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December 1, 1992

Bartran Homes, Inc.  
1136 East Stuart  
Fort Collins, CO

ATTN: Mr. Bill Bartran

RE: Pavement Section Evaluation  
English Ranch 2nd and 3rd Filings  
Fort Collins, Colorado  
Job No. 20926637

Mr. Bartran:

As requested, a senior project engineer from Empire Laboratories, Inc. has evaluated proposed pavement sections for the referenced project. Results of that evaluation are included with this report.

The English Ranch development is located east of Timberline Road and south of Horsetooth Road in Fort Collins, Colorado. The development is being constructed in several phases with phase two of the development presently under construction, and phase three in final design. Our subsurface exploration report concerning this development was submitted in August of 1986, under project number 6637-86.

During construction of the first phase of the single-family housing development, difficulties were encountered in maintaining stable roadway subgrades prior to placement of pavements. In these areas, Class "C" fly ash was used to stabilize the subgrades immediately

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**Geotechnical, Environmental and Materials Engineers**

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prior to constructing the pavement sections. Those pavement sections consisted of aggregate base overlain by hot bituminous pavement. At that time, the benefit of subgrade stabilization was not considered in reducing the layer thicknesses of the other components in the pavement section. We understand that prior to construction of the pavements in the phase two and three areas, it is desired to evaluate alternative pavement sections including sections which are designed with a Portland cement stabilized subgrade.

Design parameters used in evaluating alternative pavement sections for this project are shown below in Table I.

TABLE I - PAVEMENT DESIGN PARAMETERS

	EDLA	Reliability	"R"	Mr
Kingsley Drive	20	85%	8.3	5610
Bison Road	7	70%	8.3	5610
All Other Local Streets & Cul-De-Sacs	5	70%	8.3	5610

Equivalent daily load axle (EDLA) estimates for the pavement design were provided by City of Fort Collins personnel. The equivalent load axle (ELA) projections used in the design were based on a 20-year design life using the provided EDLA's without growth adjustments. Reliabilities for use in the local and collector streets were selected by City of Fort Collins. The Hveem stabilometer R-values ("R") were determined in laboratory testing completed as a part of our 1986 subsurface exploration. The correlation between Hveem R-value and Resilient Modulus ( $M_r$ ) as recommended by the American Association of State Highway and Transportation Officials (AASHTO) was used in this design.

The 1986 AASHTO "Guideline for Design of Pavement Structures" was used with the above parameters for calculating design weighted structural numbers (DWSN) for the roadways. The design weighted structural numbers are shown below in Table II. Table II also provides recommended pavement sections based on those design weighted structural numbers and structural numbers assumed for the various pavement components.

TABLE II - RECOMMENDED PAVEMENT SECTIONS

	DWSN	HBP/Aggregate Base	HBP/Stabilized Subgrade	HBP/Aggregate Base/Stabilized Subgrade
Kingsley Drive	2.61	4" HBP 8" Aggregate Base	4" HBP 8" Stabilized Subgrade	4" HBP 6" Aggregate Base 8" Stabilized Subgrade
Bison Road	2.04	3" HBP 7" Aggregate Base	3" HBP 8" Stabilized Subgrade	3" HBP 4" Aggregate Base 8" Stabilized Subgrade
Local Streets and Cul-De-Sacs	1.93	3" HBP 6" Aggregate Base	3" HBP 8" Stabilized Subgrade	3" HBP 4" Aggregate Base 8" Stabilized Subgrade

The recommended pavement sections which incorporate both aggregate base and stabilized subgrades include City of Fort Collins' minimum composite sections over the stabilized subgrades. The City of Fort Collins may or may not accept full depth asphalt placed directly on the stabilized subgrades.

Asphaltic concrete for use in the roadways should be compatible with City of Fort Collins standard specifications for SC1 or SC2 hot bituminous pavement blends. Those materials should be placed and compacted as recommended by appropriate City of Fort Collins and Colorado Department of Transportation standard specifications.

Aggregate base course materials should be consistent with Colorado Department of Transportation standard specifications for Class 5 or Class 6 base. Those materials should be placed in loose lifts not to exceed 9 inches thick, adjusted in moisture to a workable moisture content and compacted to at least 98 percent of the material's maximum dry density as determined in accordance with ASTM Specification D-698, the standard Proctor procedure.

Regarding cement stabilization of the subgrade, we estimate approximately 8% Portland cement, based on dry weights would be needed to stabilize the site silty clays. The project design was based on developing compressive strengths of 100 to 250 psi in compacted/cured test specimens. If extremely wet conditions are encountered, higher cement contents could be required. Care should also be taken to see that excessive strengths are not developed in the subgrades; higher strength subgrades increase the potential for shrinkage cracking in the materials.

The Portland cement should be uniformly blended with the site soils to the recommended stabilization depths and those materials subsequently compacted to at least 95% of maximum dry density as determined in accordance with ASTM Specification D-698, the standard Proctor procedure. During blending of the materials, the moisture content of the mixture should be adjusted to within  $\pm 2\%$  of the optimum moisture content as determined by the standard Proctor procedure. If desired, we can provide additional requirements for blending and placing the stabilized subgrade.

The analysis and recommendations presented are based upon the information discussed in this report. It is recommended that the geotechnical engineer be retained to review the plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical


recommendations in the design and specifications. It is further recommended that the geotechnical engineer be retained for testing and observation during earthwork and subgrade stabilization phases to help determine that the design requirements are fulfilled.


This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranty, expressed or implied, is made. In the event that any changes in the nature, design or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing by the geotechnical engineer.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we can be of further service to you in any other way, please do not hesitate to contact us.

Very truly yours,

EMPIRE LABORATORIES, INC.  
A DIVISION OF THE TERRACON COMPANIES, INC.

  
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