Ruff-Neck™ Reducing Hose

AIR ENTRAINMENT TEST REPORT

November 16, 2002

Construction Forms, Inc.

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AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- GEOTECHNICAL
- MATERIALS
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REPORT OF EVALUATION OF CONCRETE

PROJECT:

RUFF-NECK
REDUCING HOSE

REPORTED TO:

CONSTRUCTION FORMS
777 MARITIME DRIVE
PORT WASHINGTON, WI 53074

ATTN: ROLANDO ALTAMIRANO

AET JOB NO: 05-01322

DATE: NOVEMBER 27, 2002
REVISED: DECEMBER 17, 2002

INTRODUCTION

This report presents the results of our recent analysis of concrete being pumped through the Ruff-Neck Reducing Hose which Construction Forms has developed. The data for this analysis was obtained during a pump demonstration on November 16, 2002. We understand this Ruff-Neck Reducing Hose was developed to control the air content in concrete as it is being pumped. Mr. Rolando Altamirano of Construction Forms requested we determine the change in air in concrete from several discharge systems. The scope of our work consisted of testing plastic concrete for air content before and after being pumped. Also, samples were obtained for compression and possible hardened air content.

SUMMARY OF RESULTS

No air loss occurred when using the Ruff-Neck Reducing Hose while air loss did occur with each of the other four discharge systems.

TEST RESULTS

Sample No.	Truck No.	Discharge System	Location of Sample	Air (%)	Concrete Unit Wt. (pcf)	Slump (in.)	Temperature (°F) Concrete	Temperature (°F) Ambient
1	45	5" rubber hose	Truck Chute Discharge	4.3	148.0	3	65	30
2	45		Pump hose discharge	4.0	148.4	2¾	66	
3	45	5" to 4" Ruff-Neck Reducing Hose	Truck Chute Discharge	4.4	148.0	3	66	30
4	45		Pump hose discharge	4.5	147.6	3	65	

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Sample No.	Truck No.	Discharge System	Location of Sample	Air (%)	Concrete Unit Wt. (pcf)	Slump (in.)	Temperature (°F) Concrete	Temperature (°F) Ambient
5	59	36" steel reducer with 4" rubber hose	Truck Chute Discharge	4.2	147.6	3½	66	30
6	59		Pump hose discharge	3.8	148.8	3½	66	
7	59	5" to 4" Ruff-Neck Reducing Hose	Truck Chute Discharge	4.0	148.4	3½	68	30
8	59		Pump hose discharge	4.0	148.4	3½	67	
9	45	Two 90° elbows with 5" hose	Truck Chute Discharge	5.6	145.6	4½	66	31
10	45		Pump hose discharge	4.5	147.0	4½	65	
11	45	5" to 4" Ruff-Neck Reducing Hose	Truck Chute Discharge	5.6	-	3¾	66	31
12	45		Pump hose discharge	5.6	145.6	3¾	67	
13	59	Two 90° elbows with 5" hose	Truck Chute Discharge	4.6	147.2	4½	66	32
14	59		Pump hose discharge	3.8	148.6	4½	66	
15	59	Ram's horn with 4" hose	Truck Chute Discharge	4.5	148.0	3½	67	32
16	59		Pump hose discharge	4.1	148.4	3½	67	
17	59	5" to 4" Ruff-Neck Reducing Hose	Truck Chute Discharge	4.5	147.2	4½	67	32
18	59		Pump hose discharge	4.5	147.4	4½	68	

ENGINEERING REVIEW

The use of air entrainment for improving freeze-thaw durability is common practice in today's concrete industry. ACI's "Specification for Structural Concrete," 301 requires air entrainment for normal weight concrete subject to the potentially destructive exposure such as freezing and thawing, severe weathering or deicer chemicals. As noted in ACI's "Guide to Durable Concrete 201.2R," when the temperature of concrete drops below freezing, ice crystals form in the capillaries within the freezing zone. The pore water is a weak alkali solution. Crystallization increases the alkali content of the unfrozen pore water. An Osmotic potential is created which draws water to the freezing zone to dilute the alkali solution. Ice growth in the capillaries disrupts the paste when cement paste contains entrained air and the average distance between air bubbles is not great, the bubbles compete with the capillaries for the unfrozen water and normally win the competition. Ice growth does not occur in the capillaries, but rather in the air voids, leaving paste undamaged.

The concrete industry controls air content by testing plastic concrete delivered to the construction site. Many project specifications require the sampling for air content testing be done at the point of placement after pumping. The effects of pumping on the air content complicate the control of this parameter. There are studies which indicate that concrete which has lost air during pumping may actually contain an appropriate distribution of air voids, but be below the specified total air content. This fact may allow the concrete to remain freeze-thaw durable, but does not help maintain the air content to meet project specifications. It is with this in mind that Construction Forms developed this new concept that helps control the air content in concrete as it is being pumped.

