April 13th, 2022

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Subject: 1040 Somerset Street – Temporary shoring review
O/Ref. A001232 – 1040 Somerset

Mr. Poon

The city of Ottawa has requested you a peer review of the temporary shoring drawings prepared by Remisz for the excavation of the 1040 Somerset Street. One portion of the excavation will take place along the bridge crossing the railways on Somerset Street. The main concerns for this review, is the proximity of the bridge structure to the side of the excavation. To confirm the acceptance of the shoring, we have reviewed the drawings, the OSIM reports and the Geotech reports. The following pages will explain our review.

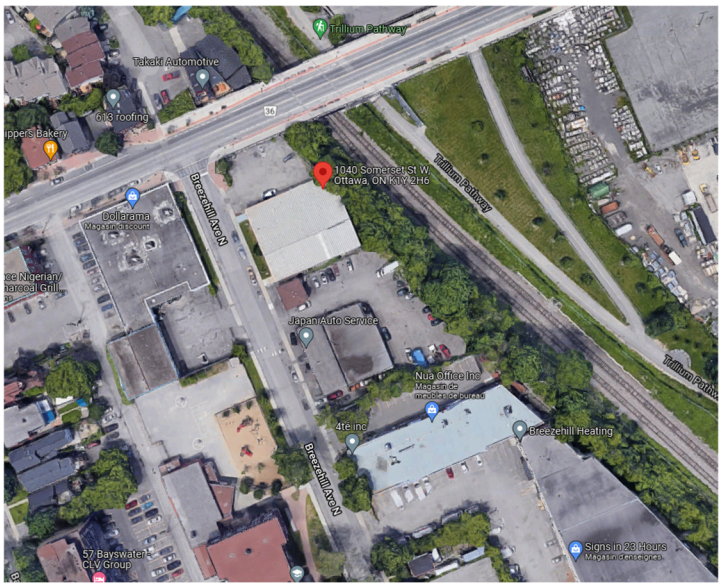

Figure 1 - Overview of the site

Description of the bridge

The bridge structure can be separated in two different parts: the bridge and the retaining walls and sidewalk deck on the top of those walls). The bridge structure take place out of the 1040 Somerset property and the retaining wall section is the one located next to the excavation site. Figures 2 and 3 are showing the two different parts of the bridge structures. The figure 4 and 5 represent what we believe to be the structure of bridge and retaining walls.

