

INFORMATION HANDOUT

**For Contract No. 12-0M1204
At 12-Ora-5-28.3/28.6**

**Identified by
Project ID 1200020296**

MATERIALS INFORMATION

Final Materials Report for Widening of NB I-5 On-ramp from Tustin Ranch Road in
Tustin, California

Memorandum

*Serious drought.
Help Save Water!*

To: **KAMRAN MAZHAR**
Branch Chief
Design Branch F

Date: March 4, 2015

File: 12-ORA-5
PM 28.3-28.6
EA 0M1201
ID 1200020296
Transmittal Letter for
Final Materials Letter
Report

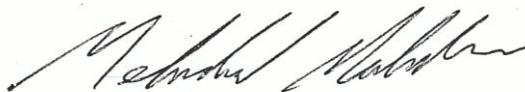
From: **MEHRDAD MAHDAVIAN, P.E.**
Transportation Engineer
Materials & Research Branch

Subject: **TRANSMITTAL OF FINAL MATERIALS LETTER REPORT FOR WIDENING OF NB I-5 ON-RAMP FROM TUSTIN RANCH ROAD IN TUSTIN, CALIFORNIA.**

Attached please find the Final Materials Report for the above referenced project for your review and comments.

If you need additional information, please contact Mehrdad Mahdavian at X-4927.

Prepared by:



Mehrdad Mahdavian, P.E.
Materials & Research Branch
Division of Project Delivery
RCE No. 47566

Concurred by:



Behdad Baseghi, PhD, PE, GE, PMP
Chief, Materials & Research Branch
Division of Project Delivery
RCE No. 47051, GE No. 2310

Cc: Tam Nguyen
Alma Olguin
File

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ID 1200020296
Final Materials Letter
Report

From: MEHRDAD MAHDAVIAN, P.E.
Transportation Engineer
Materials & Research Branch

Subject: Final Materials Letter Report For Widening Of NB I-5 On-Ramp From Tustin Ranch Road In Tustin, California.

In accordance with your request, Materials and Research (M&R) Branch has reviewed the Project Plans submitted for the above-referenced project. We have conducted Field investigation, sampling and laboratory testing in order to provide you with recommendations for pavement structural sections for the proposed widening of NB Interstate 5 (I-5) On-ramp from Tustin Ranch Road in City of Tustin, CA.

This report provides pavement design and materials recommendations in accordance with Topic 114 of Highway Design Manual (HDM 2010). There are other issues such as settlement of embankment fills, groundwater elevations, etc. that will be addressed by the project Geotechnical Design Report (GDR).

1.0 Introduction

I-5 is a major North-South Interstate freeway that is heavily used for interstate and interregional transportation. In Orange County, I-5 spans a distance of about 44 miles from San Diego County line to Los Angeles County Line. During peak hours, I-5 operates under recurrent traffic congestion within the project limits in Orange County. The proposed project is designed to improve the operation and capacity on the northbound Interstate 5 (I-5) at Tustin Ranch Rd on-ramp by widening the existing on-ramp from 2 to 3 lanes.

2.0 Existing Facility

Northbound I-5 On-ramp from Tustin Ranch Road is a 2-lane on-ramp, which takes traffic from SB Tustin Ranch Road, as well as from a NB Tustin Ranch Road left turn only lane.

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3.0 Climatic Conditions

The climate in the project area is typical of coastal region in Southern California and classifies as Mediterranean because of characteristically warm, dry summers and mild winters, with moderate precipitation. The semi-arid Southern California coastal region receives most of its precipitation from moisture-laden air masses that originate in the northern Pacific Ocean, occurring predominantly during cool winter season, with an average annual rate of about 14 inches of rainfall per year (www.weather.com). Snowfall is rare in the project area, which may be considered frost-free. The project site considered to be within “South Coast” climate region based on Caltrans Pavement Climate Region Map (Figure 615.1 of HDM).

4.0 Proposed Project Improvement

This project report proposes to improve the operation and capacity on the northbound Interstate 5 (I-5) at Tustin Ranch Rd on-ramp by widening the existing on-ramp from 2 to 3 lanes.

5.0 Terrain and Surface Drainage

The project site is located in residential area. The topography of the Tustin Ranch On-ramp alignment slopes down from south to north at about 10%. The elevation of the ramp roadway surface ranges from about 96 feet at the beginning of the ramp to about 87 feet at the freeway level.

6.0 Subsurface and Groundwater Conditions

Our field investigation was conducted on August 5, 2014 and consisted of drilling and/or coring the On-ramp at four (4) locations (See Coring MB-1, MB-2, MB-3 and MB-4 shown on Boring Location Layout Plans). The purpose of this investigation was to measure the thickness of various pavement sections and to evaluate presence of any base or subbase, as well as sampling of subsurface soils beneath the pavement for laboratory testing and evaluation. Coring of AC pavement section was conducted at MB-1, and MB-2 locations, and was terminated below the pavement section for identifying the various pavement layers only. No sample was taken from this coring site. followed by auguring of subgrade soils. At MB-3, auguring of subsurface soils encountered landscaping wires, drilling was terminated at about 3 feet below surface, and a soil sample was collected from this site. At MB-4, drilling of the subsurface soils was conducted away from the pavement to avoid any landscaping wires and a soil sample was collected at this location. Soil samples collected from the subsurface soils were sent to District 7 laboratory for testing. Table 2 presents summary of Laboratory Test Results for these samples. Table 3 presents summary of Coring data as compared to As-built plans.

