GEOTECHNICAL DESIGN & MATERIALS REPORT
SR-68/CORRAL DE TIERRA ROAD
INTERSECTION IMPROVEMENT PROJECT
MONTEREY COUNTY, CA
05-Mon-68 PM 12.8/13.2
EA 05-0H8230
ID No. 05 0000 0085

For

Wood Rodgers, Inc.
3301 C Street Bldg 100-B
Sacramento, California 95816

PARIKH CONSULTANTS, INC.
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December 4, 2012
(updated from 10/2009 version)
Wood Rodgers, Inc.
3301 C Street Bldg 100-B
Sacramento, CA 95816

Attn: Mr. Keith Hallsten

Sub: GEOTEchnICAL DESIGN & MATERIALS REPORT
SR-68/Corral De Tierra Road Intersection Improvement Project,
Monterey County, CA 05-Mon-68 PM 12.8/13.2
EA 05-0H8230 ID No. 05 0000 0085

Job No.: 206148.10
December 4, 2012
(updated from 10/2009 version)

Dear Mr. Hallsten:

Transmitted herewith is the Geotechnical Design & Materials Report for the subject project. The report was prepared in accordance with the scope of work outlined in our proposal.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning our findings or conclusions, please feel free to contact this office at (408) 452-9000.

Very truly yours,
PARIKH Consultants, Inc.

Gary Parikh, P.E., G.E.
President

Attachment: Geotechnical Design & Materials Report
"Approved as to impact on State facilities and conformance with applicable State standards and practices, and the technical oversight were performed as described in the California Department of Transportation A&E Consultant Services Manual."

Caltrans

Title

Date

Caltrans

Title

Date
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. EXISTING FACILITIES AND PROPOSED IMPROVEMENTS</td>
<td>2</td>
</tr>
<tr>
<td>3. PERTINENT REPORTS AND INVESTIGATION</td>
<td>2</td>
</tr>
<tr>
<td>4. PHYSICAL SETTING</td>
<td>3</td>
</tr>
<tr>
<td>4.1 Climate</td>
<td>3</td>
</tr>
<tr>
<td>4.2 Topography and Drainage</td>
<td>3</td>
</tr>
<tr>
<td>4.3 Man-Made and Natural Features of Engineering and Construction Significance</td>
<td>3</td>
</tr>
<tr>
<td>4.4 Regional Geology and Seismicity</td>
<td>3</td>
</tr>
<tr>
<td>5. EXPLORATION</td>
<td>4</td>
</tr>
<tr>
<td>5.1 Drilling and Sampling</td>
<td>4</td>
</tr>
<tr>
<td>5.2 Geologic Mapping</td>
<td>5</td>
</tr>
<tr>
<td>5.3 Geophysical Studies</td>
<td>5</td>
</tr>
<tr>
<td>5.4 Instrumentation</td>
<td>6</td>
</tr>
<tr>
<td>5.5 Exploration Notes</td>
<td>6</td>
</tr>
<tr>
<td>6. GEOTECHNICAL TESTING</td>
<td>6</td>
</tr>
<tr>
<td>6.1 In-Situ Testing</td>
<td>6</td>
</tr>
<tr>
<td>6.2 Laboratory Testing</td>
<td>6</td>
</tr>
<tr>
<td>7. GEOTECHNICAL CONDITIONS</td>
<td>6</td>
</tr>
<tr>
<td>7.1 Site Geology</td>
<td>6</td>
</tr>
<tr>
<td>7.1.1 Lithology</td>
<td>7</td>
</tr>
<tr>
<td>7.1.2 Structure</td>
<td>7</td>
</tr>
<tr>
<td>7.2 Subsurface Soil Conditions</td>
<td>7</td>
</tr>
<tr>
<td>7.3 Water</td>
<td>7</td>
</tr>
<tr>
<td>7.3.1 Surface Water</td>
<td>7</td>
</tr>
<tr>
<td>7.3.1.1 Scour</td>
<td>7</td>
</tr>
<tr>
<td>7.3.1.2 Erosion</td>
<td>7</td>
</tr>
<tr>
<td>7.3.2 Groundwater</td>
<td>8</td>
</tr>
<tr>
<td>7.4 Project Site Seismicity</td>
<td>8</td>
</tr>
<tr>
<td>7.4.2 Ground Rupture</td>
<td>9</td>
</tr>
<tr>
<td>8. GEOTECHNICAL ANALYSIS AND DESIGN</td>
<td>9</td>
</tr>
<tr>
<td>8.1 Dynamic Analysis</td>
<td>9</td>
</tr>
<tr>
<td>8.1.1 Parameter Selection</td>
<td>9</td>
</tr>
<tr>
<td>8.1.2 Liquefaction Potential</td>
<td>9</td>
</tr>
<tr>
<td>8.2 Cuts and Excavations</td>
<td>10</td>
</tr>
<tr>
<td>8.2.1 Stability</td>
<td>10</td>
</tr>
<tr>
<td>8.2.2 Rippability</td>
<td>10</td>
</tr>
<tr>
<td>8.2.3 Grading</td>
<td>10</td>
</tr>
<tr>
<td>8.3 Embankments</td>
<td>10</td>
</tr>
<tr>
<td>8.4 Earth Retaining System</td>
<td>10</td>
</tr>
<tr>
<td>8.5 Culverts</td>
<td>11</td>
</tr>
<tr>
<td>8.5.1 Corrosion Investigation</td>
<td>11</td>
</tr>
<tr>
<td>9. STRUCTURAL PAVEMENTS</td>
<td>12</td>
</tr>
</tbody>
</table>
10. MATERIAL SOURCES ............................................................. 13
11. MATERIAL DISPOSAL ......................................................... 13
12. CONSTRUCTION CONSIDERATIONS ................................. 14
   12.1 Construction Advisories .............................................. 14
   12.2 Construction Consideration that Influence Specifications ... 15
   12.3 Hazardous Waste Considerations ................................. 15
   12.4 Differing Site Conditions ............................................ 15
13. RECOMMENDATIONS AND SPECIFICATIONS .................... 15
   13.1 Summary of Recommendations ..................................... 15
   13.2 Recommended Materials Specifications ......................... 16
       13.2.1 Standard Specifications ...................................... 16
       13.2.2 Special Provisions ........................................... 16
14. INVESTIGATION LIMITATIONS ............................................. 17
REFERENCES ........................................................................... 19

Appendix A
Log of Test Borings

Appendix B
Laboratory Tests .................................................................. Plate B-1
R-value Test Results .......................................................... Plates B-2A, B-2B and B-2C
Corrosion Test Results ...................................................... Plates B-3A and B-3B

Appendix C
Calculation of Pavement Section

Appendix D
CULVERT 4 Analysis Result
LIST OF TABLES

1 Boring Program.................................................................05
2 Earthquake Data..............................................................09
3 Summary of Corrosion Test Results.......................................11
4 Summary of R-Value Test Results.........................................12
5 Recommended (Minimum) Structural Pavement Sections ...........13
6 Sources of Asphalt and Aggregate Material .........................13

LIST OF FIGURES

Location Map...........................................................................Plate 1
Site Plan ..................................................................................Plate 2
Geologic Map...........................................................................Plate 3
Fault Map ................................................................................Plate 4
Attenuation Relationships for Shallow Crustal Earthquakes ........Plate 5
1. INTRODUCTION

This report presents the results of our geotechnical investigation for the proposed improvements on the SR-68/Coral de Tierra Road Intersection in Monterey County. The general location of the project site and its limits are shown in Plate 1, Project Location Map.

This report addresses the design of structural pavement sections, and corrosion investigation recommendations. The investigation included review of readily available soils and geologic literature pertaining to the site including as-built information, site reconnaissance, obtaining representative samples and logging soil materials encountered in exploratory borings, laboratory testing of the representative samples, performing engineering analyses, and preparation of this report.

The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to recommend design and construction criteria for the project. This report also establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions, if any.

The report is intended for use by the project roadway design engineer, construction personnel, bidders, and contractors for information and reference purposes only and should not be construed directly as project specifications.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain a properly constructed project. We, therefore recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction.
2. EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

SR-68 is the main connector between City of Salinas and the Monterey Peninsula, the County’s two principal urbanized areas. SR-68 has one traffic lane in each direction. It serves as the main connector between the Monterey Peninsula, including Carmel Valley and the former Fort Ord area, and Southern California via US 101 and is the main commuter route between Salinas and Monterey providing access to residential developments, schools and businesses adjacent to the SR-68 corridor. The SR-68/Corral de Tierra Road Intersection is currently experiencing significant traffic congestion and needs traffic operation improvements. Based on the information provided, the proposed project consists of following improvements:

- Widening SR-68 on the north side for a distance of approximately 1,200 feet to the east of the Corral de Tierra Road intersection to accommodate a second westbound SR-68 left turn lane to southbound Corral de Tierra Road,
- Widening SR-68 on the north side for a distance of approximately 600 feet west of the intersection with Corral de Tierra Road. In order to avoid impact to potential habitat for the federally-threatened California Tiger Salamander, the designer is proposing to incorporate a retaining wall to widen the steep mechanically-stabilized embankment slope on the north side of SR-68, west of Corral de Tierra Road,
- Widening Corral de Tierra Road, primarily on the east side, from the intersection with SR-68 for a distance of approximately 1,000 feet south.
- Potentially constructing drainage system improvements on the north side of SR-68 & relocating existing utilities located on the east side of the Corral de Tierra Road and on the north side of SR-68.

