Memo on Completion of Task 1 – Pooled-Fund Skewed Abutment Testing with Rotation and Translation

Date: July 15, 2025
To: David Stevens, Project Manager, Research Group, Utah Dept. of Transportation
From: Kyle Rollins, PI, Civil and Construction Engineering Dept. Brigham Young Univ.

We have completed the work associated with Task 1- Analysis of Existing Foundation and are hereby requesting payment for this work.

Our review of the previous testing at the Salt Lake City International Airport test site indicates that the maximum difference in displacement that we can impose from one side to the other will likely be about 1.5 inches over the 11 ft width of the simulated abutment. This difference in displacement would produce a rotation of about 0.65 degrees. Prof. Ian Buckle (Univ. of Nevada-Reno) indicated to us that typical superstructure rotation for skewed bridges "falls in the range of 2 to 8 x 10^{-3} radians, i.e. up 0.45 deg. Therefore, this displacement should produce a suitable rotation. A difference of 1.5 inches relative to our simulated abutment height of 66 inches would be equal to 2.3% of the wall height, H. Typically, full passive force is developed with a displacement of 2.5 to 3.5% of H at our site. Therefore, we would expect to see significant differences in passive pressure on opposite sides of the simulated abutment, as desired.

If we try to impose a difference in deflection of more than this amount, it would likely be necessary to use one actuator to apply a compressive force while the other actuator pulled back in tension on the other side of the abutment. This could unnecessarily complicate our assessment of the behavior of the wall because an earthquake load would not likely lead to this type of loading.

After reviewing these findings and consulting with Dr. Anoosh Shamsabadi at Caltrans' Office of Seismic Design, we concluded that the simplest and most straightforward approach to the problem would be to load the abutment using only our 600 kip actuator on the opposite side from the acute angle of the simulated abutment. This procedure would lead to the lowest amount of longitudinal displacement on the acute side (without pulling backward) and the maximum amount of displacement on the obtuse side. This approach would also cause the abutment to rotate counterclockwise, as it would naturally do in an earthquake, as well as displace less than the abutment on the obtuse side of the cap. We would also anticipate that the pressure developed on the backwall could be measured for this loading and would likely show a more triangular distribution of pressure with the highest wall pressure on the obtuse side of the abutment.

The only disadvantage of this approach is that we might reach the maximum force on the actuator (600 kips) before we have fully developed the passive soil resistance. If this seems likely to occur, we plan to continue the loading process by also applying load with the actuator on the other side, while maintaining a similar rotation angle, by displacing both actuators the same amount.