7.0 Cut and Fill Construction

The proposed widening of the On-ramp embankment involves over excavation of clayey expansive soils within the embankment and its slopes, leaving the central embankment fill in place. Import materials consisting of structural backfill are required to replace the over-excavated clayey soils. *All import fills material that is going to be placed within 4 feet of finished grade shall have an R-value of at least 40, a PI of less than 12, and an Expansion Index of less than 50.* It shall be non-corrosive to metals and concrete especially if any underground utilities or structures are planned to be constructed within the embankment.

8.0 Estimate of Settlement

Estimate of settlements for the roadway embankment fill and subsurface soils will be addressed by the GDR. *All settlements have to be mitigated prior to placement of the pavement structural section.*

9.0 Seismic Considerations

The GDR provides recommendations for seismic design including liquefaction/seismic settlement and lateral spreading (as applicable).

10.0 Earthwork

10.1 General Earthwork Requirements

All earthworks shall conform to requirements of Section 19 of Caltrans 2010 edition of Standard Specifications, and project Special Provisions. Imported borrow may be required for construction of embankments. Source of imported borrow is unknown at this time. Therefore, earthwork factors cannot yet be determined. Compaction of soils shall be conducted in accordance with Section 19-5 of the Caltrans Standard Specifications. Fills placed against existing embankments shall be properly benched into the existing side slopes as described in Section 19-6.03 of the Caltrans Standard Specifications. Existing vegetation on slopes shall be removed and shall not be used as fill material. Any temporary sloping, sheeting and shoring shall be made the Contractor's responsibility. Appropriate measures shall be taken to prevent damage to adjacent structures and utilities. It should be noted that it is the responsibility of the Contractor to oversee the safety of the workers in the field during construction. The Contractor shall conform to all applicable occupational safety and health standards, rules, regulations, and orders established by the State of California.

10.2 Construction Observation and Testing

It is recommended that inspection and testing be performed during the following stages of construction:

- Grading operations, including over excavation and placement of compacted fill.
- Placement of Settlement Platforms.
- Removal of Existing MSE Wall.
- Removal of existing shoulders structural sections and Dicks.
- Preparation of pavement subgrade.
- Placement of Pavement sections.
- Excavations for utility trenches.

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- When any unusual conditions are encountered.

11.0 Traffic Index

In their email, on October 13, 2014 District 12 Traffic Branch recommended a 20-year Traffic Index (TI) value of 12 to be used for Tustin Ranch Road pavement design. A copy of their email is attached to this report.

12.0 Summary of Field Investigation and Existing Pavement Sections

Our field investigation was performed on October August 5, 2014, and consisted of conducting one core in the right lane (MB-1) at about Station 31+60 and one core in the shoulder area of the ramp (MB-2) at about station 31+70. The purpose of coring at these locations was to measure the thickness of each pavement layer. In addition to these locations, coring and drilling of subsurface soils were conducted at MB-3 location in the MVP area at about Station 34+50 and drilling of MB-4 was conducted in the dirt area near Station 36+20 (See Coring MB-1 through MB-4 locations shown on Boring Location Layout Plans). At MB-3, the auger encountered electrical wires of irrigation system and drilling was terminated at about 3-feet. Bulk soil samples collected from the subsurface soils were sent to District 7 laboratory for testing. Table 1 presents summary of boring location and sampling data. Table 3 presents summary of pavement section data as found during coring compared with the pavement sections presented in the as-built plans.

13.0 Laboratory Testing

The following laboratory tests were performed on each sample collected from the boring:

- Sieve Analysis (CTM 202)
- Mechanical Analysis (CTM 203)
- Atterberg Limits (CTM 204)
- Sand Equivalent (CTM 216)
- R-Value (CTM 301)
- Resistivity and pH (CTM 643)
- Sulfate Content (CTM 417)*
- Chloride Content (CTM 422)*

* These tests are done by HQ lab on samples having resistivity less than 1000 ohm-cm.

Expansion Index test was not performed due to the small size of samples. Table 2 presents summary of laboratory test results for each sample and its location (ramp).

13.1 Corrosion Testing

Caltrans Bridge Memo to Designers 3-1 (Caltrans, 2000), defines a corrosive environment as one where the soil has electrical resistivity of less than 1000 Ω -cm, sulfate content of greater than

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2,000 ppm, chloride content of greater than 500 ppm, or pH of less than 5.5. Two Soil samples collected from borehole locations MB-3 and MB-4 were tested for corrosion. Results showed the existing embankment fill soils are corrosive to foundation elements and metals. For widening areas, it is recommended that the import soils used in construction are non-corrosive to metals and concrete. For existing embankments, please follow the recommendations provided in the attached section on Corrosion Results.

14.0 Findings, Conclusions and Recommendations

Our field investigation revealed that the existing pavement is different than what is shown on the As-Built plans. Table 3 presents a summary of existing pavement as depicted in our coring operation versus the As-Built data presented on the October 5, 1964 plans (revised November 23, 1964). The main area of difference exists in the presence of 0.1' of Hot Mixed Asphalt-Open Graded that may have been placed after the construction of the ramps. The existing subsurface soils as depicted in boring MB-4 is expansive. Subsurface soils at boring MB-3 is corrosive to metals and foundation elements, therefore we recommend removal of existing subsurface soils within the widened areas to a depth of 4 feet below the pavement surface and replacing them with import materials having an R-value of 40, Plasticity Index (PI) of 12 or less and an Expansion Index of less than 50. There is an existing Asphalt Treated Permeable Base (ATPB) layer within the existing pavement section, however the new pavement section cannot provide a lateral access to this layer, therefore we recommend not utilizing ATPB in the new pavement. A cross drain should be provided to remove any trapped water within the existing pavement.