3. PERTINENT REPORTS AND INVESTIGATION

Except Traffic Index (TI) value provided by the designer, no other report or investigation pertinent to the site was available.
4. PHYSICAL SETTING

4.1 Climate

The climate in the project area is characterized by moderate climatic conditions, which consists of mild winters, mild summers, small daily and seasonal temperature ranges, and mild humidity. Based on the statistical data from “Western Regional Climate Center”, the average total annual precipitation along the project vicinity is approximately 9.5 inches and is principally during the months of December through February. January usually has the most precipitation accumulation and July the least. Extreme temperature ranges from location and the average minimum temperature is approximately 50.0°F in January to average maximum temperature of 70.0°F in July.

4.2 Topography and Drainage

The topography within the project site along SR-68/Corral de Tierra Road Intersection is mainly at level with existing grade ranging from Elev. 271.6 to 308.6 ft. The site drainage is generally by sheet flow, or collected by local drainage systems.

4.3 Man-Made and Natural Features of Engineering and Construction Significance

The subject was considered and was determined to be not significant for the project.

4.4 Regional Geology and Seismicity

General geologic features pertaining to the site were evaluated by reference to the Geologic Map of Spreckels 7.5 Minute Quadrangle; Monterey County, CA (Joseph C. Clark, Earl E. Brabb, and Lewis I. Rosenberg 1997). The Spreckels Quadrangle lies at the north end of the Sierra De Salinas and extends from the Salinas Valley on the northeast across Los Laureles Ridge south to Carmel Valley, an Intermontane Valley that separates the Santa Lucia Range from the Sierra De Salinas. The Toro Regional Park occupies the east-central part of the Quadrangle, whereas the former Fort Ord Military Reservation covers the northwestern part of the area. Subdivisions largely occupy the older floodplain of Toro Creek and the adjacent foothills, with less dense development along the narrower canyons of the Corral de Tierra and San Benancio Gulch to the south. The foothills
southwest of the Salinas River are the sites of active residential development. A geologic map of the general project area is shown on Plate 3.

Liquefaction, which seriously affected the Spreckels area in the 1906 San Francisco earthquake (Lawson, 1908), and landsliding are the two major geological hazards in the area. The landslides consist mainly of older larger slides in the southern and younger debris flows in the northern part of the Quadrangle.

The regional structure of the area is similar to the other portions of the California Coast Ranges, consisting of a complex series of steeply dipping, northwesterly striking faults extends into the Spreckels Quadrangle from the south and locally bounds Salinian granitic rocks. Significant earthquakes, which have occurred in this area, are generally associated with crustal movements along well-defined active fault zones. The attached Fault Map (Plate 4) presents the locations of the fault systems relative to the project site. Maximum Credible Earthquake Magnitudes (MCE) for the major faults in the area are determined by Mualchlin (California Seismic Hazard Map 1996). These magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure. Faults in the vicinity include the King City Reliz fault and Zayante Vergales fault. Based on Caltrans updated map and readily available geological data, the governing fault for the structure is the Zayante Vergales (a strike-slip fault, Mw = 7.25).

5. EXPLORATION

5.1 Drilling and Sampling

Based on the preliminary plans, discussions with the design team, and readily available geotechnical data in the area, 6 borings were drilled at selected locations to a depth of 5 ft below the existing ground surface.

- Six borings, namely A-07-B1 through A-07-B6 were drilled in the vicinity for the design of roadway. Bulk Samples were collected at shallow depth (approximately 5ft).
Borings A-07-B1 through A-07-B6 was drilled by a Jeep Rig on March 14\textsuperscript{th}, 2007 under the supervision of our field engineer. The borings were advanced using a Jeep-mounted rig using 8” auger. The boring locations are shown on Plate 2, Site Plan. The descriptions of the soils encountered and relevant boring information are presented on the Log of Test Boring (LOTB) in Appendix A. The samples were sealed and transported to our laboratory for further evaluation and testing. The field investigation was conducted under the supervision of our field engineer who logged the test borings and prepared the samples for subsequent laboratory testing and evaluation. Table 1 below summarizes the boring program.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Station (ft.)</th>
<th>Offset (ft.) From &quot;SR 68&quot; line</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-07-B1</td>
<td>20+41</td>
<td>Lt. 29</td>
<td>SILTY SAND (SM), brown, moist</td>
</tr>
<tr>
<td>A-07-B2</td>
<td>29+00</td>
<td>Lt. 31</td>
<td>SILTY SAND (SM), brown, moist</td>
</tr>
<tr>
<td>A-07-B3</td>
<td>34+85</td>
<td>Lt. 38</td>
<td>SILTY SAND (SM), brown, moist</td>
</tr>
<tr>
<td>A-07-B4</td>
<td>38+20</td>
<td>Lt. 18</td>
<td>SILTY SAND (SM), brown, moist</td>
</tr>
<tr>
<td>A-07-B5</td>
<td>24+14</td>
<td>Rt. 391</td>
<td>SILTY SAND (SM), brown, moist</td>
</tr>
<tr>
<td>A-07-B6</td>
<td>22+52</td>
<td>Rt. 719</td>
<td>SILTY SAND (SM), brown, moist</td>
</tr>
</tbody>
</table>

5.2 **Geologic Mapping**

No site-specific geologic mapping was conducted. However, general geologic features pertaining to the site were evaluated by reference to Spreckels 7.5 Minute Quadrangle Geology of Monterey County, California by Joseph C. Clark, Earl E. Brabb, and Lewis I. Rosenberg 1997 (Plate 3). Detailed descriptions of the geology are described in Sections 4.4 & 7.1.

5.3 **Geophysical Studies**

The subject was considered and was determined to be not applicable to the project.
5.4 Instrumentation
The subject was considered and was determined to be not applicable to the project.

5.5 Exploration Notes
The exploratory borings mainly encountered older flood plain deposits (Holocene). Drilling conditions using augers were considered normal for this site.

6. GEOTECHNICAL TESTING
6.1 In-Situ Testing
The subject was considered and was determined to be not applicable to the project. The borings were drilled using a jeep rig with solid stem auger to collect bulk samples.

6.2 Laboratory Testing
Laboratory tests performed for the study include the following: R-value Test (California Test Method 301), and Corrosion Test (California Test Method 643). The laboratory test results are attached in Appendix B.

7. GEOTECHNICAL CONDITIONS
7.1 Site Geology
General geologic features pertaining to the site were evaluated by reference to the Geologic Map of Spreckels 7.5 Minute Quadrangle; Monterey County, CA (Joseph C. Clark, Earl E. Brabb, and Lewis I. Rosenberg 1997). Based on the map, the site subsoil’s consist of Older Flood Plain Deposits (Qof) and Continental Deposits, undivided (QTc). A geologic map of the project vicinity is shown on Plate 3.

Qof – Older flood-plain Deposits (Holocene) – Older flood-plain Deposits are stratigraphically between terrace deposits and younger flood-plain deposits and are Holocene in age. Older flood-plain deposits consist of unconsolidated, relatively fine-grained, heterogenous deposits of sand and silt, commonly including relatively thin layers of clay. The grain size of levee deposits decreases away from abandoned channel-fill deposits. Interpretation of well log data suggests that the older flood-plain deposits are typically less than 60 ft thick in the study area, but locally may
be as much as much as 40 m thick.

7.1.1 Lithology

The site consists of older flood-plain deposits. The subject was considered and was determined to be not applicable for the project. Detailed description of subsoil conditions are presented in Section 7.2.

7.1.2 Structure

The subject was considered and was determined to be not applicable for the project

7.2 Subsurface Soil Conditions

Based on the boring data, the subsurface soil conditions of the site generally consist of silty sand with some clay and gravel to the maximum depth explored (5 ft below existing grade). Detailed descriptions of the materials encountered in the exploratory borings are presented in the LOTB in Appendix A “Log of Test Borings”. It should be noted that these descriptions and related information depict subsurface conditions only at the locations indicated and on the particular date noted on the LOTB. Because of the variability from place to place within soil/rock in general, subsurface soil conditions at other locations may differ from conditions occurring at the locations explored. The abrupt stratum changes shown on the logs may be gradational and relatively minor changes in soil types within a stratum may not be noted due to field limitations. Also, the passage of time may result in a change in the soil conditions at the locations due to environmental changes.

7.3 Water

7.3.1 Surface Water

There is no surface water body at the site.

7.3.1.1 Scour

The subject was considered and was determined to be not applicable for the roadway project.

7.3.1.2 Erosion

Based on the U.S. Department of Agricultural Soil Survey for the project site area, following soil
type exists:

- Gorgonio sandy loam (GkB): Texturally it is defined as gravelly sandy loam and has high conductivity, high infiltration or water transmission rate, excessively draining capability and low runoff potential. Erosion hazard in this soil is generally considered moderately high.
- Santa Ynez sandy loam (ShE): Texturally it is defined as fine sandy loam and has moderately high conductivity, moderately high draining capability, very slow infiltration or water transmission rate and high runoff potential. Erosion hazard in this soil is also considered moderately high.

