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Laboratory Test Report

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Client: Italian-Thai Development Public Co. Ltd.
2034/132-161 Italian-Thai Tower, New Petchburi Rd.
Bangkapi, Huaykwang, Bangkok 10320

Test: Hydrostatic Pressure Test Capacity of Thai Waterstop Co. Ltd's **RHINOSWELL Swelling Waterstop (20x15 mm)** with **RHINOLATEX** adhesive

Project: Construction of Red Line (Bang Sue-Rangsit) Project Contract 3: E &M for Bangsue-Rangsit Railway System

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1 INTRODUCTION

The purpose of this laboratory test is to determine the maximum hydrostatic pressure capacity of **RHINOSWELL Swelling Waterstop (20x15 mm)** with **RHINOLATEX** adhesives in preventing water leakages along the construction joints of cast-in-place concrete. The test was designed to simulate jobsite conditions wherein the waterstop sample was installed along the construction joints of a specially made concrete test chamber and subjected to controlled hydrostatic pressures in the laboratory.

2 LABORATORY TEST SET-UP

To carry out the test, a specially made cylindrical concrete test chamber Ø0.60 m in diameter and 0.70 m high was constructed using conventional construction techniques. The concrete test chamber had a wall thickness of 200 mm (8") and reinforced by two rows of Ø12 mm steel bars with Ø9 mm lateral ties. In preparing the concrete test chamber, the following design mix was used:

Mix proportion of concrete per cubic meter:

Cement Type 1 (Elephant Brand)	*350 kg*
Fine aggregate, sand	*720 kg*
Coarse aggregate, 3/8"	*1,100 kg*
Water, W/C (0.46)	*160 kg*

The concrete test chamber construction was carried out in two stages, i.e., the base and the side walls. A sample of **RHINOSWELL Swelling Waterstop (20 x 15 mm)** with **RHINOLATEX** adhesives were installed at two locations, namely, (i) along the concrete construction joint between the base and the wall, and (ii) along the joint between the steel cylinder and the concrete side walls as shown in Figure 1 below.

Prior to the concrete pouring of the side walls, a 5 mm thick steel cylinder was firmly welded on the vertical steel bars to be left imbedded during the concrete pouring.

After completion of the side wall construction, a 20 mm thick steel plate was welded on the steel cylinder to provide an air tight seal of the concrete test chamber. The concrete test chamber was filled with water and allowed to cure for 7 days prior to the hydrostatic pressure tests.

The sketch of the completed hydrostatic pressure test set-up is shown on Figure 1 below.

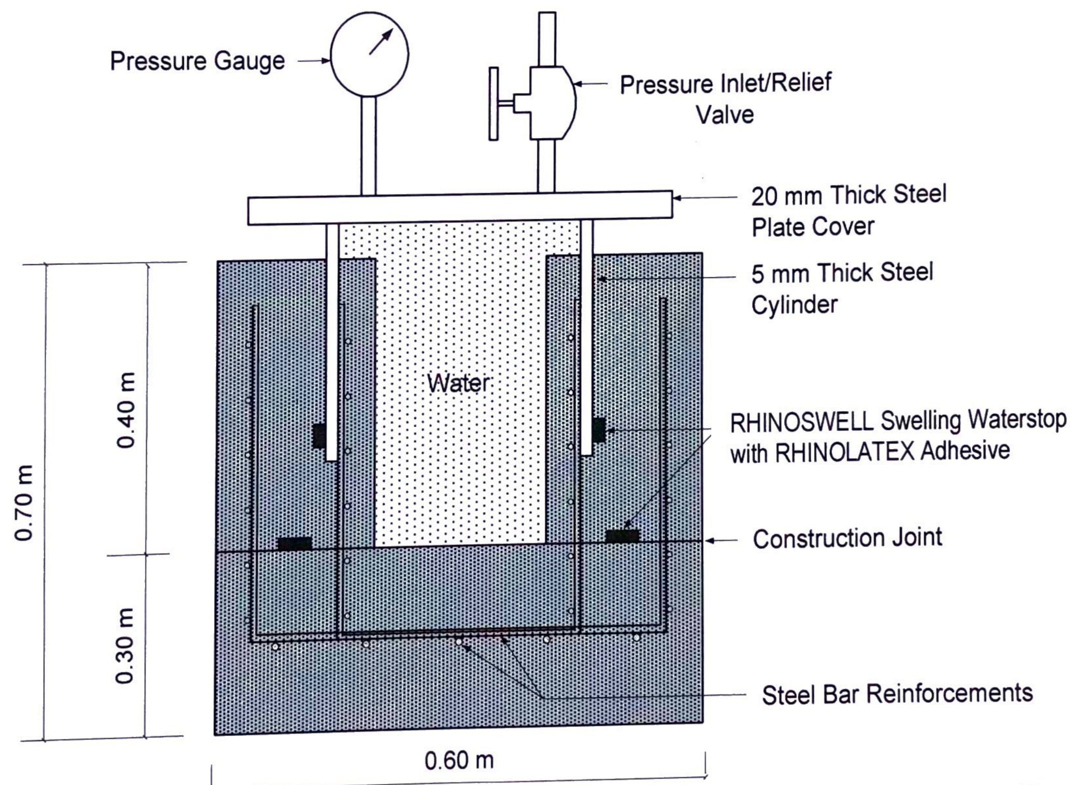

Figure 1. Sketch of the complete hydrostatic pressure test set-up

3 HYDROSTATIC PRESSURE TESTS

The hydrostatic pressure test was carried out by supplying pressure inside the concrete test chamber starting at 50 psi and gradually increasing by 10-psi increments every hour while monitoring the construction joints for any leakages. The pressure increments were continued until the waterstop material failed and leakages were observed along the construction joints.

