ALHAMBRA UNDERPASS
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UPDATE TO FEASIBILITY STUDIES FOR BICYCLE/PEDESTRIAN AND VEHICULAR UNDERPASS ALTERNATIVES

Submitted to:

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REFERENCED DOCUMENTS:
Feasibility Studies For Bicycle/Pedestrian And Vehicular Underpass Alternatives: March 6, 2014 (PARSONS)

SUMMARY

As discussed in the study referenced on the cover page, we have continued to study feasible methods to design and construct the 12.5 foot high by 25 foot wide bicycle and pedestrian underpass. Through discussions with experienced ground improvement and tunneling contractors, we have determined that ground improvement methods including grout injection or deep soil mixing will not be feasible at this location given the limited access directly over the zone of needed soil improvement. The time and equipment needed to perform the work will conflict with Union Pacific's requirement that all three tracks remain in continuous service on this important rail corridor. Additionally, discussions with the contractor resulted in the elimination of an alternative method of grout injection performed from the two sides of the embankment to avoid conflicts with Union Pacific's operations as the injection pattern from the two sides would not produce the needed block of improved ground.

However, continued efforts by our geotechnical and structural engineers and discussions with contractors have indicated that micropiles, capable of being installed in low overhead conditions such as will exist under the pipe screen during the staged construction, may be a constructible and structurally adequate method to construct the bicycle and pedestrian tunnel in a manner that meets the requirements of Union Pacific. Of course, as noted below, while our preliminary analysis indicates this approach may be a viable means of construction, it must still go through the full design process and is subject to Union Pacific's formal review and approval requirements.

Additionally, in the course of evaluating the bicycle and pedestrian tunnel, we have determined the load and spacing limitations of micropiles makes a larger tunnel (e.g. the 19.25 foot high by 38.5 width single lane vehicular tunnel) infeasible using this method of construction.

TUNNEL CONSTRUCTION USING MICROPILES

Micropiles consist of a steel reinforcing bar centered in a drilled and grouted hole cased with a steel pipe. After the installation of the pipe screen and during the staged tunnel excavation and construction sequencing, specialized drilling equipment will be installed in the excavated zone to drill 8 inch diameter holes spaced 2 feet on center in two rows (one along each inside face of the pipe arch). The drilled holes are cased with steel pipe as the holes are advanced and extend several feet into the dense cobble layer and reach a total length of 55 feet below the finished tunnel floor. The drilling equipment is configured for the low overhead geometry inside the tunnel and the casing is installed in sections as the drilling continues downward with new pipe sections added to previously installed pipe sections via threaded connections. After each cased hole is completed, a steel reinforcing bar with threaded couplers and centralizers are installed in each hole. Grout is then poured into the annular space between the reinforcing bar and casing and allowed to cure, completing each micropile. Reinforcing and concrete is then placed to construct the floor of the tunnel with the micropile steel reinforcing extending into the floor concrete to create the structural connection. Finally, reinforced shotcrete is placed around the inside perimeter of the pipe screen to complete the work for that stage.

The preliminary estimated cost of constructing the bicycle and pedestrian tunnel utilizing this method is $2.2 million.

TUNNEL SIZE LIMITATIONS WHEN USING MICROPILES

Three micropile configurations with different load capacities and anticipated settlements were provided by the geotechnical engineer for further structural engineering alternative studies. Additionally, the geotechnical engineer noted that pile capacity must be reduced at least 25% or more when the spacing of piles is below 3 times the pile diameter to account for group action effects. Group action is a condition where the piles and soil around them act as single, but weaker, foundation system than the sum of a similar foundation with the same number of piles installed at a greater spacing, and in this case, the minimum spacing without the reduction is 24 inches (3 times the pile diameter of 8 inches). Based on our preliminary load analysis the 12.5 foot high by 25 foot wide bicycle and pedestrian tunnel requires a pile spacing of 24 inches using 102 kip capacity piles (the highest capacity piles that meet Union Pacific's track settlement criteria) and is therefore the upper bound to tunnel size using micropiles. A tunnel greater than 25 feet in width (a single lane vehicular tunnel needs 38.5 feet in width) cannot be constructed using micropiles because the required pile spacing would be less than 24 inches, requiring a capacity reduction due to group action. This condition would result in the need for higher capacity piles (above 102 kips). However, higher capacity piles exceed Union Pacific's maximum track settlement criteria.

CONCLUSION

As noted above, we have identified a potentially feasible foundation type using micropiles that may meet the structural, safety, and operational requirements set forth by Union Pacific for the bicycle and pedestrian tunnel. This approach must still go through a complete design process and is subject to approval through Union Pacific's formal review and approval requirements. It is the only viable alternative identified to date, although at the direction of our client, Parsons continues to investigate other possible constructible solutions that meet the railroad's requirements.

However, the analysis performed to date demonstrates that a larger opening such as that required for the single lane vehicular tunnel is not feasible using micropiles. Therefore, currently, the only identified method of construction for a vehicular underpass is the conventional cut and cover method requiring the construction of a shoofly as identified in the study referenced on the cover page. As noted in the referenced study, the preliminary cost estimate for a full vehicular underpass constructed in this manner is $28.4 million. Constructing a vehicular underpass using conventional cut and cover techniques in combination with the potential future Capital Corridor project is estimated to cost roughly $11.0 million assuming that the bulk of the shoofly costs are borne by the Capital Corridor project.