Majority of the roadway alignment is generally in level area, covered with vegetation and appears to be in good condition. Normal erosion control measures should be applied to prevent erosion on the newly constructed embankment.

7.3.2 Groundwater

Groundwater was not encountered to the depth of 5 ft. It is anticipated that groundwater level will vary with the passage of time due to seasonal runoff, groundwater fluctuations, surface and subsurface flow, ground surface run-off, and other factors that were not existent at the time of investigation.

7.4 Project Site Seismicity

7.4.1 Ground Motions

The project is located in a seismically active part of northern California. Many faults in the Monterey County Area are capable of producing earthquakes, which may cause strong ground shaking at the site. The attached Fault Map (Plate 4) presents the locations of the fault systems relative to the project site.

Maximum Credible Earthquake (MCE) magnitudes for some of the major faults in the area determined by Mualchín (California Seismic Hazard Map 1996) are summarized below. These maximum credible earthquake magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure.
7.4.2 Ground Rupture

Since no active faults pass through the project site, the potential for fault rupture is low.

8. GEOTECHNICAL ANALYSIS AND DESIGN

8.1 Dynamic Analysis

8.1.1 Parameter Selection

Based on the seismic hazard map prepared by Mualchin (1996) and the attenuation relationship by Sadigh et al. (1997), the Peak Bedrock Acceleration (PBA) at the project site is 0.41 g.

8.1.2 Liquefaction Potential

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and silts of low relative density are the type of soils that usually are susceptible to liquefaction. Clays are generally not susceptible to liquefaction. For relatively low risk improvements (pavement widening), the liquefaction potential at the project site is generally considered low.
8.2 Cuts and Excavations

Based on the plans and profiles provided by the designer, the proposed SR-68/Corral de Tierra Road Intersection widening work is generally at grade and no deep cuts or excavations are required.

8.2.1 Stability

The proposed road way alignment is at existing grade. No cut slopes are proposed for the project.

8.2.2 Rippability

Based on the investigation, rippability does not appear to be a concern for construction.

8.2.3 Grading

Typical grading specifications should conform to Caltrans Standards. A representative from our office or regulatory agency should observe all grading operations and perform moisture and density tests on prepared subgrade, base rock and asphalt concrete. Should there be any alterations of the proposed construction that will affect the stated bases of our recommendations, we should be informed so that we can review such changes and amend or submit additional recommendations.

8.3 Embankments

Based on the plans and profiles, majority of the project work is at existing grade, generally in level area. The existing small embankment fill northwest of the intersection will be widened with a small retaining wall (Section 8.4). The maximum height of the slope face is about 8 feet. The depth of the new fill under the proposed pavement is relatively small. Settlement resulting from this fill is expected to be negligible and most of it should occur during construction.

8.4 Earth Retaining System

In order to avoid impact to potential habitat for the federally-threatened California Tiger Salamander (CTS), the designer proposes to incorporate a retaining wall to widen the existing steep mechanically-stabilized embankment slope on the north side of SR-68, west of Corral de
Tierra road. The existing embankment slope, constructed in 1993, is steeper than 2H:1V and is mechanically stabilized per as-built information.

Per the designer, the wall height varies from 4 to 8 ft. This assumes a 2.5H:1V fill slope on top of the wall. The wall face would not be visible from SR-68 or any other public road or residence, so the aesthetics of the wall face are not a significant design consideration. The designer considers a Steel Crib Wall per Caltrans 2010 standard plans. This a MSE type of application, similar to the existing mechanically stabilized slope. The subsoil is sandy and the height is relatively low to moderate, we believe the proposed crib wall is feasible. The wall subgrade should be scarified and compacted to 95% relative compaction per Caltrans standards.

8.5 Culverts
It is our understanding that small diameter culverts (2 ft and under) can be designed and constructed using Standard Plans and Specifications, and no specific geotechnical investigation is required per Caltrans guidelines.

8.5.1 Corrosion Investigation
The corrosion investigation for this project was performed in general accordance with the provisions of California Test Method 643. Chemical test was performed on a representative soil sample of Boring R-1, to evaluate the corrosion potential of the subsurface soil. A summary of the corrosion test results is presented in Table 3.

<table>
<thead>
<tr>
<th>Boring No</th>
<th>Depth (ft)</th>
<th>Resistivity (ohm-cm)</th>
<th>pH</th>
<th>Sulfate (ppm)</th>
<th>Chloride (ppm)</th>
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<tbody>
<tr>
<td>A-07-B3</td>
<td>0' – 5'</td>
<td>6700</td>
<td>7.70</td>
<td>12.5</td>
<td>6.9</td>
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<tr>
<td>A-07-B6</td>
<td>0' – 5'</td>
<td>9650</td>
<td>7.05</td>
<td>0.2</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Based on the Corrosion Guidelines by Caltrans Division of Engineering Services, the test results indicate that the soil is not corrosive. CULVERT 4 analysis result is attached in Appendix D.
WOOD RODGERS, INC.
Job No. 206148.10
December 4, 2012 (updated from 10/2009 version)
Page 12

Standard reinforced concrete pipe design is suitable. Thermoplastic pipe can be used as an alternative and should not have corrosion concerns.

9. STRUCTURAL PAVEMENTS

R-value tests were conducted on representative samples collected at proposed subgrade level. The test results are summarized in Table 4.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Station (ft.)</th>
<th>Offset (ft.) From “SR 68” line</th>
<th>Date Drilled</th>
<th>Description</th>
<th>R-value</th>
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<tr>
<td>A-07-B1</td>
<td>20+41</td>
<td>Lt. 29</td>
<td>03/14/2007</td>
<td>Brown SILTY SAND (SM)</td>
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<tr>
<td>A-07-B2</td>
<td>29+00</td>
<td>Lt. 31</td>
<td>03/14/2007</td>
<td>Brown SILTY SAND (SM)</td>
<td>28</td>
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<tr>
<td>A-07-B3</td>
<td>34+85</td>
<td>Lt. 38</td>
<td>03/14/2007</td>
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<tr>
<td>A-07-B4</td>
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<td>52</td>
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</tbody>
</table>

Based on these results a design R-value of 25 is considered reasonable for native soils. Based on discussion with the designer, the anticipated Traffic Index (TI) values are 7.5, 8.0 and 8.5 for Corral de Tierra Road and 10.0, 10.5 and 11.0 for SR-68. Based on discussion with the designer, we understand that is preferred to use a pavement section consisting of HMA, base and subbase for the project.

The following pavement sections are provided in accordance with anticipated 20-year design TIs for the roadway:
TABLE 5 – RECOMMENDED (MINIMUM) STRUCTURAL PAVEMENT SECTIONS

<table>
<thead>
<tr>
<th>Location</th>
<th>R-Value</th>
<th>TI</th>
<th>Structural Pavement Section</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>HMA</td>
<td>AB</td>
<td>AS</td>
<td>HMA (Full Depth)</td>
</tr>
<tr>
<td>Corral de Tierra Road</td>
<td>25</td>
<td>7.5</td>
<td>0.40'</td>
<td>0.55'</td>
<td>0.40'</td>
<td>0.85'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.0</td>
<td>0.40'</td>
<td>0.65'</td>
<td>0.45'</td>
<td>0.90'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.5</td>
<td>0.45'</td>
<td>0.65'</td>
<td>0.45'</td>
<td>0.95'</td>
</tr>
<tr>
<td>SR-68</td>
<td>25</td>
<td>10.0</td>
<td>0.50'</td>
<td>0.75'</td>
<td>0.60'</td>
<td>1.10'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.5</td>
<td>0.55'</td>
<td>0.85'</td>
<td>0.65'</td>
<td>1.20'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.0</td>
<td>0.60'</td>
<td>0.85'</td>
<td>0.65'</td>
<td>1.25'</td>
</tr>
</tbody>
</table>

Design R-value = 25
HMA: Hot Mix Asphalt;
AB: Class 3 Aggregate Base with R-value equal to 78;
AS: Class 4 Aggregate Sub-base with the R-value equal to 50;
Design values are based on the Highway Design Manual Tables (empirical method).

10. MATERIAL SOURCES

There are several commercial sources of asphalt, concrete, and aggregate products in the area. Table 6 lists available commercial suppliers in the area.

