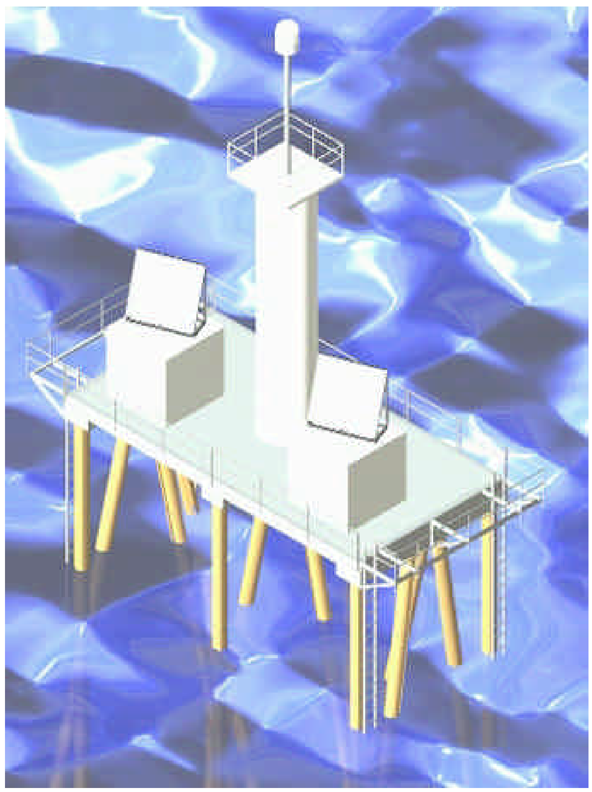
Sandheads Light Structure:

A Case Study of High Volume Flyash Concrete



Prepared By: Brian Konrad

Co-op Student

April 30, 2002

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

Acknowledgments:

Cheryl Nelms EIT, Civil Engineer PWGSC, provided assistance with research.

David Blythe P. Eng, Project Manager PWGSC.

Dave Chang P. Eng, Senior Structural Engineer PWGSC, provided concrete mix information.

Percy Liang, Project Manager PWGSC, provided financial project data.

1.0 HVFA Concrete In Use Today - Sandheads Light

Structure:

Graphic 1 - Sandheads Lighthouse

HVFA Concrete has been successfully used in several projects across the lower mainland. Some examples include the Liu Center for the study of Global Issues (UBC), the Brentwood and Gilmore Stations on the Millennium Sky Train Line, and the Sandheads Light Structure at the end of the Steveston/Sandheads Jetty.

1.1 Background:

In 1880, a screw-pile lighthouse was built at Sandheads off the mouth of the Fraser river; it was demolished in 1913 and replaced by a lightship. In 1955, a new lighthouse was built at Sandheads after building a long jetty to stabilize the channel location. This lighthouse was repaired in 1977 and now is being replaced by a new longer lasting unmanned light station.

1.2 Project Overview:

The new light station was built in six stages: Pile Driving, Pile Caps, Scour Protection, Precast Panels, Final Slab and Prefabricated Buildings. HVFA Concrete was selected because PWGSC supports the Canadian Government’s commitment to reduce greenhouse gas emissions. HVFA Concrete also has

Graphic 3 - Piles

desirable properties like increased ultimate strength and durability and decreased permeability (meaning less corrosion of steel).

1.3 HVFA Concrete Usage:

HVFA Concrete supplied by Rempel Bros Concrete was used for the piles, pile caps and precast panels. All 120 cubic meters of concrete used in this project was HVFA Concrete.

1.4 Environmental Impact:

The manufacturing of the concrete for the Sandheads Light Structure avoided approximately 44% of the $C0_2$ emissions that manufacturing of conventional all-cement concrete would have created. This was calculated by adding the Flyash and Silica Fume by weight and dividing them by the weight of the cement. 276 tonnes of CO_2 was reduced because of the use of HVFA Concrete in the Sandheads Light Station Project. These density of concrete was assumed to be 2300 kg/m^3. A 1:1 ratio of tonnes of cement replaced to tonnes of CO_2 reduced was also assumed.

1.5 Results:

HVFA Concrete provides greater strength and less permeability, which will result in a higher durability in the harsh sea environment. The results from the cylinder tests met the required 35 MPa at 56 days and in most cases was met at 28 days far exceeding the design. Concrete testing was done by Levelton Engineering Ltd. Some of their test records are included in Appendix B. The slower hydration time did not disrupt the project schedule as the contractor completed the scour protection while the HVFA Concrete gained strength. Leaving the forms on while doing the scour protection was advantageous as it protected the fresh concrete from the bucket they used to place the rock. When deciding on the type of concrete to be placed in the piles workability was a factor. HVFA Concrete provided more workability making it easier to place the concrete in the piles. The slower setting time was beneficial to the project as the concrete trucks had to be brought to the site by tug boat and barge. The HVFA Concrete performed well even with a delivery time of four hours. Economically, in the short term, HVFA Concrete was more expensive than conventional concrete. The additional costs of mix design and extra construction time could have been offset by funding from the HVFA Partnership; also, the additional lifetime of the structure, less maintenance, and reduced environmental effects increase the value of HVFA Concrete above the value of conventional concrete. Using HVFA Concrete resulted in a longer lasting light station with less environmental impact.