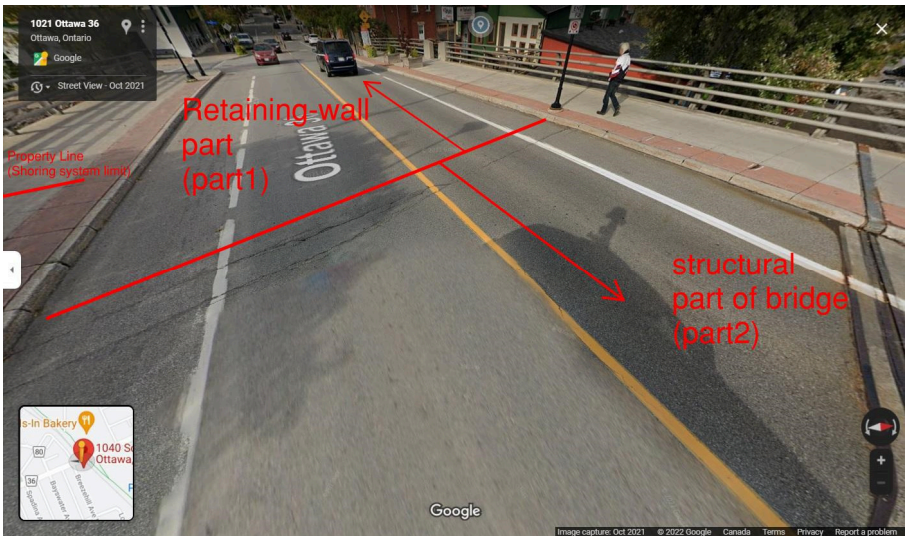

Figure 2 - Bridge configuration

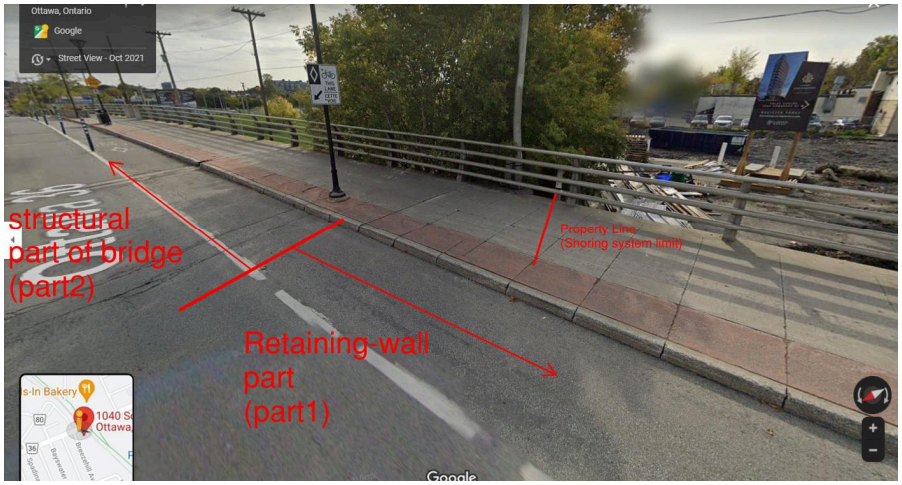

Figure 3- Bridge configuration

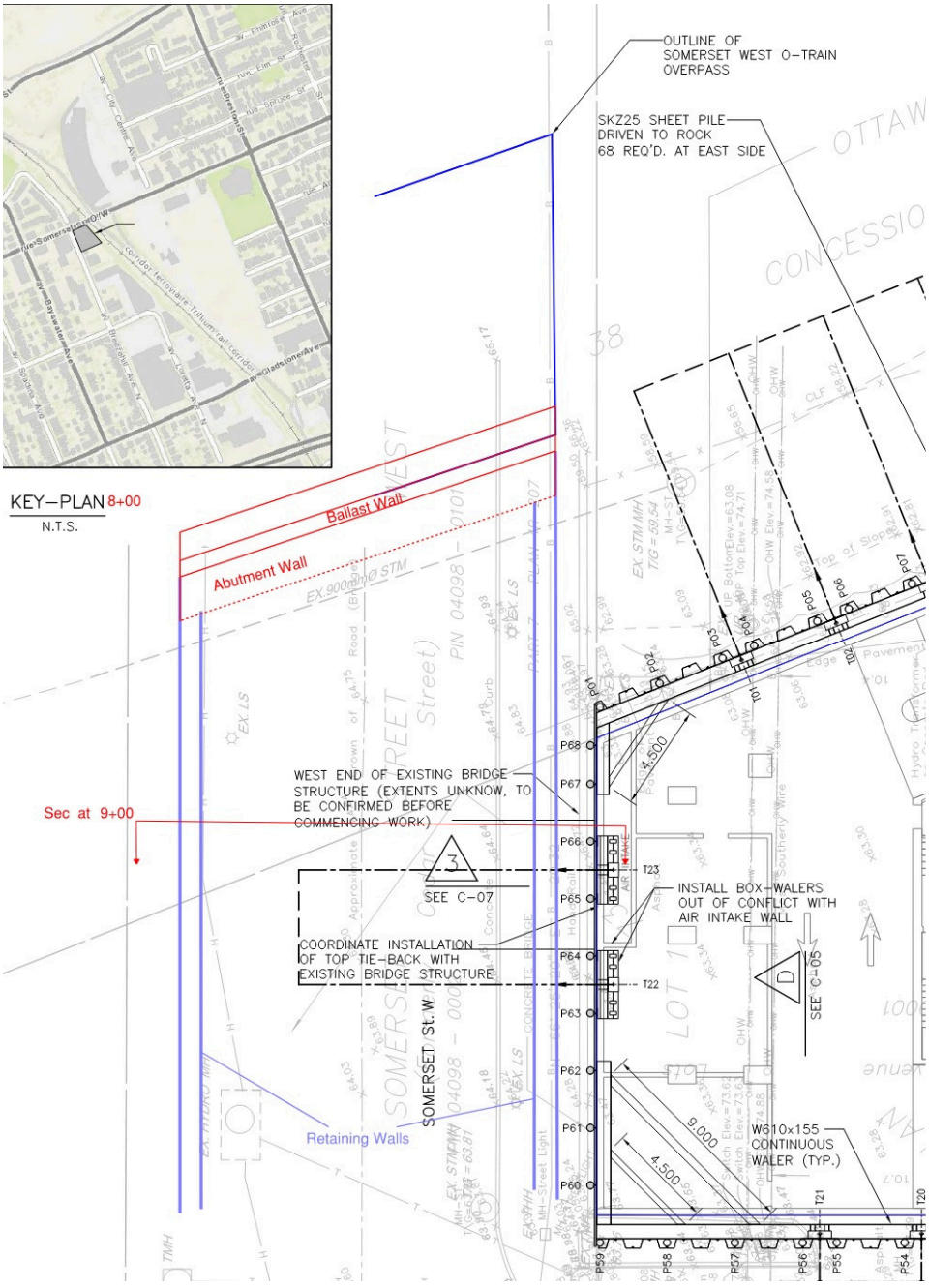

Figure 4 - Shoring and bridge

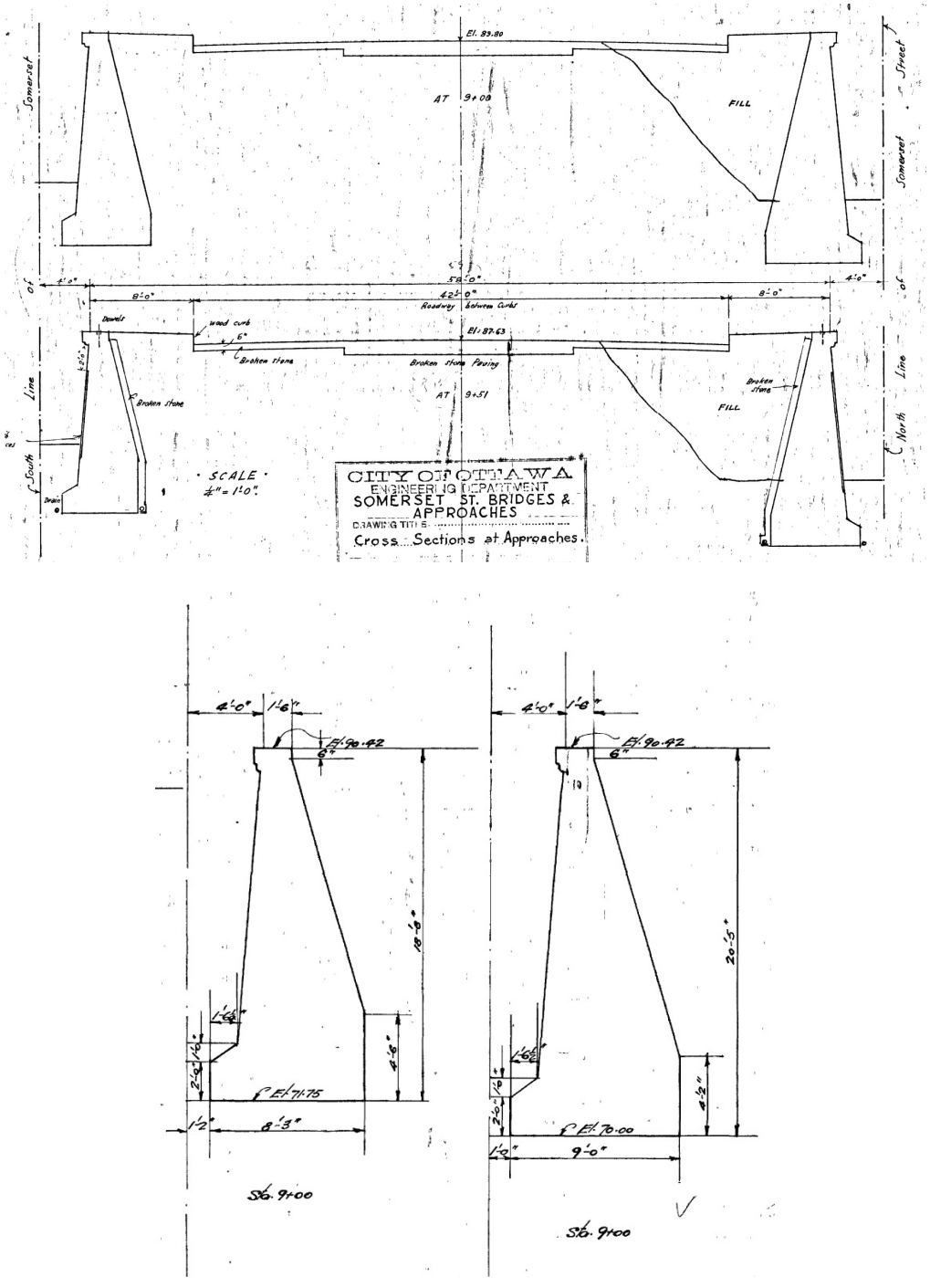

Figure 5 - Retaining walls Section

Monitoring program

We have reviewed the monitoring program proposed by Paterson. The program is proposing sensor for the watermain located on Breezehill avenue and for the retaining wall on somerset street. The two sensors for watermains seems sufficient to notice and settlement occurring. The inclinometers install on the face of the temporary shoring if also a good indication of potential settlement. For the retaining wall only settlement and horizontal deflection will be monitored. Since the sensor will be installed on the top portion of the retaining wall, any movement or inclination of the wall will be noticeable. The settlement/Displacement Criteria & Associated actions is also acceptable. CIMA+ will review the settlement value and comment if needed.