TABLE 6 - SOURCES OF ASPHALT AND AGGREGATE MATERIAL

<table>
<thead>
<tr>
<th>Source</th>
<th>Location</th>
<th>Approx. Haul Dist. (One way, miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMC Pacific Material, Inc.</td>
<td>54 Summers St, Salinas, CA</td>
<td>8.5</td>
</tr>
<tr>
<td>Antuzzi Concrete, Inc.</td>
<td>17583 Winding Creek Rd, Salinas, CA</td>
<td>6.5</td>
</tr>
<tr>
<td>ABC Supply Comp Inc.</td>
<td>11180 Commercial Pkwy, Castroville, CA</td>
<td>17.0</td>
</tr>
<tr>
<td>Granite Rock</td>
<td>1755 Del Monte Blvd SE, Monterey CA</td>
<td>10.0</td>
</tr>
</tbody>
</table>

11. MATERIAL DISPOSAL

Majority of the project will require fill for the proposed widening. Based on our understanding, the project will require minimal disposal of the excess materials.
12. CONSTRUCTION CONSIDERATIONS

12.1 Construction Advisories

The sections are written primarily for the engineer responsible for the preparation of plans and specifications. Since these sections identify potential construction issues related to the project, it may also be of use to the Agency’s representatives involved in monitoring of construction activity. The field investigation performed by us primarily addresses design issues and was not planned specifically to identify construction issues.

The project site is located along the existing US Route 68/Corral de Tierra Road junction. Therefore, traffic control is required to maintain traffic flow along Route 68 and the respective local streets. Several underground utilities exist at the site. The contractor should verify the utility lines, be aware of the existing conditions and plan the construction activities accordingly.

In our opinion, conventional equipment may be used to excavate the on-site soil materials. The materials to be excavated may consist of predominantly sandy material. Localized subgrade pumping may be encountered during earthwork construction depending on the weather, moisture condition of the subsurface soils, and surface drainage conditions. Equipment mobility may also be difficult if the subgrade is wet. In which case, the subgrade soils may require reworking, aeration, or over-excavation and replacing with dry granular fill to facilitate earthwork construction. It is possible that unknown old buried utilities or abandoned structures, concrete rubble etc. are located along the alignment. It might require special equipment and additional efforts to remove these buried objects.

Prospective contractors for the project must evaluate construction-related issues on the basis of their own knowledge and experience in the local area, on the basis of similar projects in other localities, or on the basis of field investigation on the site performed by them, taking into account their proposed construction methods and procedures. In addition, construction activities related to excavation and lateral earth support must conform to safety requirements of OSHA and other applicable municipal and Stage regulatory agencies.
12.2 Construction Consideration that Influence Specifications

The contractor should verify the conditions of the existing utility lines. These locations should not be used for stockpiling of borrow materials. Any conflicts with proposed construction should also be reviewed prior to construction.

12.3 Hazardous Waste Considerations

The project environmental study report should be referred to for further details about any potential hazardous materials within the project site.

12.4 Differing Site Conditions

The soil conditions described in this report are based on available boring data. It should be noted that these borings depict subsurface conditions only at the locations drilled. Because of the variability from place to place within soils in general, and the nature of geologic depositions, subsurface conditions could change between the explored locations.

Early communication should be made between the Resident Engineer, the Contractor, and the Geotechnical Engineer as soon as conditions that differ from those established in this report are recognized by any of the parties. Additional recommendations could be provided if such conditions arise.

13. RECOMMENDATIONS AND SPECIFICATIONS

13.1 Summary of Recommendations

If the designer has questions or concerns with any of these recommendations, or, if conditions are found to be different during construction, the Geotechnical Engineer who prepared this report should be contacted. Additional fieldwork, analysis or changes in recommendations may be required. These services may be provided under a separate authorization, as necessary. A concise summary of the geotechnical recommendations is presented below:

- The subsoils consist of silty sand.
- Based on investigation, groundwater was not encountered during exploration below the existing ground surface. The impact of liquefaction is considered low at the site. (Ref: Section 8)
- Pavement Sections (Ref: Section 9). Refer to Tables 5 for the design structural pavement sections.
13.2 Recommended Materials Specifications

13.2.1 Standard Specifications

Unless otherwise stated in the special provisions, all materials specifications should conform to Caltrans Standard Specifications, May 2006 edition, including but not limited to the following: Earthwork, Structure Backfill, Pervious Backfill Material, Reinforcing Geofabric, Thermoplastic Pipes, Asphalt Concrete, Aggregate Base, Aggregate Subbase, Cement Treated Base, etc.

13.2.2 Special Provisions

Imported Borrow:
Imported material should be in accordance with the specifications set forth in Caltrans Section 19. In particular, for new embankment/roadway construction, the material placed within 4 ft of the finish pavement subgrade should meet the following requirements:

1. Free of organic or other deleterious materials.
2. An R-value of no less than 25.

Aggregate Base: Class 3 aggregate base shall conform to the provisions in Section 26 of the Standard Specifications and to these Special Provisions. It shall also be clean and free from organic matter and other deleterious substances. The percentage composition by weight of Class 3 aggregate base shall conform to the following grading as determined by California Test Method No. 202.

<table>
<thead>
<tr>
<th>Sieve Sizes</th>
<th>1-1/2 inch Maximum</th>
<th>3/4 inch Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operating Range</td>
<td>Contract Compliance</td>
</tr>
<tr>
<td>2&quot;</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>90 – 100</td>
<td>87 - 100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>50 – 85</td>
<td>45 – 90</td>
</tr>
<tr>
<td>No. 4</td>
<td>24 - 45</td>
<td>20 – 50</td>
</tr>
<tr>
<td>No. 30</td>
<td>10 – 25</td>
<td>6 – 29</td>
</tr>
<tr>
<td>No. 200</td>
<td>2 -11</td>
<td>0 -14</td>
</tr>
</tbody>
</table>
Aggregate Subbase: Aggregate Subbase shall be Class 4 and shall conform to the provisions in Section 25 of the Standard Specifications and to these Special Provisions. Class 4 aggregate subbase shall be clean and free from organic matter and other deleterious substances. The percentage composition by weight of Class 4 aggregate subbase shall conform to the following grading as determined by California Test Method No. 202.

14. INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our field exploration and the assumption that the soil conditions do not deviate from observed conditions.
WOOD RODGERS, INC.
Job No. 206148.10
December 4, 2012 (updated from 10/2009 version)
Page 18

this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed project as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our findings and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the soil conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,

PARIKH CONSULTANTS, INC.

Y. David Wang, Ph.D., P.E., 52911
Senior Engineer

Gary Parikh, P.E., G.E. 666
Project Manager

S:ONGOING PROJECTS2006/206148.10
REFERENCES


4. Geologic Map of Spreckles 7.5 Minute Quadrangle; Monterey County, CA (Joseph C. Clark, Earl E. Brabb, and Lewis I. Rosenberg 1997).


Approximate Project Limits
Approximate Project Location

Legend:
- Qyf: Younger flood-plain deposits (Holocene)
- Qtc: Continental deposits, undivided (Pleistocene-Pliocene(?))
- Qof: Older flood-plain deposits (Holocene)
- Tsm: Santa Margarita Sandstone (Miocene)
- Qls: Landslide deposits (Quaternary)

Source: Spreckels 7.5 Minute Quadrangle Geology of Monterey County, California by Joseph C. Clark, Earl E. Brabb, and Lewis I. Rosenberg 1997
FAULT MAP

Legend
- KCR (7.0) - King City Reliz (ST)
- QSE (6.25) - Quin Sabe (XX)
- SRT (6.75) - Sargent (ST)
- ZVS (7.25) - Zayante Vergales (ST)
- TNY (7.0) - Tularcitos Navy (ST)
- MBY (6.5) - Monterey Bay Zone (RO)
- CPT (6.0) - Cypress Point (XX)
- SGC (7.5) - San Gregorio-Palo Colorado (ST)

Source: Modified from "California Seismic Hazard Map, 1996" by L. Mualchin

Approximate Project Location

Fault = Zayante Vergales (ST) - Strike Slip

Mw = 7.25  
Rrup = 9.5  
km

M>=6.5

ROCK SITE:

C1 = -1.274  
C2 = 1.1  
C3 = 0  
C4 = -2.1  
C5 = -0.48451  
C6 = 0.524  
C7 = 0

A= C1+C2M+C3(8.5M)^2.5 = 6.701
B= C4*Ln(Rrup+exp(C5+C6M)) = -7.583
C= C7*Ln(Rrup+2) = 0

Ln(y) = A+B+C = -0.882
y = Exp(Ln(y)) = 0.41
Peak Bed Rock Acceleration (PBA = 0.41g)

Fault = King City Reliz (ST) - Strike-Slip

Mw = 7  
Rrup = 10.5  
km

A= 6.426
B= -7.444
C= 0

Ln(y) = -1.018
y = 0.36
Peak Bed Rock Acceleration PBA = 0.36g

Fault = Monterey Bay Zone (RO) - Reverse-Oblique

Mw = 6.5  
Rrup = 20  
km

A= 5.876
B= -7.670
C= 0

Ln(y) = -1.794
y = 0.17
Peak Bed Rock Acceleration PBA = 0.17*1.2 = 0.20g
APPENDIX A
### Field and Laboratory Testing

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay content</td>
<td>20%</td>
</tr>
<tr>
<td>Organic content</td>
<td>3%</td>
</tr>
<tr>
<td>Plastics</td>
<td>1%</td>
</tr>
<tr>
<td>Silt Kidsen</td>
<td>5%</td>
</tr>
<tr>
<td>Gravel</td>
<td>10%</td>
</tr>
<tr>
<td>Sand</td>
<td>45%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Attraction Object of Control

