto 3 prepared supports
   - filling of the trench with concrete

2) **Shaft erection**
   - shaft lowered onto hydraulic jacks on top of the pier base
   - accurately levelled with hydraulic jacks
   - made monolithic with the pier base (grouting of a joint and continuity post-tensioning)

3) **Pier top template adjustment**

4) **Main span installation**
Main sequences of construction: longitudinal view
Welcome in Legoland !!!

1) Pier bases erection
2) Shafts erection
3) Pier top templates adjustment
4) Double cantilevers installation
5) Fixed drop-in span installation
6) Hinged drop-in span installation
Example of a Large-Scale Precasting

3D detail of the base/shaft connection

Grooves for grout joint
Example of a Large-Scale Precasting

Detail of the pier/deck connection

Precast template (100 t) is match cast to the bottom of the pier segment in the casting yard.
Template: sequence of work

1) Surveyors directed the geometrically correct positioning of the template at top of pier
2) Grouting of the gap between template and the top of the shaft
3) Main girder is lowered into place by Svanen crane
4) Tensioning of vertical tendons to connect main girder and pier
Example of a Large-Scale Precasting

General view of the precasting yard: four production lines

- Deck (balance cantilever)
- Deck (drop-in spans)
- Load-out jetty
- Pier shafts
- Pier bases

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Example of a Large-Scale Precasting

Precasting yard: pier bases

- Six pier bases fabricated simultaneously
- Up to 16 stored in the yard
Precasting yard: pier shafts and drop-in spans

- Four pier shafts are constructed simultaneously
- Eight completed units can be stored

- The drop-in spans are prefabricated in one piece at one location
- Storage is provided for 12 units
Example of a Large-Scale Precasting

Precasting yard: balance cantilever spans

- All segments of a double cantilever in ten fixed locations
- Storage is provided for 12 units
Example of a Large-Scale Precasting

Precasting yard: Balance cantilever spans – Storage area
Transport of the precast elements on the casting yard

- All precast units are being moved using two custom-made transporters (sledges)
- The sledges are equipped with caterpillar tracks of stainless steel and Teflon
Transport of the precast elements on the casting yard

- The sledges slid on tracks composed of two parallel RC beams at ground level.
- The sledges move longitudinally using a hydraulic pushing system.
Transport of the precast elements on the casting yard

- All the precast units must be cast on “tables” around 6 m above the ground level so that the transporters can get underneath and pick the pieces up
Example of a Large Scale Precasting

Transport of the precast elements on the casting yard

The sledge transporting one pier shaft onto the jetty

One main girder being moved from the yard storage area
Transport of the precast elements – Marine operations

- Use of a heavy-lift floating catamaran crane, called the Svanen, previously used for the Storebaelt project (in Denmark)

- Svanen is used to lift the precast elements off the jetty and carry them out to the strait where they are placed in their permanent position

- Owing to the exceptional sizes and weights of the precast elements, the Svanen required extensive modification prior to being brought to site
Example of a Large-Scale Precasting

A pier base is being picked up from the staging area jetty by Svanen
Example of a Large-Scale Precasting

A pier shaft has just been placed by Svanen
Example of a Large-Scale Precasting

Svanen is about to pick up a main girder
Example of a Large-Scale Precasting

A balance cantilever is being transported by Svanen
Example of a Large-Scale Precasting

A balance cantilever is being placed on top of a pier by Svanen
Example of a Large-Scale Precasting

A drop-in span is being placed between two cantilevers by Svanen
Example of a Large-Scale Precasting

Views of the bridge after completion of the construction
VINCI Construction Grands Projets, leader of a consortium, has recently signed the design-build contract for the causeway between Qatar and Bahrain. The Qatar–Bahrain causeway project is a 40 km two-lane dual carriageway motorway between Qatar and Bahrain. The road will run over a total of 18 km of embankments where the sea is shallow and 22 km of viaducts and bridges over deep water, including two 400 metre cable-stayed bridges over shipping channels.
Conclusion

«Descendant » of Confederation Bridge: Qatar Barhein Causeway

- Large-scale precasting will also be used for these bridges
- We will take advantage of the experience we had with the Confederation Bridge

For further information, see you in a few years…!!!