Otherwise, we found the proposed program to be acceptable to ensure the security of the construction workers and the city infrastructures.

Regarding the vibration control the program proposed by Explotech follow the guidelines from the city of Ottawa and is acceptable on the structural side.

General review of the shoring system

We have reviewed the general layout, pile locations, tie back strength, sheet piles and all other elements to ensure that the design is acceptable. As indicate on the drawings, the design has been designed in accordance with OPSS 539 performance level 2. This level of conformance is acceptable for this project. A performance level 1 could have been considered on the west elevation where the watermain is but as discussed with Paterson the settlement due to the dewatering will not be significant. All the coefficient for soil pressure and rock bond resistance are as per Geotechnical report. All the applicable Standards are the ones in effect.

The size and spacing of the piles are adequate to support the sheet piles and tie backs. Regarding the sheet piles, the distance between the walers in the middle portion of the east and west elevation seams high but a validation was made, and the resistance and deflection meets the performance level.

For piles P35 to P39 that are close to the adjacent building of the 55 Breezehill avenue a close monitoring will be required to avoid damage to the building. The vibration monitoring plan will cover a part of the monitoring, but a visual inspection needs to be performed daily.

The tieback resistance seems adequate based on the value provide in the geotechnical study. The spacing and the distance with adjacent structure is adequate. During the installation of the tieback T15 to T21 a close monitoring will be required on the watermain.

Retaining walls

According to available retaining walls usual design methods, calculation of retaining walls are usually done based on the absence of soil in front of them, so the excavation beside retaining walls won't affect them until their foundation level.

Considering retaining walls design based on the weight of soil behind them, the existence or nonexistence of soil in front of them doesn't have an important effect on the failure mechanism of soil (Figure 6). In addition, regarding the plans, we can see that tiebacks used on the retaining walls can prevent all types of settlement (file: 2021-010-3 C-07A REV 5.pdf) (Figure 7). However, it is recommended to use subsidence control sensors on the body of the retaining wall to check all types of settlement at each stage of excavation. If the overturning of the retaining walls is more than 0.002 Radian, it will be recommended to use more tiebacks on the retaining walls. The note on the drawings regarding the possible redesign of tie back depending on the soil condition will be evaluate on site during the excavation process.

Also, as per discussion with Paterson, the effect of the dewatering cause by this excavation will be very minimal due to the nature of the soil. If some settlement occurs the possible damage on the structure will be repairable and cosmetic only.