- **Compliance:** 0.240 m (0.8 ft)
- **Distance:** 0 to 4 m (0 to 13 feet)
- **Obstacle:** 5 to 10 m (16 to 33 feet)
- **Obstruction:** 10 to 20 m (33 to 66 feet)
- **Obstacle:** > 20 m (> 66 feet)

### Moisture

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content</td>
<td>5 to 40%</td>
</tr>
<tr>
<td>Sand</td>
<td>30 to 40%</td>
</tr>
<tr>
<td>Mixture</td>
<td>50 to 100%</td>
</tr>
</tbody>
</table>

### Field or Properties of Soil

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voids</td>
<td>5 to 10%</td>
</tr>
<tr>
<td>Ultimate density</td>
<td>15 to 25%</td>
</tr>
<tr>
<td>Density</td>
<td>20 to 30%</td>
</tr>
<tr>
<td>Mixture</td>
<td>50 to 100%</td>
</tr>
</tbody>
</table>

### Particle Size

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk</td>
<td>0.27</td>
</tr>
<tr>
<td>Clay</td>
<td>10 to 17%</td>
</tr>
<tr>
<td>Silt</td>
<td>15 to 40%</td>
</tr>
<tr>
<td>Gravel</td>
<td>&gt; 100%</td>
</tr>
<tr>
<td>Sand</td>
<td>&gt; 200%</td>
</tr>
</tbody>
</table>

### Core Recovery

- **Recovery:** 90% to 100%
- **Diameter:** 0 to 50 mm (0 to 2 inches)
- **Material:** 0 to 500 mm (0 to 20 inches)
- **Material:** 0 to 2000 mm (0 to 80 inches)

### Schedule Identification

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Auger boring</td>
</tr>
<tr>
<td>B</td>
<td>Rotary percussion boring (dc)</td>
</tr>
<tr>
<td>C</td>
<td>Rotary percussion drilling (ac)</td>
</tr>
<tr>
<td>D</td>
<td>Hollow-sleeve coring core</td>
</tr>
<tr>
<td>E</td>
<td>Hard driven (1-inch rod) tube</td>
</tr>
<tr>
<td>F</td>
<td>Sleeve sampled core</td>
</tr>
<tr>
<td>G</td>
<td>Dynamic Core Percussion Boring</td>
</tr>
<tr>
<td>H</td>
<td>Core Recovery Test (GSM-0 0799-95)</td>
</tr>
<tr>
<td>I</td>
<td>Other</td>
</tr>
</tbody>
</table>

### Notes:

- **Drilling:** Use in soft to medium hard formations, maximum 150 ft.
- **Sampling:** Use for short sections, maximum 300 ft.
- **Coring:** Use in hard formations, maximum 100 ft.

---

**SOIL LEGEND**

- **SR-68/CORRAL DE TIERRA ROAD**
- **SOIL LEGEND**

---

**REFERENCES:**

- CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)
CLASSIFICATION TESTS

Classification Tests

The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented in “Log of Test Borings”, Appendix A.

R-value Tests
R-value tests were performed on representative bulk samples for pavement design. The tests were performed according to California Test Method 301. The test results are presented on Plates B-2A, B-2B and B-2C.

Corrosion Tests
Corrosion tests were performed on a selected sample to determine the corrosion potential of the soils. The pH and minimum resistively tests were performed according to California Test Method 643. The tests were performed by Sunland Analytical. The test results are presented on Plates B-3A and B-3B.
Project Name: SR 68 / Corral De Tierra Intersection Improvements  
Client: Wood Rodgers
Sample #: B2  
Location / Source: Hiway 68 / Salinas
Material: Silty sand with clay lumps, brown

R-VALUE REPORT

ASTM D2844 or CTM 301

(408) 945-1011

Date: 3/20/07

Project #: 206148.10
Lab #: M613
Sample Date:

Specimen No. | A | B | C |
--- | --- | --- | --- |
Exudation Pressure, psi | 222 | 431 | 525 |
Expansion Pressure, psf | 0 | 0 | 0 |
R-Value | 17 | 45 | 53 |
Moisture Content at Test, % | 13.8 | 13.4 | 12.9 |
Dry Density at Test, pcf | 114.8 | 115.3 | 116.9 |

R-Value @ 300 psi Exudation Pressure = 28

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

PLATE NO: B-2A
R-VALUE REPORT

Project Name: SR 68 / Corral De Tierra Intersection Improvements
Client: Wood Rodgers
Sample #: B4
Location / Source: Hiway 68 / Salinas
Material: Silty sand with gravel and some clay lumps, brown

Date: 3/21/07
Project #: 206148.10
Lab #: M613
Sample Date:

Specimen No. | A | B | C
---|---|---|---
Exudation Pressure, psi | 110 | 234 | 747
Expansion Pressure, psf | 0 | 0 | 0
R-Value | 4 | 32 | 76
Moisture Content at Test, % | 14.1 | 12.2 | 10.8
Dry Density at Test, pcf | 114.5 | 118.2 | 120.0

R-Value @ 300 psi Exudation Pressure = 38
Expansion Pressure @300 psi Exudation, psf = 0

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

PLATE NO: B-2B
Project Name: SR 68 / Corral De Tierra Intersection Improvements  
Date: 3/20/07

Client: Wood Rodgers  
Project #: 206148.10

Sample #: B6  
Depth: 0' - 5'

Location / Source: Hiway 68 / Salinas  
Sample Date:

Material: Silty sand with gravel, dark grayish brown  
Sampled By:

---

**Graph:**

- **R-VALUE**
- **EXP. PRESS.**

---

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exudation Pressure, psi</td>
<td>139</td>
<td>269</td>
<td>642</td>
</tr>
<tr>
<td>Expansion Pressure, psf</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>R-Value</td>
<td>21</td>
<td>49</td>
<td>72</td>
</tr>
<tr>
<td>Moisture Content at Test, %</td>
<td>12.8</td>
<td>11.9</td>
<td>11.0</td>
</tr>
<tr>
<td>Dry Density at Test, psf</td>
<td>117.0</td>
<td>119.5</td>
<td>121.4</td>
</tr>
</tbody>
</table>

**R-Value @ 300 psi Exudation Pressure =** 52  
Expansion Pressure @300 psi Exudation, psf = 0

**Minimum R-Value Requirement:**

Comments:

Report By: Prav Dayah

---

PLATE NO: B-2C
Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 04/04/2007
Date Submitted 03/30/2007

To: Prav Dayah
Parikh Consultants, Inc.
356 S. Milpitas Blvd.
Milpitas, Ca  95035

From: Gene Oliphant, Ph.D.  Randy Horney
General Manager  Lab Manager

The reported analysis was requested for the following location:
Location :  206148.10/SR68    Site ID : B3 @ 0-5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 50187-99965.

-----------------------------------------------
EVALUATION FOR SOIL CORROSION
-----------------------------------------------

Soil pH 7.71
Minimum Resistivity 6.70  ohm-cm (x1000)
Chloride 5.9 ppm  0.000059 %
Sulfate 12.5 ppm  0.00125 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

PLATE NO: B-3A
To: Prav Dayah  
Parikh Consultants, Inc.  
356 S. Milpitas Blvd.  
Milpitas, Ca  95035

From: Gene Oliphant, Ph.D. \ Randy Horney  
General Manager \ Lab Manager

The reported analysis was requested for the following location:  
Location: 206148.10/SR68  Site ID: B6 @ 0-5'.  
Thank you for your business.

* For future reference to this analysis please use SUN # 50187-99966.

---------------------------------------------------------------------
EVALUATION FOR SOIL CORROSION
---------------------------------------------------------------------

Soil pH 7.05

Minimum Resistivity 9.65 ohm-cm (x1000)

Chloride 4.5 ppm 0.00045 %

Sulfate 0.2 ppm 0.00002 %

METHODS
pH and Min. Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422
APPENDIX C
Design Case: AC over AB

Design TI = 7.5  input  
R_{BS} = 25  input  
R_{AB} = 78

\[ GE_{AC\over AB} = 0.0032 * Tl * (100 - R_{BS}) = 1.80 \]

\[ GE_{HMA} = 0.0032 * Tl * (100 - R_{AB}) = 0.53 \]

=> \[ GE'_{HMA} = 0.73 \] (add 0.2 ft safety factor)

AC Thickness = 0.35 ft

=> AC Thickness = 0.40 ft (round up to the nearest 0.05 ft)

\[ G_{f, HMA} = 2.07 \]

\[ G_{E, HMA} = 0.83 \]

\[ GE_{AB} = GE_{HMA\over AB} - GE_{HMA} = 0.97 \]

AB thickness = 0.88 ft

=> AB Thickness = 0.90 ft (round up to the nearest 0.05 ft)

\[ G_{f, AB} = 1.1 \]

Design Section:

```
     HMA
       0.40 ft

     AB
       0.90 ft

Base Soil
```
PAVEMENT DESIGN (CORRAL DE TIERRA ROAD)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 207132.10

**Design Case: AC over AB over AS**

Design T1= 7.5 input  
R_{BS}= 25 input  
R_{AB}= 78  
R_{AS}= 50 check

\[ GE_{TOTAL} = 0.0032 \cdot T1 \cdot (100 - R_{BS}) = 1.80 \]

\[ GE_{HMA} = 0.0032 \cdot T1 \cdot (100 - R_{AB}) = 0.53 \]

\[ \Rightarrow GE_{HMA} = 0.73 \text{ (add 0.2 ft safety factor)} \]

