MORSE BROTHERS, INC. CLACKAMAS
CONCRETE CYLINDER MOLD INVESTIGATION

SEPTEMBER, 1986

STUDY MADE BY
OREGON STATE HIGHWAY DIVISION
MATERIALS SECTION

DONALD E. WENCE
MATERIALS TESTING ENGINEER

Department of Transportation

HIGHWAY DIVISION

Materials Section

DOCUMENT NUMBER 00007

Technical Report Documentation Page

Specification No. 504	**ODOT No.**
Report Date September, 1986	**Report No.**

Title
Morse Brothers, Inc. Clackamas
Concrete Cylinder Mold Investigation

Subtitle

Author
Donald E. Wence - Materials Testing Engineer

Performing Organization
Materials Section
Oregon State Highway Division
2950 State Street
Salem, OR 97310

Sponsoring Agency

Notes

Key Words Concrete Cylinder Molds Compressive Strength Portland Cement Concrete	**Type** Research Report **Location**

INTRODUCTION

On May 5, 1986 Keith Johnston, Structural Materials Engineer, initiated an in house study of concrete cylinder molds. The purpose of this study was to prove if steel concrete cylinder molds produce higher compressive strengths than plastic concrete cylinder molds. Also, this study will determine the amount of strength difference, if any. This study was performed under the direction of Hal Baird, Assistant District Inspection Manager. All concrete was batched at the Morse Brothers Clackamas Prestress Plant.

METHODOLOGY

Five concrete cylinders were cast for each set of 32 acceptance tests on the N.W. Front Ave. - N.W. Yeon Ave. project. Three cylinders were cast in plastic molds and two in steel molds. One of the cylinders cast in plastic was tested for 7-day compressive strength, and the remaining cylinders were tested for 28 day compressive strength. All five cylinders were cast from the same sample of concrete batched from OSHD Mix Design numbers 86-7825 and 86-7826. These designs are for classes 4000 3/4 and 5000 3/4 respectfully.

Immediately after molding, the five cylinders were covered with a cure box composed of a wooden frame lined with styrofoam. The cylinders remained undisturbed after molding for approximately 24 hours. The steel cylinders used were not sealed to prevent water loss through the seams. After the 24-hour cure period, the steel cylinders were stripped from the molds, and placed in plastic bags for shipping to the OSHD Materials Laboratory. The plastic cylinder molds were left intact during shipping, and all cylinders were shipped via OSHD Shuttle Service. Once at the OSHD Materials Laboratory the cylinders were promptly capped with sulfur mortar caps, and placed in a 73.4 degree F. + or - 3 degree F. moist cure room until tested for 28- day compressive strength.

TEST RESULTS

The average compressive strength for each set of two cylinders is listed in Table One. The categories are as follows:

A. Steel molds
B. Plastic molds

1. For statistical analysis between steel molds and Plastic molds, category A vs. B, exhibited a significant difference.

The 28-day compressive strength was tested using the nominal area for concrete cylinders, so this value was adjusted for the actual area. Since only two steel molds were used for the entire procedure, the average of these areas where compared to nominal for a ratio that yields actual compressive strength. Likewise, the plastic cylinders were adjusted to exhibit actual compressive strength.

CONCLUSIONS

The compressive strength difference between steel and plastic molds was significant at the 95% level.

When acceptance testing is being performed, concrete cylinder molds should comply to AASHTO Test Designation: M 205 - 83I (ASTM Designation: C 470 - 81) for watertightness. The steel cylinders used in this testing did not comply to this specification while the plastic molds did. The additional water loss through the seams of the steel molds could bias the mean strength higher than if the molds were watertight.

Currently OSHD specifies the use of plastic single-use cylinder molds for all acceptance testing. This policy promotes uniformity in concrete cylinders, prevent waterloss, and protects while in transit. After careful review of the data herein, it is concluded that the small difference in compressive strength caused by the use of plastic molds instead of steel molds is more than compensated by the ease of use of plastic molds, uniformity and quality of cylinders produced. Therefore, no change in our policy is recommended at this time.

COMPRESSIVE STRENGTH OF CYLINDERS

TABLE I

CATEGORY	A	B
TYPE	STEEL	PLASTIC
	0512.5	8165.0
	8040.0	7237.5
	8287.5	7675.0
	8165.0	7702.5
	7915.0	7472.5
	5895.0	5345.0
	7182.5	6747.5
	6990.0	6287.5
	6952.5	6615.0
	6855.0	6485.0
	7032.5	6325.0
	6935.0	6325.0
	6980.0	7040.0
	6117.5	5842.5
	7155.0	7197.5
	7215.0	7160.0
	6757.5	6477.5
	6487.5	6062.5
	7037.5	6870.0
	6147.5	5962.5
	7675.0	7252.5
	8125.0	7587.5
	8062.5	8025.0
	7635.0	7275.0
	7850.0	7795.0
	7320.0	7462.5
	7955.0	7902.5
	8125.0	7677.5
	7955.0	7737.5
	8355.0	7810.0
	7240.0	7045.0
	8102.5	7630.0
MEAN	7408.1	7068.6
STD. DEV.	703.69	717.87
STD. ERROR	124.40	126.90

STATISTICAL COMPARISON OF CATEGORIES

TABLE II

TYPE	STEEL vs. PLASTIC	(ADJUSTED) STEEL vs. PLASTIC
CATEGORY	A vs. B	A VS. B
MEAN DIFF.	339.5	464.4
% MEAN DIFF	4.58%	6.22%
STUDENT t VALUE	7.96	10.84
SIGNIFICANCE	HIGHLY	HIGHLY
CONFIDENCE LEVEL	99	99

COMPRESSIVE STRENGTH OF CYLINDERS
(Corrected for diameters)

TABLE II

CATEGORY	A	B
TYPE	STEEL	PLASTIC
	8580	8080
	8100	7170
	8350	7600
	8230	7630
	7970	7400
	5940	5290
	7240	6680
	7040	6230
	7000	6550
	6910	6420
	7080	6260
	6990	6260
	7030	6970
	6160	5780
	7210	7130
	7270	7090
	6810	6410
	6540	6000
	7090	6800
	6190	5900
	7730	7180
	8180	7510
	8120	7950
	7690	7200
	7910	7720
	7370	7390
	8010	7820
	8180	7600
	8010	7660
	8420	7730
	7290	6980
	8160	7550
MEAN	7462.5	6978.1
STD. DEV.	708.7	711.4
STD. ERROR	125.28	125.75