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Project No. 12181.G1
3 May 2010

Ms Kelly Reynolds
Ruggeri-Jensen-Azar
4690 Chabot Drive, Suite 200
Pleasanton, CA 94588

Subject: Union City Transit-Oriented District
11th Street near Decoto Road
Union City, California
**ADDITIONAL FOUNDATION RECOMMENDATIONS AND RETAINING WALL RECOMMENDATIONS**

Reference: 1) Geotechnical Investigation Report
By ***TERRASEARCH, inc.***
Dated 7 April 2009

Dear Ms Reynolds:

At your request, we have prepared additional foundation recommendations for construction of fountains and landscape retaining walls at the subject site.

The geotechnical investigation report performed by ***Terrasearch, inc.*** (reference 1) provides recommendations for spread footing foundations. Site retaining walls and the fountain may be supported on spread footing foundations designed in accordance with the recommendations contained therein.

If the foundation for the fountain is to be designed as a mat slab foundation, the foundation may be designed as follows: Structural mat slabs should be a minimum of 10 inches in thickness and designed using the method presented in the WRI/CSRI Design of Slab-on-Grade Foundations manual. Based on the above method, it is recommended that the structural mat foundation be designed using a minimum Weighted Plasticity Index value of 16 for the site in its current condition.

A modulus of subgrade reaction of 75 psi per inch (for a 1-foot-square plate) may be used in designing the slab for a subgrade of native soil. The mat foundation can be designed for allowable bearing pressures of 1,500 pounds per square foot (p.s.f.) due to dead plus sustained live loads and 2,000 p.s.f. for all loads including wind and seismic.

**Site Retaining Walls**

Site retaining walls should be designed to resist lateral pressures exerted from a media having an equivalent fluid weight as follows:

| | | |
|---|---|---|
| Active Condition | = | 50 p.c.f. for horizontal backslope |
| At-rest Condition | = | 70 p.c.f. for horizontal backslope |
| Passive Condition | = | 250 p.c.f. for horizontal toe slope |
| Coefficient of Friction | = | 0.30 |

Active conditions occur when the top of the wall is free to move outward. At-rest conditions apply when the top of wall is restrained from any movement, including any walls incorporated into or attached to structures. It should be noted that the effects of any surcharge or compaction loads behind the walls must be accounted for in the design of the walls.

The active and at-rest pressures may be reduced if engineered granular fill is used for backfill of a zone behind the retaining wall where the width of the zone is at least two-thirds the height of retained earth. Specific recommendations will depend on specific materials used.

For a non-horizontal backslope, the active or at-rest condition equivalent fluid weight can be increased by a 1.5 p.c.f. for each 2 degree rise in slope from the horizontal. For a dipping toe slope, the passive condition equivalent fluid weight should be reduced by 8 p.c.f. for each degree of slope below horizontal. Backslopes and toe slopes steeper than 2:1 should not be used with conventional retaining walls.

The above criteria are based on fully drained conditions. If drained conditions are not possible, then the hydrostatic pressure must be included in the design of the wall. Hydrostatic pressure will be a lateral fluid pressure of of 63 p.c.f. in this case.

In order to achieve fully-drained conditions, a drainage filter blanket should be placed behind the wall. The blanket should be a minimum of 12 inches thick and should extend the full height of the wall to within 12 inches of the surface. If the excavated area behind the wall exceeds 12 inches, the entire excavated space behind the 12-inch blanket should consist of compacted engineered fill or blanket material. The drainage blanket material may consist of either granular crushed rock and drain pipe fully encapsulated in geotextile filter fabric or Class II permeable material that meets CalTrans Specification, Section 68, with drainage pipe but without fabric. A 4-inch perforated drain pipe should be installed in the bottom of the drainage blanket and should be underlain by at least 4 inches of filter type material.

As an alternate to the 12-inch drainage blanket, a pre-fabricated drain board (such as Miradrain) may be used between the wall and retained soil, extending to within 6 inches of the top of the soil. A 4-inch perforated drain pipe should be installed at the bottom of the drain board and wrapped in filter fabric.

Piping with adequate gradient shall be provided to discharge water that collects behind the walls to an adequately controlled discharge system away from the structure foundation.

The retaining walls may be founded on either a spread footing foundation using the criteria given in Reference 1 or on a friction pier foundation using the following criteria:

Retaining wall piers should be designed on the basis of skin friction acting between the soil and that portion of the pier that extends below a depth of two feet below finished grade. For the soils at the site, an allowable skin friction value of 400 p.s.f. can be used for combined dead and live loads. This value can be increased by one-third for total loads which include wind or seismic forces. Spacing should be determined as required by the load distribution, but minimum spacing should not be less than 3 pier diameters, center to center. Maximum spacing and the minimum depth of piers is to be determined by the Structural Engineer.

Soil passive pressures equivalent of that of a fluid weighing 250 p.c.f. can be assumed to act against twice the pier diameter.

It is important that care be exercised to ensure that any concrete spills during the concrete pour must be removed and no "mushrooming" effects are allowed to remain around the top of the pier.

**Utility Vault**

Lateral earth pressures for the proposed deep utility vault will be the same as those for site retaining walls above, noting that the vault will experience at-rest earth pressures.

Applicable OSHA safety standards require that excavations in excess of 4 feet in depth must be properly shored or that the walls of the excavation slope back to provide safety for installation of lines. The site soils in the upper 10 feet of the site are generally OSHA Class C soils.

Groundwater was encountered at about 30 feet below grade at the site. Despite the depth of groundwater, transient water flows may pass by the vault. Therefore, the exterior of the vault should be waterproofed, and the interior of the vault should be provided with a sump pump to prevent accumulation of water inside the vault. Specification of appropriate waterproofing and sump pumps should be prepared by specialists in this field

Should you have any questions relating to the contents of this letter or should you require additional information, please do not hesitate to contact our office at your convenience.

Very truly yours,
Reviewed by **RMA Group of Northern California**

Simon Makdessi, P.E., G.E.
Principal Engineer

Anthony Argyriou
Senior Engineer

Copies: 2 to RJA