We also recommend that **same structural section as the ramp be used for the shoulder area in order to compensate for truck off-tracking on the shoulder area (See Section 607.4-2 of HDM)**. If shoulders are being used for temporary detours or permanent traffic lanes, the **shoulder structural section has to be redesigned for the expected traffic prior to its intended usage**.

The following pavement sections for the Tustin Ranch Road On-ramp to NB I-5 mainline and shoulder pavements are designed based on a 20-year TI of 12 and an R-value of 40:

Alternative 1:

0.1'HMA-O over 0.6' HMA-Type A over 1.15' Class 2 AB over 2.15' Class 3 AS

Alternative 2:

0.1'HMA-O over 1.1' HMA-Type A over 2.8' Class 3 AS

Pavement section for shoulders to be used as detour:

0.1'HMA-O over 1.0' HMA-Type A over Existing Embankment or Subsurface Soils

15.0 Life Cycle Cost Analysis (LCCA)

LCCA is an analytical technique based on economic principals to evaluate long-term alternative

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investment options. LCCA studies the life cycle cost for various pavement strategies for new pavements or rehabilitation projects in order to evaluate the long-term alternative investment options for the pavement. LCCA accounts for relevant cost to the agency, owner, operator of the facility, and the roadway user that will occur throughout the life of the pavement. After cost evaluation of various alternatives and based on discussions with HQ Pavement Program Branch, LCCA is not required for this project since the pavement work is short and the cost difference is not significant.

16.0 Materials Available

Imported borrow may be required for construction of embankments and replacement of unsuitable soils within the project limits. Local sources of construction materials were not investigated in this study. However, materials are available from several commercial suppliers throughout Orange, Los Angeles, Riverside and San Bernardino Counties. Furthermore, the Web Site of Department of Conservation on the Internet contains a current listing of mining operations eligible to sell materials to the State of California. The page can be accessed at: <http://www.consrv.ca.gov/omr/index.htm>

18.0 Limitations

This report is intended for the use of Caltrans for the proposed Widening Of NB I-5 On-Ramp From Tustin Ranch Road In Tustin, California. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses on soil samples obtained from the site. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. District Materials and Research Branch should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s), which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of the District Materials and Research Branch.

This report is prepared in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

19.0 Recommended Materials Specifications

The following requirements shall be included in the project specifications:

- Hot Mixed Asphalt shall be Type A-3/4 inch.
- Aggregate Base (AB) shall be Class 2 and Aggregate Subbase (AS) shall be Class 3 and follow requirements in sections 26 and 25 of Caltrans Standard Specifications respectively.
- Flexible pavement sections for the shoulder and ramps were designed using the Caltrans computer program "CALFP" (Caltrans, 2008), which was also based on the design method outlined in Chapter 600 of the Highway Design Manual (HDM).
- ***All import fills material that is going to be placed within 4 feet of finished grade shall have an R-value of at least 40, a PI of less than 12, and an Expansion Index of less than 50.*** It shall be non-corrosive to metals and concrete especially if any underground utilities or structures are planned to be constructed within the embankment. If the existing native soils within upper 4 feet of finished grade is determined not to meet the above requirements, the existing native soils shall be over-excavated and replaced with imported borrow to meet the imported fill recommendations herein. Borrow materials shall conform to Section 19-7 of Caltrans Standard Specifications (2010).
- Prior to the placement of pavement sections, the subgrade soils shall be compacted in accordance with Section 19-5.03 of Caltrans Standard Specification (2010).
- It is critical that construction and rehabilitation effort be coordinated such that a uniform superior product is delivered.
- All Standard Special Provisions (SSPs) to be included in the project shall be submitted the Materials and Research Branch for review and approval.
- Special attention is required to be given to the following sections of July 2010 Standard Specifications:
 - Section 19: Earthwork;
 - Section 25: Aggregate Subbases;
 - Section 26: Aggregate Bases;
 - Section 28: Concrete Bases;
 - Section 39: Hot Mixed Asphalt;
 - Section 61: Culvert and Drainage Pipe Joints;
 - Section 64: Plastic Pipe;
 - Section 65: Concrete Pipe;
 - Section 66: Corrugated Metal Pipe;
 - Section 68: Subsurface Drains;
 - Section 92: Asphalts;
 - Section 93: Liquid Asphalts;
 - Section 94: Asphaltic Emulsion.

If you have any questions, please call Mehrdad Mahdavian at (949) 756-4927.