TESTING METHODS AND OBSERVATIONS

On November 16, 2002, 34 cubic yards of concrete were placed at the Construction Form facility in Port Washington, Wisconsin. The concrete was provided by Schmitz's Ready Mix. The proportions for the mix delivered are attached to this report.

The construction consisted of an exterior slab-on-grade. The overall dimensions were measured 30 feet by 60 feet. Six discharge systems at end of pump line were used:

- 5" rubber hose
- 36" steel reducer with 4" rubber hose
- Ram horn with 4" hose
- Two 90-degree elbows with 5" hose
- Ruff-Neck Reducing Hose

The concrete was pumped with a 52 meter Schwing pump.

Four truckloads of concrete were tested to document slump, air content, temperature and unit weight. The slump was documented in accordance with ASTM:C143, "Standard Test Method for Slump of Portland Cement Concrete." The air content of the concrete was tested by the pressure method according to ASTM:C231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method." The unit weight testing was performed in accordance with ASTM:C138, "Standard Test Methods for Unit Weights, Yield and Air Content of Concrete." Fifty-four standard cylinders for compression and hardened air contents were also cast in accordance with ASTM:C32, "Standard Practice for Making and Curing Concrete Test Specimens in the Field."

Load #1

Six yards arrived in Truck #45. Approximately one yard of concrete was discharged through the pumping system before sampling at the truck chute discharge. This sample was tested for slump, air content, temperature, unit weight, and three standard cylinders were cast. After allowing for the concrete in the hopper to make it through the pumping system, a sample at the end of the 5" rubber hose (pump discharge) was tested for slump, air content, temperature, unit weight, and three standard cylinders were cast.

The pump was then shut off and the 5" rubber hose was replaced with the Ruff-Neck Reducing Hose. Once again, samples were tested from the truck chute discharge and the pump discharge.

Load #2

Six yards arrived in Truck #59. Approximately one yard of concrete was discharged through the pumping system before sampling at the truck chute discharge. This sample was tested for slump, air content, temperature, unit weight, and three standard cylinders were cast. After allowing for the concrete in the hopper to make it through the pumping system, a sample at the end of the Ruff-Neck Reducing Hose was tested for slump, air content, temperature, unit weight, and three standard cylinders were cast.

The pump was then shut off and the Ruff-Neck Reducing Hose was replaced with a 36" steel reducer with a 4" rubber hose. Once again, samples were tested from the truck chute discharge and the pump discharge.

Load #3

Before load arrived, the 36" steel reducer was replaced with two 90-degree elbows with a 5" hose. Load #3 arrived with six yards in Truck #45. Approximately one yard of concrete was discharged through the pumping system before sampling at the truck chute discharge. This sample was tested for slump, air content, temperature, unit weight, and three standard cylinders were cast.

The pump was then shut off and two 90-degree elbows with a 5" hose was replaced with the Ruff-Neck Reducing Hose. Once again, samples were tested from the truck chute discharge and the pump discharge.

Load #4

Six yards arrived in Truck #59. Approximately one yard of concrete was discharged through the pumping system before sampling at the truck chute discharge. The sample was tested for slump, air content, temperature, unit weight, and three standard cylinders were cast. After allowing for the concrete in the hopper to make it through the pumping system, a sample at the end of the Ruff-Neck Reducing Hose was tested for slump, air content, temperature, unit weight, and three standard cylinders were cast.

The pump was then shut off and the Ruff-Neck Reducing Hose was replaced with two 90° elbows with 5" hose. Once again, samples were tested from the truck chute discharge and the pump discharge.

The pump was then shut off and the two 90° elbows with the 5" hose were replaced with a ram's horn with a 4" hose and the samples were tested one final time from the truck chute and pump discharge.

REMARKS

Compressive strength results will be reported when they become available.

Report Prepared by:

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REPORT OF CONCRETE MIX DESIGN

PROJECT:

STANDARD MIXES

REPORTED TO:

CONSTRUCTION FORMS
777 MARITIME DRIVE
PORT WASHINGTON WI 53074

ATTN: ROLANDO ALTAMIRANO

AET JOB NO: 05-01322

DATE: DECEMBER 16, 2002

Mix Number: 1
Application: Pump demonstration

Materials:

Cement	Portland Cement, ASTM:C150, Type I
Coarse Aggregate	Size #67, ASTM:C33
Fine Aggregate	Concrete Sand, ASTM:C33
Water Reducer	Type A, ASTM:C494
Air Entrainment	Vinsol Resin, ASTM:C260

Design Specification:

Compressive Strength	5000 psi @ 28 days
Slump, inch	4
Air Content, %	4½ - 6½

Proportions:

Cement, pcy	658
Coarse Aggregate, pcy	1745
Fine Aggregate, pcy	1205
Water Reducer, ocy	20.0
Air Entrainment, ocy	5
Water, pcy	265
W/C Ratio	0.40
Air Content, calculated, %	6.0

Concrete supplied by Schmitz Ready Mix.

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