4 TEST RESULTS

Time Elapsed (hour)	Test Chamber Pressure (psi)	(m of water)	Remarks
Day 1, 10:00 hrs	50	35.2	no leakage at construction joints
Day 1, 11:00 hrs	60	42.3	no leakage at construction joints
Day 1, 12:00 hrs	70	49.2	no leakage at construction joints
Day 1, 13:00 hrs	80	56.3	no leakage at construction joints
Day 1, 14:00 hrs	90	63.3	no leakage at construction joints
Day 1, 15:00 hrs	100	70.3	no leakage at construction joints
Day 1, 16:00 hrs*	110	77.4	no leakage at construction joints
Day 2, 08:00 hrs	120	84.4	no leakage at construction joints
Day 2, 09:00 hrs	130	91.4	no leakage at construction joints
Day 2, 10:00 hrs	140	98.5	no leakage at construction joints
Day 2, 11:00 hrs	150	105.5	no leakage at construction joints
Day 2, 12:00 hrs	160	112.5	no leakage at construction joints
Day 2, 13:00 hrs	170	119.5	no leakage at construction joints
Day 2, 14:00 hrs	180	126.6	no leakage at construction joints
Day 2, 15:00 hrs	190	133.6	no leakage at construction joints
Day 2, 16:00 hrs	200	140.6	no leakage at construction joints
Day 2, 17:00 hrs*	210	147.7	no leakage at construction joints
Day 3, 10:00 hrs	220	154.7	Initial leakage noted at steel-concrete joint. No leakage at concrete construction joint was noted.
Day 3, 11:00 hrs	230	161.7	Leakage at steel-concrete joint. No leakage at the concrete construction joint was noted.
Day 3, 12:00 hrs	240	168.7	Leakage at steel-concrete joint. No leakage at the concrete construction joint was noted.
Day 3, 13:00 hrs	250	175.8	Leakage at steel-concrete joint. No leakage at the concrete construction joint was noted.
Day 3, 14:00 hrs	260	182.8	Leakage at steel-concrete joint. No leakage at the concrete construction joint noted.
Day 3, 15:00 hrs	**270**	**189.8**	**Leakage at both steel-concrete joint and concrete construction joint were noted.**

** Pressure inside the concrete test chamber released after tests on both Day 1 and Day 2. The hydrostatic pressure test was continued the following day at the next pressure level.*

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5 CONCLUSIONS

Based from the samples tested and following the hydrostatic pressure test procedure described in this report, the **RHINOSWELL Swelling Waterstop (20x15 mm)** sample with **RHINOLATEX** adhesive was found to be effective in preventing water leakages along the concrete construction joints of the specially made concrete test chamber up to a maximum hydrostatic pressure of 260 psi (182.8 m of water).

Tests performed by:		Checked and Approved:	
ชัชวาล ปั้นตระกูล	2-11-18		2 NOV 2018
Mr. Chachawan Pantrakul	Date	Mr. Arturo G. Roa	Date
Laboratory Technician		*Research Lab Manager*	

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Note:
Results obtained from this test are based on the materials submitted as samples to the laboratory and testing conditions and procedures described in this report. No statement can be made on the precision or bias of this test method in relation with the actual performance in the field.

Reference:

Robert L. Nelson and Associates Inc. Construction Materials Laboratory, "A Study to Determine the Effectiveness of Swellable Waterstop Barriers in Concrete Joints".

APPENDIX – PHOTOGRAPHS OF THE LABORATORY TESTS

Photograph 1 – **RHINOSWELL Swelling Waterstop (20x15 mm)** and **RHINOLATEX** adhesives used in the laboratory tests.

Photograph 2 – Installation of **RHINOSWELL Swelling Waterstop (20x15 mm)** along the construction joints of the concrete test chamber.

Photograph 3 – Completed concrete test chamber prior to the pressurization and at 100 psi (70.3 m water) pressure. No leakages at the joints were noted.

Photograph 4 – Concrete test chamber at 220 psi and 240 psi pressure. No leakages were observed at the concrete construction joints after one hour of tests. At the steel-concrete joint, initial leakage was noted at 220 psi pressure.

Photograph 5 – Concrete test chamber at 260 psi and 270 psi pressure. At 260 psi pressure (182.8 m water), no leakages were observed at the concrete construction joint. At the steel-concrete joint, leakages were noted. At 270 psi pressure (189.8 m water), initial water leakage was noted at the concrete construction joint. Therefore, the maximum effective pressure of **RHINOSWELL Swelling Waterstop (20x15 mm)** with **RHINOLATEX** adhesives to prevent water leakages along concrete construction joints is at 260 psi (182.8 m water) pressure.