Prepared by:



Mehrdad Mahdavian, PE
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Division of Project Delivery
RCE # 47566

Concurred by:



Behdad Baseghi, PhD, PE, GE, PMP
Chief, Materials & Research Branch
Division of Project Delivery
RCE # 47051

Attachments: Figures
Tables
Lab Results
Corrosion Analysis Results
Copy Of Traffic Index Email

Cc: Tam Nguyen
Alma Olguin
File

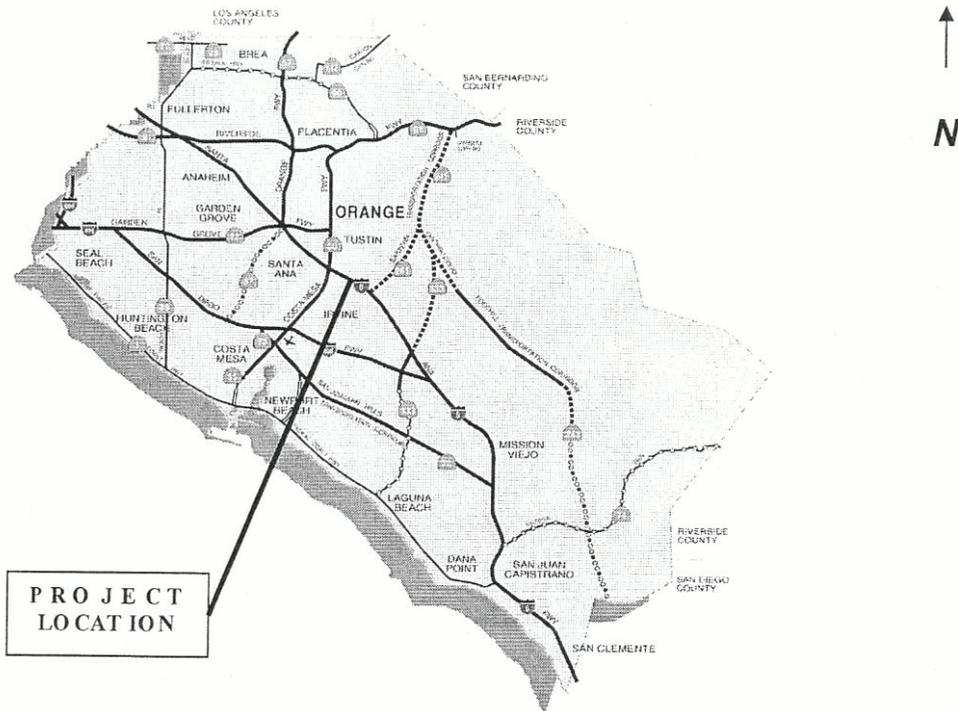


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FIGURES

Figure 1: Site Location Map



**In Orange County, City of Tustin
On NB Route 5 at Tustin Ranch Road On-Ramp**

DATE PLOTTED	12-09-2014
TIME PLOTTED	08:37
PROJECT NUMBER & PHASE	1200020961
UNIT	UNIT 2996
SCALE	SCALE 1" = 50'

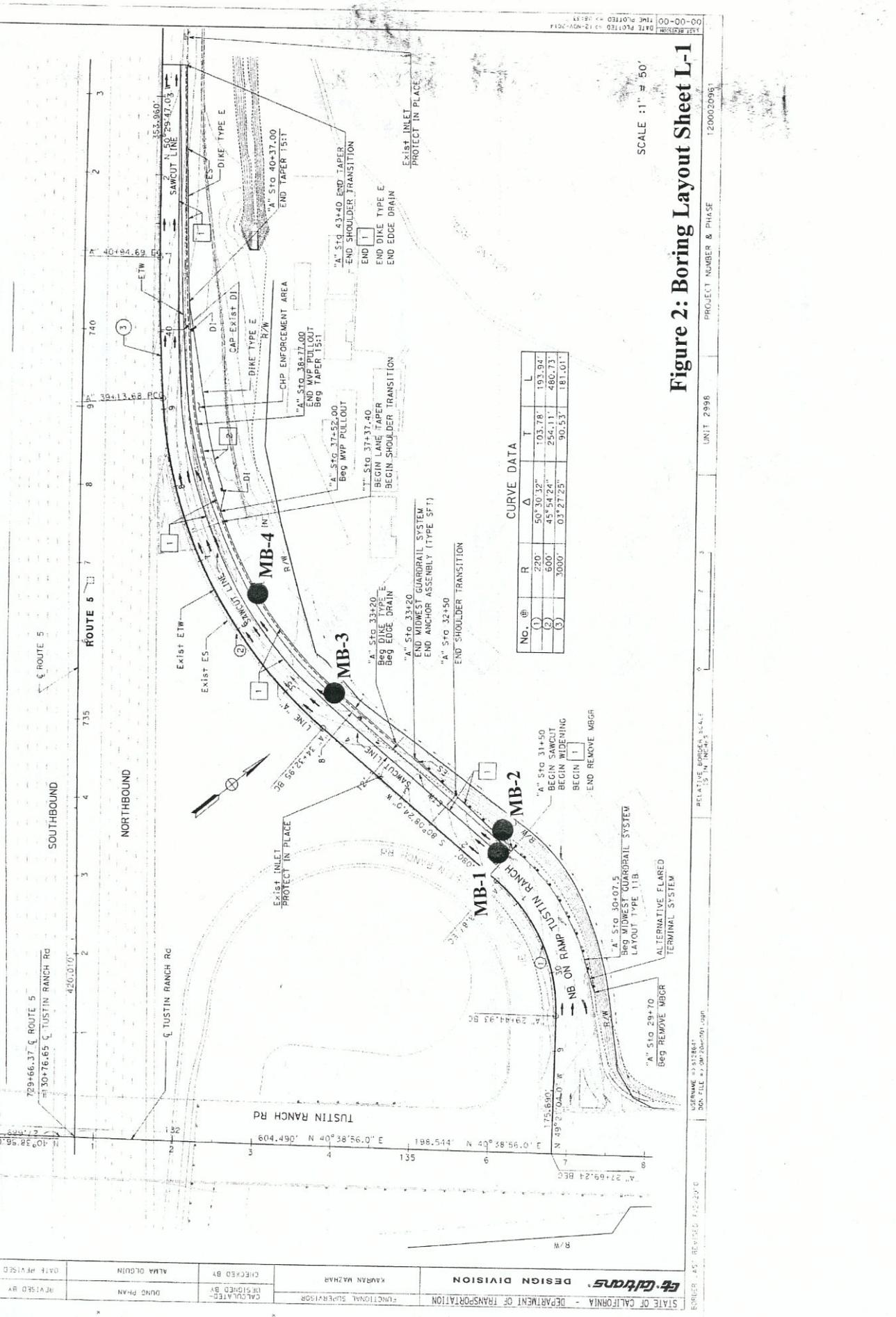
DATE	12-09-2014
TIME	08:37
PROJECT NUMBER & PHASE	1200020961
UNIT	UNIT 2996
SCALE	SCALE 1" = 50'