AC thickness = 0.35 ft

\[ \Rightarrow \text{HMA Thickness} = 0.40 \text{ ft (round up to the nearest 0.05 ft)} \]

GE_{HMA} = 2.07  
GE_{HMA} = 0.83

\[ GE_{AB+HMA} = 0.0032 \cdot T1 \cdot (100 - R_{AS}) = 1.20 \]

\[ \Rightarrow GE_{HMA+AB} = 1.40 \text{ (add 0.2 ft safety factor)} \]

\[ GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 0.57 \]

\[ \Rightarrow \text{AB thickness} = 0.52 \]

\[ \Rightarrow \text{AB Thickness} = 0.55 \text{ ft (round up to the nearest 0.05 ft)} \]

GE_{AB} = 0.61  
G_{I,AB}=1.1

\[ GE_{AS} = GE_{TOTAL} - GE_{AB} - GE_{HMA} = 0.37 \]

\[ \Rightarrow \text{AS Thickness} = 0.40 \text{ ft (round up to the nearest 0.05 ft)} \]

**Design Section:**

```
   HMA     0.40 ft
     ↑

   AB     0.55 ft
     ↑

   AS     0.40 ft
     ↑

   Base Soil
```
Design Case: Full depth AC

Design Ti = 7.5 \text{ input}
R_{BS} = 25 \text{ input}

\[ GE_{HMA} = 0.0032 \times TI \times (100 - R_{BS}) = 1.80 \]

=> \[ GE_{HMA}^\ast = 1.90 \] (add 0.1 ft safety factor)
=> HMA Thickness = 0.80

=> HMA Thickness = 0.85 ft (round up to the nearest 0.05 ft)

Design Section:

\begin{center}
\begin{tikzpicture}
\node at (0,0) {Base Soil};
\node at (0,1) {HMA};
\node at (0,1.85) {0.85 ft};
\end{tikzpicture}
\end{center}
PAVEMENT DESIGN (CORRAL DE TIERRA ROAD)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 206148.10

Design Case: AC over AB

Design Tl= 8 input
R_{BS}= 25 input
R_{AB}= 78

GE_{AC+AB} = 0.0032*Tl*(100-R_{BS}) = 1.92

GE_{HMA} = 0.0032*Tl*(100-R_{AB}) = 0.56
=> GE'_{HMA} = 0.76 (add 0.2 ft safety factor)
    AC Thickness = 0.38 ft

=> AC Thickness = 0.40 ft (round up to the nearest 0.05 ft)
    G_t,_{HMA} = 2.00
    GE_{HMA} = 0.80

GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 1.12
    AB thickness= 1.02 ft

=> AB Thickness= 1.05 ft (round up to the nearest 0.05 ft)
    GE_{AB} = 1.16 G_t,_{AB}=1.1

Design Section:

```
 HMA     0.40 ft
  
 AB     1.05 ft

Base Soil
```
Design Case: AC over AB over AS

Design TI= 8  input
R_{BS} = 25  input
R_{AB} = 78
R_{AS} = 50  check

\[ GE_{TOTAL} = 0.0032*TI*(100-R_{BS}) = 1.92 \]

\[ GE_{HMA} = 0.0032*TI*(100-R_{AB}) = 0.56 \]
  \[ \Rightarrow GE_{HMA} = 0.76 \text{ (add 0.2 ft safety factor)} \]
  \[ AC \text{ thickness} = 0.38 \text{ ft} \]

\[ \Rightarrow HMA \text{ Thickness} = 0.40 \text{ ft (round up to the nearest 0.05 ft)} \]

\[ G_{t,HMA} = 2.00 \]
\[ GE_{HMA} = 0.80 \]

\[ GE_{AB+HMA} = 0.0032*TI*(100-R_{AS}) = 1.28 \]
  \[ \Rightarrow GE_{HMA+AB} = 1.48 \text{ (add 0.2 ft safety factor)} \]

\[ GE_{AB} = GE_{HMA+AB}-GE_{HMA} = 0.68 \]
  \[ \Rightarrow AB \text{ thickness} = 0.62 \]

\[ \Rightarrow AB \text{ Thickness} = 0.65 \text{ ft (round up to the nearest 0.05 ft)} \]

\[ GE_{AB} = 0.72  \quad G_{t,AB} = 1.1 \]

\[ GE_{AS} = GE_{TOTAL}-GE_{AB}-GE_{HMA} = 0.40 \]
  \[ \Rightarrow AS \text{ Thickness} = 0.45 \text{ ft (round up to the nearest 0.05 ft)} \]

Design Section:

\[
\begin{array}{c}
HMA \\
\uparrow \\
AB \\
\uparrow \\
AS \\
\uparrow \\
Base \ Soil
\end{array}
\]

\[
0.40 \text{ ft} \\
0.65 \text{ ft} \\
0.45 \text{ ft}
\]
PAVEMENT DESIGN (CORRAL DE TIERRA ROAD)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 207132.10

Design Case: Full depth AC

Design TI= 8 input
R_{BS}= 25 input

\[ GE_{HMA} = 0.0032 \times TI \times (100 - R_{BS}) = 1.92 \]

=> \[ GE'_{HMA} = 2.02 \] (add 0.1 ft safety factor)

=> HMA Thickness= 0.86

=> HMA Thickness= 0.90 ft (round up to the nearest 0.05 ft)

Design Section:

\[ \begin{align*}
\text{HMA} & \quad 0.90 \text{ ft} \\
\text{Base Soil} &
\end{align*} \]
Design Case: AC over AB

Design TI= 8.5 input
R_{BS}= 25 input
R_{AB}= 78

\[ GE_{AC+AB} = 0.0032 \times TI \times (100 - R_{BS}) = 2.04 \]

\[ GE_{HMA} = 0.0032 \times TI \times (100 - R_{AB}) = 0.60 \]

\[ => GE_{HMA} = 0.80 \text{ (add 0.2 ft safety factor)} \]

AC Thickness = 0.41 ft

\[ => AC Thickness = 0.45 \text{ ft (round up to the nearest 0.05 ft)} \]

\[ G_{f,HMA} = 1.94 \]

\[ GE_{HMA} = 0.88 \]

\[ GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 1.16 \]

AB thickness= 1.06 ft

\[ => AB Thickness = 1.10 \text{ ft (round up to the nearest 0.05 ft)} \]

\[ GE_{AB} = 1.21 \text{ G}_{f,AB}=1.1 \]

**Design Section:**

```
+-----------------------------+
| HMA                        |
| 0.45 ft                    |
+-----------------------------+
|                           |
| AB                        |
| 1.10 ft                   |
+-----------------------------+
| Base Soil                  |
```
PAVEMENT DESIGN (CORRAL DE TIERRA ROAD)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 207132.10

Design Case: AC over AB over AS

Design TI= 8.5 input
R_{BS}= 25 input
R_{AB}= 78
R_{AS}= 50 check

\[ GE_{\text{TOTAL}} = 0.0032 \times T I \times (100 - R_{BS}) = 2.04 \]

\[ GE_{\text{HMA}} = 0.0032 \times T I \times (100 - R_{AB}) = 0.60 \]
\[ \Rightarrow GE_{\text{HMA}} = 0.80 \] (add 0.2 ft safety factor)
AC thickness = 0.41 ft

\[ \Rightarrow \text{HMA Thickness} = 0.45 \text{ ft (round up to the nearest 0.05 ft)} \]
\[ G_t,_{\text{HMA}} = 1.94 \]
\[ GE_{\text{HMA}} = 0.88 \]

\[ GE_{\text{AB+HMA}} = 0.0032 \times T I \times (100 - R_{AS}) = 1.36 \]
\[ \Rightarrow GE_{\text{HMA+AB}} = 1.56 \] (add 0.2 ft safety factor)

\[ GE_{\text{AB}} = GE_{\text{HMA+AB}} - GE_{\text{HMA}} = 0.68 \]
\[ \Rightarrow \text{AB thickness} = 0.62 \]

\[ \Rightarrow \text{AB Thickness} = 0.65 \text{ ft (round up to the nearest 0.05 ft)} \]
\[ \text{GE}_{\text{AB}} = 0.72 \]
\[ G_t,_{\text{AB}} = 1.1 \]

\[ GE_{\text{AS}} = GE_{\text{TOTAL}} - GE_{\text{AB}} - GE_{\text{HMA}} = 0.45 \]
\[ \Rightarrow \text{AS Thickness} = 0.45 \text{ ft (round up to the nearest 0.05 ft)} \]

Design Section:

- **HMA**
  - 0.45 ft
- **AB**
  - 0.65 ft
- **AS**
  - 0.45 ft

Base Soil
**Design Case: Full depth AC**

Design TI= 8.5  input  
R_{BS}= 25  input  

\[GE_{HMA} = 0.0032*TI*(100- R_{BS}) = 2.04\]

\[=> GE'_{HMA} = 2.14 \quad \text{(add 0.1 ft safety factor)}\]

\[=> \text{HMA Thickness} = 0.92\]

\[=> \text{HMA Thickness} = 0.95 \quad \text{ft (round up to the nearest 0.05 ft)}\]