DATE	12-09-2014
TIME	08:37
PROJECT NUMBER & PHASE	1200020961
UNIT	UNIT 2996
SCALE	SCALE 1" = 50'

DATE	12-09-2014
TIME	08:37
PROJECT NUMBER & PHASE	1200020961
UNIT	UNIT 2996
SCALE	SCALE 1" = 50'

DATE	12-09-2014
TIME	08:37
PROJECT NUMBER & PHASE	1200020961
UNIT	UNIT 2996
SCALE	SCALE 1" = 50'

DATE	12-09-2014
TIME	08:37
PROJECT NUMBER & PHASE	1200020961
UNIT	UNIT 2996
SCALE	SCALE 1" = 50'



LEGEND:

- [X] STRUCTURAL SECTION TYPE SEE SHEET X-1
- (X) CURVE NO.

CURVE DATA

No. @	R	Δ	T	L
(1)	220	50°30'32"	103.78	193.94'
(2)	600	45°54'24"	254.11'	480.73'
(3)	3000'	03°27'25"	90.53'	181.01'

NOTES:

- FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

NO. STATE OF CALIFORNIA OR ITS OFFICERS

THE ASSIGNED TO COMPLETE THESE PLANS

COMPETENT OF THIS PLAN SHEET

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

FUNCTIONAL SUPERVISOR

DESIGNED BY

CHECKED BY

DATE REVISED

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

DESIGN DIVISION

FUNCTIONAL SUPERVISOR

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TABLES

TABLE 1- SUMMARY OF BORING AND SAMPLING DATA

Route No.	Boring No.	Boring Location	PM	Ramp Station	Offset	Sample No.	Sample Depth (ft)	Sample Type	USCS Soil Type	HMA-O/AC/ATPB/AB (ft)	Sampled by	Sampling Date	Date Sent to Lab	Date Received Results
I-5	MB-1	Tustin On-ramp Right Lane	28.4	31+60	30R	No Sample	NS	NS		0.1/0.35/0.25/0.8	MM		NS	
	MB-2	Tustin On-ramp Right Shoulder	28.4	31+70	40R	No Sample	NS	NS		0.1/0.35/0.25/0.8	MM		NS	
	MB-3	Tustin On-ramp MVP	28.5	34+50	40R	MB-3	2-5	Bulk	SM-SC	0.35/0.0/0.8	MM	8/5/2014	8/5/2014	10/5/2014
	MB-4	Tustin On-ramp Right Shoulder in Dirt	28.5	36+20	40R	MB-4	2-5	Bulk	CH	Dirt	MM	8/5/2014	8/5/2014	10/5/2014

N/A Not Available or Not Applicable
 NS Not Sampled

TABLE 2-SUMMARY OF LABORATORY TEST RESULTS

Route No.	Boring No.	Sample No.	Sample Depth (ft)	Percent Passing No. 200 Sieve	SE (%)	USCS	Expansion Index	Atterberg Limits (%)			R-Value	Corrosivity		
								LL	PL	PI		pH	Sulfate Content (ppm)	Chloride Content (ppm)
I-5	MB-3	MB-3	2-5	31.2	16	SM-SC	NT	22	18	4	>40	4372	23	830
	MB-4	MB-4	2-5	68.9	35	CH	NT	41	19	22	10	370	30	967

Notes: 1) NT Not Enough Material to Perform the Test

TABLE 3-SUMMARY OF CORING VS AS-BUILT DATA

Route No.	Direction	Coring Location	Coring No.	Ramp Station	Offset (ft)	Lane No.	Existing Pavement (ft)			As-Built Pavement (ft)			Recommended Pavement Section for Mainline and Shoulder (ft)		
							HMA-O	HMA	AB	HMA-O	HMA	AB	HMA-O	HMA	AS
I-5	NB	Tustin On-ramp MVP	MB-3	34+50	40R	MVP	0.1	0.35	0.8	0	0.35	0.8			
	NB	Tustin On-ramp Right Shoulder in Dirt	MB-4	36+20	40R	Right Shoulder in Dirt	N/A	N/A	N/A	N/A	N/A	N/A	0.1	1.1	2.8

Notes:

- 1 Coring Data was obtained from core samples taken on August 5, 2014.
- 2 Ramp Mainline and its shoulder shall have the same structural section.
- 3 N/A - Not Applicable
- 4 Acronyms:
 - HMA-O** Hot Mix Asphalt Concrete-Open Graded
 - HMA** Hot Mix Asphalt Concrete, Type A - 3/4-inch Maximum, Coarse
 - AB** Class 2 Aggregate Base (See Std. Spec. Section 26-1.02A)
 - AS** Class 2 Aggregate Subbase (See Std. Spec. Section 25)

LAB RESULTS

SRL SOIL & AGGREGATE TESTS

Sample of: Subsurface Soils from Boring MB-4		SRL Lab. Stamp	
Sampled from: 0-5' below surface at Tustin Ranch		By _____ for _____	
Material Source: Road on-ramp to I-5 North		D. OZOWARA SRL Materials Engineer	
Owner / Mfr.: Caltrans		SOUTHERN REGIONAL LABORATORY 13970 Victoria Street Fontana, CA 92336 Phone: (909) 350 9039 Fax: (909) 829 6294	
Date Sampled: 8/5/14		R.E.: Mehrdad Mahdavian Address: Caltrans-Dist 12 Phone No.: (949) 756-4927 Fax No.: 949 724-2519	
GRADING ANALYSIS			
Total Wt.	8868 g	By:	Date:
Wt. Ret.	Size (mm)	Acc. Wt. Ret.	% Ret.
		% Pass	% Pass
			SPEC.
0	25	0	100
48	19	48	99
297	12.5	345	96
348	9.5	693	92
838	4.75	1531	83
7337		8868	
FINE GRADE / MECHANICAL ANALYSIS			
Dry Wt. (g)	2.36 mm	3	100
	1.18 mm	8	99
	600 µm	16	98
	300 µm	30	97
	150 µm	52	94
	75 µm	85	90
			83
			68.9
MECH. / HYDRO.			
1hr.	5M	R	Comb. % In Sus
24hr.	1M	Corr.	C.R.
SAND EQUIVALENT			
Sand R2	0.3	0.4	Avg.
Clay R1	13.8	13.9	
S.E. Value	3	3	3
L.A.R.T.	Rev.	Wt. Ret.	% Ret.
A	100	5000g	% Loss
C	500	5000g	
No. of spheres = _____ Wt. of spheres = _____			
DURABILITY INDEX			
Dura-Coarse	Sed Ht. =		
Dura-Fine	R2/R1 =		
SPEC.			

DATE RCVD: 8/6/14		CONTRACT NO. 1 2 0 M 1 2 0 0	
DATE OUT: 8/14/14		SAMPLE NO. M B - 4	
NUMBER OF CONTAINERS: 2 Bags		DATE: 8/14/14	
NORMAL PRIORITY DATE NEEDED: <input checked="" type="checkbox"/>		By: FAX MAIL PHONE OTHER	
TEST(S) REQUESTED			
<input checked="" type="checkbox"/> Fine Grade	202	A.B.	<input checked="" type="checkbox"/> SAMPLE TYPE
<input checked="" type="checkbox"/> Coarse Grade	202	A.S.	<input checked="" type="checkbox"/> PCC
<input checked="" type="checkbox"/> Filter Material	202	EMB	<input checked="" type="checkbox"/> Bk Fill
<input checked="" type="checkbox"/> Mech. Analysis	203	O.G.	<input checked="" type="checkbox"/> MISC.
<input checked="" type="checkbox"/> Plasticity Index	204	A.C. Agg.	<input checked="" type="checkbox"/> Sub-Grade
<input checked="" type="checkbox"/> % Crushed Particles	205		<input checked="" type="checkbox"/> SOIL
<input checked="" type="checkbox"/> SpG. Coarse	206		TL-101 S.I.C. NO.
<input checked="" type="checkbox"/> SpG. Fine (SSD)	207		
<input checked="" type="checkbox"/> SpG. of Soils	209		Expansion Index
<input checked="" type="checkbox"/> L.A.R.T.	211		
<input checked="" type="checkbox"/> Unit Wt.	212		
<input checked="" type="checkbox"/> Organic Impurities	213		
<input checked="" type="checkbox"/> Soundness	214		
<input checked="" type="checkbox"/> Relative Compaction	216		
<input checked="" type="checkbox"/> Sand Equivalent	217		Dry Density
<input checked="" type="checkbox"/> Moisture Content	226		
<input checked="" type="checkbox"/> Cleaness Value	227		
<input checked="" type="checkbox"/> Durability Fine	229		Max. Dry Density (pcf)
<input checked="" type="checkbox"/> Durability Coarse	229		Opt. Moist Content (%)
<input checked="" type="checkbox"/> Flat & Elongated	ASTM D 4791		Laboratory Remarks:
<input checked="" type="checkbox"/> R-Value	301		Did not have enough sample to perform E. I.
<input checked="" type="checkbox"/> Fine Agg Angularity	AASHTO T 304		Samples of the Mat'l will be sent to SAC for Chlorides and Sulfates.
<input checked="" type="checkbox"/> Mortar Strength	515		
<input checked="" type="checkbox"/> pH (RC)	532		
<input checked="" type="checkbox"/> pH (CMP)	643		
<input checked="" type="checkbox"/> Resistivity (CMP)	643		
<input checked="" type="checkbox"/> Expansion Index	UBC-29-2		
<input checked="" type="checkbox"/> Max. Dry Density/ Opt. Moist Content	ASTM-D1557		
SPECIFIC GRAVITY OF SOILS			
Wt Oven Dry Soil (Wo)			
Wt Pycnometer + H ₂ O (Wa)			
Wt Pycnometer + H ₂ O + Soil (Wb)			
Wo / (Wo + Wa - Wb)			
Wo	Spec. Grav.		
Wa			
Wb			
CONTRACT NO.			
1	2	0	M
1	2	0	0
LAB. NO.			
4	2	1	3
B			