*Design Section:*

```
<table>
<thead>
<tr>
<th>HMA</th>
<th>0.95 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Soil</td>
<td></td>
</tr>
</tbody>
</table>
```
PAVEMENT DESIGN (SR-68)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 206148.10

Design Case: AC over AB

Design \( T_i = 10 \) input
\( R_{BS} = 25 \) input
\( R_{AB} = 78 \)

\[ GE_{AC+AB} = 0.0032 \times T_i \times (100 - R_{BS}) = 2.40 \]

\[ GE_{HMA} = 0.0032 \times T_i \times (100 - R_{AB}) = 0.70 \]

\[ \Rightarrow GE'_{HMA} = 0.90 \text{ (add 0.2 ft safety factor)} \]

AC Thickness = 0.51 ft

\[ \Rightarrow \text{AC Thickness} = 0.55 \text{ ft (round up to the nearest 0.05 ft)} \]

\( G_{f,HMA} = 1.81 \)

\( GE_{HMA} = 1.00 \)

\[ GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 1.40 \]

AB thickness = 1.27 ft

\[ \Rightarrow \text{AB Thickness} = 1.30 \text{ ft (round up to the nearest 0.05 ft)} \]

\( G_{f,AB} = 1.1 \)

Design Section:

```
 Base Soil

 AB

 0.55 ft

 HMA
```

Base Soil
PAVEMENT DESIGN (SR-68)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 207132.10

**Design Case: AC over AB over AS**

Design TI= 10 input
R$_{BS}$= 25 input
R$_{AB}$= 78
R$_{AS}$= 50 check

$$GE_{\text{TOTAL}} = 0.0032 \times \text{TI} \times (100 - R_{BS}) = 2.40$$

$$GE_{HMA} = 0.0032 \times \text{TI} \times (100 - R_{AB}) = 0.70$$

=> $$GE_{HMA} = 0.90$$ (add 0.2 ft safety factor)

AC thickness = 0.51 ft

=> HMA Thickness= 0.55 ft (round up to the nearest 0.05 ft)

G$_{f,HMA}$= 1.81

GE$_{HMA}$= 1.00

$$GE_{AB+HMA} = 0.0032 \times \text{TI} \times (100 - R_{BS}) = 1.60$$

=> $$GE_{HMA+AB} = 1.80$$ (add 0.2 ft safety factor)

$$GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 0.80$$

=> AB thickness= 0.73

=> AB Thickness= 0.75 ft (round up to the nearest 0.05 ft)

G$_{f, AB}$= 1.1

GE$_{AB}$= 0.83

$$GE_{AS} = GE_{\text{TOTAL}} - GE_{AB} - GE_{HMA} = 0.58$$

=> AS Thickness= 0.60 ft (round up to the nearest 0.05 ft)

Design Section:

- **HMA**: 0.55 ft
- **AB**: 0.75 ft
- **AS**: 0.60 ft
Design Case: Full depth AC

Design TI = 10
R$_{BS}$ = 25

\[ GE_{HMA} = 0.0032 \times TI \times (100 - R_{BS}) = 2.40 \]

=> GE$'_{HMA}$ = 2.50 (add 0.1 ft safety factor)

=> HMA Thickness = 1.10 ft (round up to the nearest 0.05 ft)

Design Section:

```
            HMA
            1.10 ft
            Base Soil
```
**Design Case: AC over AB**

Design TI = 10.5 (input)

\[ R_{BS} = 25 \quad \text{input} \]

\[ R_{AB} = 78 \]

\[ GE_{AC+AB} = 0.0032\times TI'\times (100-R_{BS}) = 2.52 \]

\[ GE_{HMA} = 0.0032\times TI'\times (100-R_{AB}) = 0.74 \]

=> \[ GE'_{HMA} = 0.94 \] (add 0.2 ft safety factor)

AC Thickness = 0.54 ft

=> AC Thickness = 0.55 ft (round up to the nearest 0.05 ft)

\[ G_{f,HMA} = 1.77 \]

\[ GE_{HMA} = 0.97 \]

\[ GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 1.55 \]

AB thickness = 1.41 ft

=> AB Thickness = 1.45 ft (round up to the nearest 0.05 ft)

\[ G_{f,AB} = 1.1 \]

**Design Section:**

- **HMA**
  - 0.55 ft

- **AB**
  - 1.45 ft

- **Base Soil**
Design Case: AC over AB over AS

Design TI= \textbf{10.5} input
\[ R_{BS} = 25 \text{ input} \]
\[ R_{AB} = 78 \]
\[ R_{AS} = 50 \text{ check} \]

\[ GE_{TOTAL} = 0.0032*TI*(100-R_{BS}) = 2.52 \]

\[ GE_{HMA} = 0.0032*TI*(100-R_{AB}) = 0.74 \]
\[ \Rightarrow GE_{HMA} = 0.94 \text{ (add 0.2 ft safety factor)} \]
\[ \text{AC thickness} = 0.54 \text{ ft} \]
\[ \Rightarrow \text{HMA Thickness} = 0.55 \text{ ft (round up to the nearest 0.05 ft)} \]
\[ G_{t,HMA} = 1.77 \]
\[ GE_{HMA} = 0.97 \]

\[ GE_{AB+HMA} = 0.0032*TI*(100-R_{AS}) = 1.68 \]
\[ \Rightarrow GE_{HMA+AB} = 1.88 \text{ (add 0.2 ft safety factor)} \]

\[ GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 0.91 \]
\[ \Rightarrow \text{AB thickness} = 0.82 \]
\[ \Rightarrow \text{AB Thickness} = 0.85 \text{ ft (round up to the nearest 0.05 ft)} \]
\[ G_{t,AB} = 1.1 \]
\[ GE_{AB} = 0.94 \]

\[ GE_{AS} = GE_{TOTAL} - GE_{AB} - GE_{HMA} = 0.61 \]
\[ \Rightarrow \text{AS Thickness} = 0.65 \text{ ft (round up to the nearest 0.05 ft)} \]

Design Section:

```
```

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>0.55 ft</td>
</tr>
<tr>
<td>AB</td>
<td>0.85 ft</td>
</tr>
<tr>
<td>AS</td>
<td>0.65 ft</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Soil</td>
<td></td>
</tr>
</tbody>
</table>
```
PAVEMENT DESIGN (SR-68)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 207132.10

Design Case: Full depth AC

Design TI= 10.5 input
$R_{BS}=$ 25 input

$GE_{HMA} = 0.0032 \cdot TI \cdot (100 - R_{BS}) = 2.52$

=> $GE'_{HMA} = 2.62$ (add 0.1 ft safety factor)

=> HMA Thickness= 1.16

=> HMA Thickness= 1.20 ft (round up to the nearest 0.05 ft)

Design Section:

```
          HMA
          | 1.20 ft
  +-------------------------
  |  Base Soil
```


PAVEMENT DESIGN (SR-68)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 206148.10

Design Case: AC over AB

Design Tl= 11  input
R_{BS}= 25  input
R_{AB}= 78

\[ GE_{AC+AB} = 0.0032^*Tl^*(100-R_{BS}) = 2.64 \]

\[ GE_{HMA} = 0.0032^*Tl^*(100-R_{AB}) = 0.77 \]

=> \[ GE'_{HMA}= 0.97 \] (add 0.2 ft safety factor)

\[ AC \text{ Thickness} = 0.56 \text{ ft} \]

=> \[ AC \text{ Thickness} = 0.60 \text{ ft} \] (round up to the nearest 0.05 ft)

\[ G_{t,HMA}= 1.78 \]
\[ GE_{HMA} = 1.07 \]

\[ GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 1.57 \]

\[ AB \text{ thickness}= 1.43 \text{ ft} \]

=> \[ AB \text{ Thickness}= 1.45 \text{ ft} \] (round up to the nearest 0.05 ft)

\[ G_{t,AB}=1.1 \]

Design Section:

```
HMA
    0.60 ft

AB
    1.45 ft

Base Soil
```
PAVEMENT DESIGN (SR-68)
PER HIGHWAY DESIGN MANUAL, CHAP. 600

PROJECT NAME: SR-68/CORRAL DE TIERRA ROAD INTERSECTION IMPROVEMENT PROJECT
PROJECT NO.: 207132.10

Design Case: AC over AB over AS

Design TI= 11 input
R_{BS} = 25 input
R_{AB} = 78
R_{AS} = 50 check

\[ GE_{TOTAL} = 0.0032 \times TI \times (100 - R_{BS}) = 2.64 \]

\[ GE_{HMA} = 0.0032 \times TI \times (100 - R_{AB}) = 0.77 \]
\[ => GE_{HMA} = 0.97 \text{ (add 0.2 ft safety factor)} \]
\[ AC \text{ thickness} = 0.56 \text{ ft} \]
\[ => HMA \text{ Thickness} = 0.60 \text{ ft (round up to the nearest 0.05 ft)} \]
\[ G_{t,HMA} = 1.78 \]
\[ GE_{HMA} = 1.07 \]

\[ GE_{AB+HMA} = 0.0032 \times TI \times (100 - R_{AS}) = 1.76 \]
\[ => GE_{HMA+AB} = 1.96 \text{ (add 0.2 ft safety factor)} \]

\[ GE_{AB} = GE_{HMA+AB} - GE_{HMA} = 0.89 \]
\[ => AB \text{ thickness} = 0.81 \]
\[ => AB \text{ Thickness} = 0.85 \text{ ft (round up to the nearest 0.05 ft)} \]
\[ GE_{AB} = 0.94 \quad G_{t,AB}=1.1 \]

\[ GE_{AS} = GE_{TOTAL} - GE_{AB} - GE_{HMA} = 0.64 \]
\[ => AS \text{ Thickness} = 0.65 \text{ ft (round up to the nearest 0.05 ft)} \]

Design Section:

<table>
<thead>
<tr>
<th>HMA</th>
<th>0.60 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>(GE_{HMA+AB})</td>
<td></td>
</tr>
<tr>
<td>(GE_{AB})</td>
<td>0.85 ft</td>
</tr>
<tr>
<td>(GE_{AS})</td>
<td>0.65 ft</td>
</tr>
</tbody>
</table>

Base Soil
Design Case: Full depth AC

\[ GE_{HMA} = 0.0032 \cdot Tl \cdot (100 - R_{BS}) = 2.64 \]

\[ \Rightarrow GE'_{HMA} = 2.74 \quad \text{(add 0.1 ft safety factor)} \]

\[ \Rightarrow \text{HMA Thickness} = 1.22 \]

\[ \Rightarrow \text{HMA Thickness} = 1.25 \text{ ft (round up to the nearest 0.05 ft)} \]

Design Section:

```
          HMA
         |   1.25 ft
         |   
           Base Soil
```
MAINTENANCE-FREE SERVICE DESIGN ESTIMATES FOR DRAINAGE FACILITIES USING:
CALIFORNIA CULVERT CRITERIA AND CULVERT4.EXE, (RELEASE DATE 04-16-99)

PROJECT LOCATION...206148-SR 68/Coral

PROJECT ACCOUNT NO.206148.10

SAMPLE LOCATION....B 3 @ 0-5'

TEST SAMPLE NO.....

OPERATOR............Ganga

TEST DATE..........04-05-07

*************** A DATA VALUE OF ZERO INDICATES NO DATA INPUT ***************
CSP SITE pH = 7.7, WATER pH = 0.0, SOIL pH = 7.7
MINIMUM RESISTIVITY, OHM-CM: CSP SITE = 6700, WATER = 0, SOIL = 6700

ESTIMATED SERVICE LIFE OF CSP CULVERTS, YEARS
SEE CALTRANS HIGHWAY DESIGN MANUAL CHAPTER 850

<table>
<thead>
<tr>
<th>CSP</th>
<th>GALV.</th>
<th>GALV.+</th>
<th>GALV.+</th>
<th>GALV.+</th>
<th>GALV.+</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICK</td>
<td>57 g</td>
<td>BIT COAT.</td>
<td>BIT COAT &amp; WATER SIDE</td>
<td>PAVED INVERT (SOIL SIDE)</td>
<td>90 DEG</td>
</tr>
<tr>
<td>Gage &amp; mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>1.3</td>
<td>54</td>
<td>62</td>
<td>69</td>
<td>79</td>
</tr>
<tr>
<td>16</td>
<td>1.6</td>
<td>70</td>
<td>78</td>
<td>85</td>
<td>95</td>
</tr>
<tr>
<td>14</td>
<td>2.0</td>
<td>87</td>
<td>95</td>
<td>102</td>
<td>112</td>
</tr>
<tr>
<td>12</td>
<td>2.8</td>
<td>119</td>
<td>127</td>
<td>134</td>
<td>144</td>
</tr>
<tr>
<td>10</td>
<td>3.5</td>
<td>152</td>
<td>160</td>
<td>167</td>
<td>177</td>
</tr>
<tr>
<td>8</td>
<td>4.3</td>
<td>185</td>
<td>193</td>
<td>200</td>
<td>210</td>
</tr>
</tbody>
</table>

FLOW VEL. <1.5 m/s WITH NON-ABRASIVE CONDITIONS, (DEFAULT VALUES)
CAP, 18 GAGE (1.3 mm) CSP AND CASP MAY BE USED WITH THESE FLOW VELOCITIES

STANDARD REINFORCED CONCRETE PIPE DESIGN SHOULD BE
SUITABLE FOR THIS USER DEFINED LEVEL OF CHLORIDES

CONCRETE AND RCP MITIGATION MEASURES FOR pH
TYPE IP (MS) MODIFIED CEMENT OR TYPE II MODIFIED CEMENT
MINIMUM REQUIRED BY CALTRANS STD. SPECS. 90-1.01

A CORRUGATED ALUMINUM PIPE, CAP, MAY BE USED
IF ABRASIVE CONDITIONS DO NOT EXIST
SITE CONDITIONS MEET CORROSION REQUIREMENTS

A CORRUGATED ALUMINIZED STEEL PIPE, CASP, MAY BE USED
SITE CONDITIONS MEET CORROSION REQUIREMENTS

PLASTIC PIPE IS APPROVED FOR 50 YEARS SERVICE LIFE FOR
CORROSIVE CONDITIONS. ABRASION MUST BE EVALUATED. ALSO,
CONSIDER CONCRETE HEADWALLS AND CONCRETE OR METAL END
TREATMENT WHERE HIGH FIRE POTENTIAL EXISTS.
PROJECT LOCATION...206148-SR 68/Corral

PROJECT ACCOUNT NO.206148.10

SAMPLE LOCATION....B 6 @ 0-5'

TEST SAMPLE NO.....

OPERATOR.........Ganga

TEST DATE.........04-05-07

*************** A DATA VALUE OF ZERO INDICATES NO DATA INPUT ***************

CSP SITE pH = 7.1 ,  WATER pH = 0.0 ,  SOIL pH = 7.1
MINIMUM RESISTIVITY, OHM-CM: CSP SITE = 9650 , WATER = 0 , SOIL = 9650

DETERMINATION OF SERVICE LIFE OF CSP CULVERTS, YEARS
SEE CALTRANS HIGHWAY DESIGN MANUAL CHAPTER 850

<table>
<thead>
<tr>
<th>CSP</th>
<th>GALV.</th>
<th>GALV.+</th>
<th>GALV.+</th>
<th>GALV.+</th>
<th>GALV.+</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICK</td>
<td>57 g</td>
<td>BIT COAT.</td>
<td>BIT COAT &amp; PAVED INV.</td>
<td>BIT COAT</td>
<td>POLYMER</td>
</tr>
<tr>
<td>Gage &amp; mm.</td>
<td>(WATER SIDE)</td>
<td>(SOIL SIDE)</td>
<td>90 DEG ABRASION</td>
<td>INVERT</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>1.3</td>
<td>31</td>
<td>39</td>
<td>46</td>
<td>56</td>
</tr>
<tr>
<td>16</td>
<td>1.6</td>
<td>41</td>
<td>49</td>
<td>56</td>
<td>66</td>
</tr>
<tr>
<td>14</td>
<td>2.0</td>
<td>50</td>
<td>58</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>12</td>
<td>2.8</td>
<td>69</td>
<td>77</td>
<td>84</td>
<td>94</td>
</tr>
<tr>
<td>10</td>
<td>3.5</td>
<td>88</td>
<td>96</td>
<td>103</td>
<td>113</td>
</tr>
<tr>
<td>8</td>
<td>4.3</td>
<td>107</td>
<td>115</td>
<td>122</td>
<td>132</td>
</tr>
</tbody>
</table>

FLOW VEL. <1.5 m/s WITH NON-ABRASIVE CONDITIONS, (DEFAULT VALUES)
CAP, 18 GAGE (1.3 mm) CSP AND CASP MAY BE USED WITH THESE FLOW VELOCITIES

STANDARD REINFORCED CONCRETE PIPE DESIGN SHOULD BE SUITABLE FOR THIS USER DEFINED LEVEL OF CHLORIDES

CONCRETE AND RCP MITIGATION MEASURES FOR pH
TYPE IP (MS) MODIFIED CEMENT OR TYPE II MODIFIED CEMENT MINIMUM REQUIRED BY CALTRANS STD. SPECS. 90-1.01

A CORRUGATED ALUMINIZED STEEL PIPE, CASP, MAY BE USED IF ABRASIVE CONDITIONS DO NOT EXIST SITE CONDITIONS MEET CORROSION REQUIREMENTS

A CORRUGATED ALUMINIZED STEEL PIPE, CASP, MAY BE USED SITE CONDITIONS MEET CORROSION REQUIREMENTS

PLASTIC PIPE IS APPROVED FOR 50 YEARS SERVICE LIFE FOR CORROSIVE CONDITIONS. ABRASION MUST BE EVALUATED. ALSO, CONSIDER CONCRETE HEADWALLS AND CONCRETE OR METAL END TREATMENT WHERE HIGH FIRE POTENTIAL EXISTS.