**CORROSION
ANALYSIS
RESULTS**

Results sent to: MEHRDAD MAHDAVIAN

Division of Engineering Services
Materials Engineering and Testing Services
Corrosion and Structural Concrete Field Investigation Branch

Report Date: 8/22/2014
Reported by Michael Mirkovic

CORROSION TEST SUMMARY REPORT - SOIL

EFIS: 120020296

Dist/Co/Rte/PM 12 / ORA /005/R / 28.3 PM

CORROSION LAB #	TL101 #	BORE #	DEPTH (FT)		MINIMUM RESISTIVITY ¹ (ohm-cm)	pH ¹	CHLORIDE CONTENT ² (ppm)	SULFATE CONTENT ³ (ppm)	IS SAMPLE CORROSIVE?
			START	END					
CR20140232	C080059	MB-3	0	5	830	7.92	23	4372	YES
CR20140233	C080060	MB-4	0	5	967	8.17	30	370	NO

SOIL SAMPLE FROM: TUSTIN RANCH RD. (NORTH BOUND ONRAMP)

This site is corrosive to foundation elements (see note below).

Controlling corrosion parameters are as follows:

- Sulfate concentration is 2000 ppm or greater

Note: For Structural Elements, the Department considers a site corrosive if one or more of the following conditions exist: pH is 5.5 or less, chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater. Resistivity is not considered for Structural Elements. MSE backfill shall conform to the requirements of section 47-2.02C Structure Backfill in the 2010 Standard Specifications.

¹CT 643, ²CT 422, ³CT 417



Table of Contents

- [1. Structural Requirements](#)
- [2. Steel Pipes](#)
- [3. Reinforced Concrete Pipe](#)
- [4. Aluminum \(CAP & ASRP\)](#)
- [5. Plastic Pipes](#)
- [6. Actions](#)

1. Structural Requirements

Minimum Steel Thickness For Structural Overfill Requirements (in)
 Corrugated Steel Pipe Helical Corrugations 2 2/3" x 1/2" Corrugations – 0.052

Minimum Aluminum Thickness For Structural Overfill Requirements (in)
 Corrugated Aluminum Pipe Annular Corrugations 2 2/3" x 1/2" Corrugations – 0.06
 Corrugated Aluminum Pipe Helical Corrugations 2 2/3" x 1/2" Corrugations – 0.06

Plastic Pipe Adequacy:
 PVC Corrugated
 HDPE Corrugated - Type S
 HDPE Corrugated - Type C

2. Steel Pipes

<i>Estimated steel thickness loss due to abrasion:</i> <input style="width: 100px;" type="text" value="0.000"/> (More Information)
--

Estimated Service Life (years)

Steel Thickness (in)	Plain Galvanized	Aluminized Steel (Type 2)	Bituminous Coating (Hot-Dipped)	Bituminous Coating & Paved Invert	Polymeric Sheet Coating	Composite SSRP
0.052	24.284	N/A	32.284	39.284	*	N/A
0.064	29.888	N/A	37.888	44.888	*	N/A
0.079	36.894	N/A	44.894	*	*	N/A

Notes:
 N/A : Not available
 * : Provides adequate abrasion resistance to meet or exceed a 50-year design service life
 Aluminized Steel: pH and/or Resistivity out of allowed ranged.

3. Reinforced Concrete Pipe

Minimum Cementitious Material Content (lbs/C.Y.)		
Minimum Cover (in)	Maximum Water-Cementitious Material Ratio	
	0.35	0.40
1.00	470	470
1.25	470	470
1.50	470	470

IF THE ABOVE-LISTED STEPS DO NOT YIELD A PIPE THAT MEETS THE REQUIRED SERVICE, CONTACT HEADQUARTERS OFFICE OF HIGHWAY DRAINAGE DESIGN.

(NOTE: RCP IS NOT RECOMMENDED FOR ABRASION LEVELS 4-6).
ALTPipe WILL ENFORCE THE ABOVE STEPS

4. Aluminum (CAP & ASRP)



**Minimum Soil Resistivity Is Too Low
(<1500) For Aluminum Or Aluminized Pipe.**



5. Plastic Pipes

HDPE

Estimated loss due to abrasion 0.000

Allow Corrugated HDPE To Be Used? Yes

PVC

Estimated loss due to abrasion 0.000

Allow Corrugated PVC To Be Used? Yes

6. Actions

Please choose one of the following actions.

Return to Step 1

Save this pipe to the worksheet

**COPY OF
TRAFFIC
INDEX (TI)
EMAIL**

Mahdavian, Mehrdad@DOT

From: Mahdavian, Mehrdad@DOT
Sent: Monday, October 13, 2014 4:09 PM
To: Olguin, Alma@DOT; Mazhar, Kamran@DOT
Cc: Baseghi, Behdad@DOT; Bazargan, Bob@DOT
Subject: TI & Pavement Sections for NB On-ramp from Tustin Ranch Road, EA 0M1201

Hi Alma: Lab results on the soil samples from the widening areas indicate that we have highly plastic clayey soils with low R-value of 10. They are also highly corrosive to metals and concrete, therefore we recommend that import borrow with R-value of 40 or more (Class 3 Aggregate Subbase) shall be used below the pavement to a depth of 4 feet below the roadway surface. The existing pavement includes a 0.1' layer of HMA-Open Graded and it has ATPB below the top HMA layer. Based on these and a TI of 12 recommended by Traffic Branch we recommend the following pavement sections for the **widening lane and shoulder**:

Alternative 1: 0.1' HMA-O over 0.6' HMA-Type A over 0.25' ATPB over 0.85' Class 2 AB over 1.2' Class 3 AS

If you do not want to include ATPB in your pavement, we recommend using one of the following sections, by providing a cross drain for the existing ATPB layer to remove the water from the pavement

Alternative 2: 0.1' HMA-O over 0.6' HMA-Type A over 1.15' Class 2 AB over 1.15' Class 3 AS or

Alternative 3: 0.1' HMA-O over 1.1' HMA-Type A over 2.8' Class 3 AS

Once again we recommend using the same structural section for the widening of the right lane and shoulder in order to compensate for wheel off tracking of heavy trucks on the shoulder areas. If shoulders are planned to be used as temporary detours during construction they need to be improved for higher traffic. We recommend the following pavement sections for the shoulders that are being used as detour:

HMA-O over 1.0' of HMA-Type A over existing embankment or subsurface soils.

I will provide my final recommendations in the Materials Report for you, in the meantime you can use these sections for your estimate. Call me at X-4927 if you have any questions. Thanks

From: Temori, Habib@DOT
Sent: Monday, October 13, 2014 10:16 AM
To: Mahdavian, Mehrdad@DOT
Cc: Baseghi, Behdad@DOT; Bazargan, Bob@DOT
Subject: RE: TI for NB On-ramp from Tustin Ranch Road, EA 0M1201

Mehrdad,

We don't calculate TI values for ramps. Per Table 613.5A of the HDM, you can use a TI value of 12 for this ramp. Thanks.

From: Mahdavian, Mehrdad@DOT
Sent: Friday, October 10, 2014 1:48 PM
To: Temori, Habib@DOT
Cc: Baseghi, Behdad@DOT; Bazargan, Bob@DOT
Subject: TI for NB On-ramp from Tustin Ranch Road, EA 0M1201

Hi Habib: Can you give me the 20-year TI for this ramp. I need it to calculate the pavement sections for extending the right lane of the ramp.

Mahdavian, Mehrdad@DOT

From: Mahdavian, Mehrdad@DOT
Sent: Tuesday, October 14, 2014 10:08 AM
To: Bazargan, Bob@DOT; Olguin, Alma@DOT; Mazhar, Kamran@DOT
Cc: Baseghi, Behdad@DOT
Subject: RE: TI & Pavement Sections for NB On-ramp from Tustin Ranch Road, EA 0M1201

Bob: The pavement sections I have given is for both the lane and shoulder so HMA-O should be on the shoulders too (as is now) and is 0.1'.

The existing structural section is 0.1' HMA-O over 0.35' HMA over 0.25' ATPB over 0.8' Class 2 AB over AS for the mainline and 0.1' HMA-O over 0.35' HMA over 1.05' Class 2 AB over AS for the shoulders. 0.1' got dropped in the text below because of Word thinking it is a numbered sequence format and replaced it with Blank space.

From: Bazargan, Bob@DOT
Sent: Monday, October 13, 2014 4:29 PM
To: Mahdavian, Mehrdad@DOT; Olguin, Alma@DOT; Mazhar, Kamran@DOT
Cc: Baseghi, Behdad@DOT
Subject: RE: TI & Pavement Sections for NB On-ramp from Tustin Ranch Road, EA 0M1201

What is the thickness of HMA-O on the "... sections for the shoulders that are being used as detour ..."?

What is the existing structural section in the "... sections for the shoulders that are being used as detour ..."?

Thanks,
Bob Bazargan, PM
SR-55, RTE 405 from I-5 to SR-55, & Minor Program
(949) 724-2100

From: Mahdavian, Mehrdad@DOT
Sent: Monday, October 13, 2014 4:09 PM
To: Olguin, Alma@DOT; Mazhar, Kamran@DOT
Cc: Baseghi, Behdad@DOT; Bazargan, Bob@DOT
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Alternative 1: 0.1' HMA-O over 0.6' HMA-Type A over 0.25' ATPB over 0.85' Class 2 AB over 1.2' Class 3 AS

If you do not want to include ATPB in your pavement, we recommend using one of the following sections, by providing a cross drain for the existing ATPB layer to remove the water from the pavement

Alternative 2: 0.1' HMA-O over 0.6' HMA-Type A over 1.15' Class 2 AB over 1.15' Class 3 AS or

Alternative 3: 0.1' HMA-O over 1.1' HMA-Type A over 2.8' Class 3 AS

Once again we recommend using the same structural section for the widening of the right lane and shoulder in order to compensate for wheel off tracking of heavy trucks on the shoulder areas. If shoulders are planned to be used as temporary detours during construction they need to be improved for higher traffic. We recommend the following pavement sections for the shoulders that are being used as detour:

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