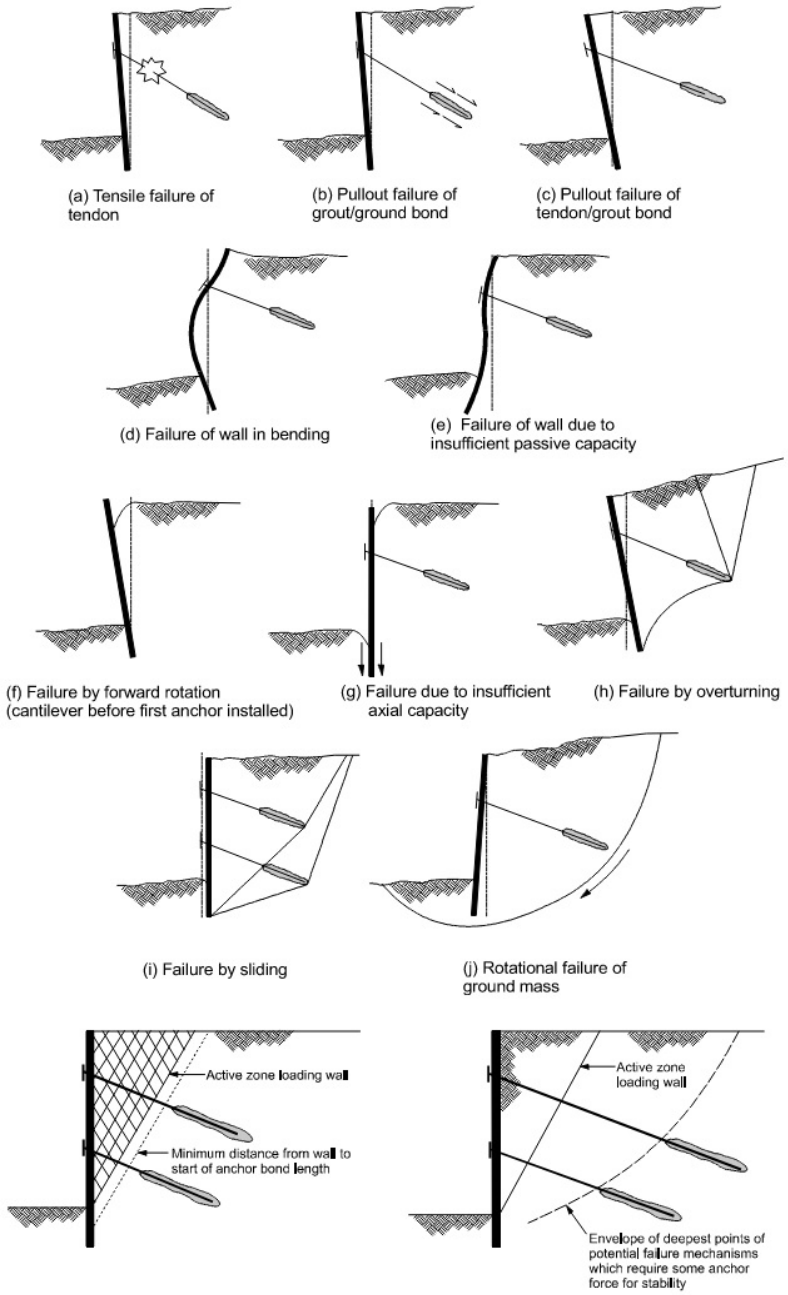

Figure 6 – Potential failure conditions to be considered in the design of anchored walls

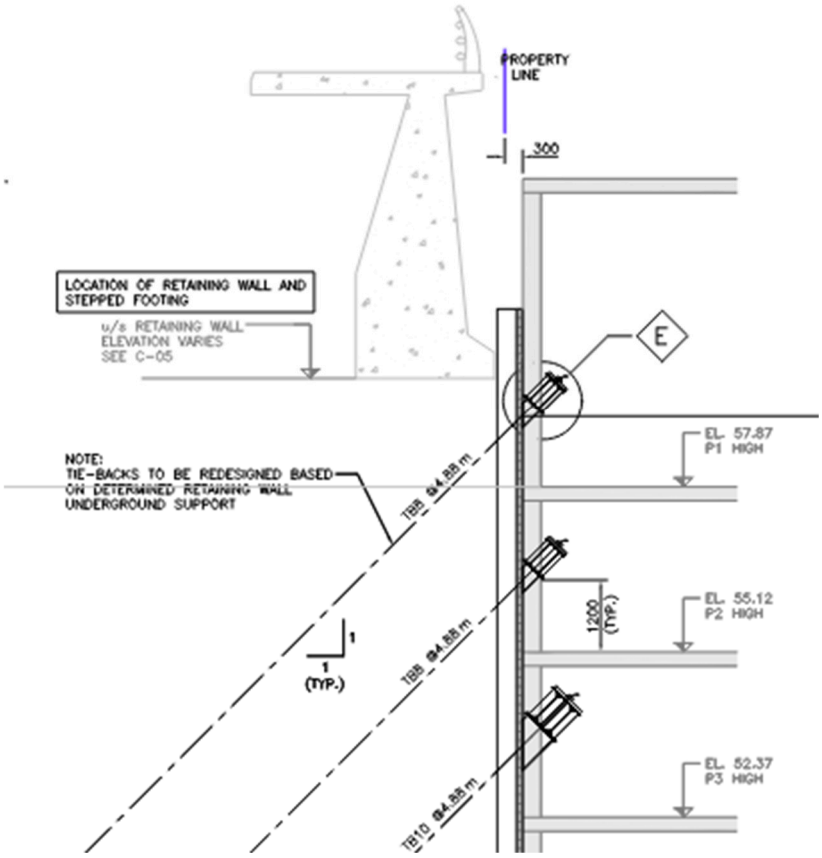

Figure 7 - Tie back design

Bridge

This part included the abutment walls, abutment foundations (Footing with piles), Beams (Girders), and Deck. What is important to prevent is the settlement of the foundation. (Figure 8)

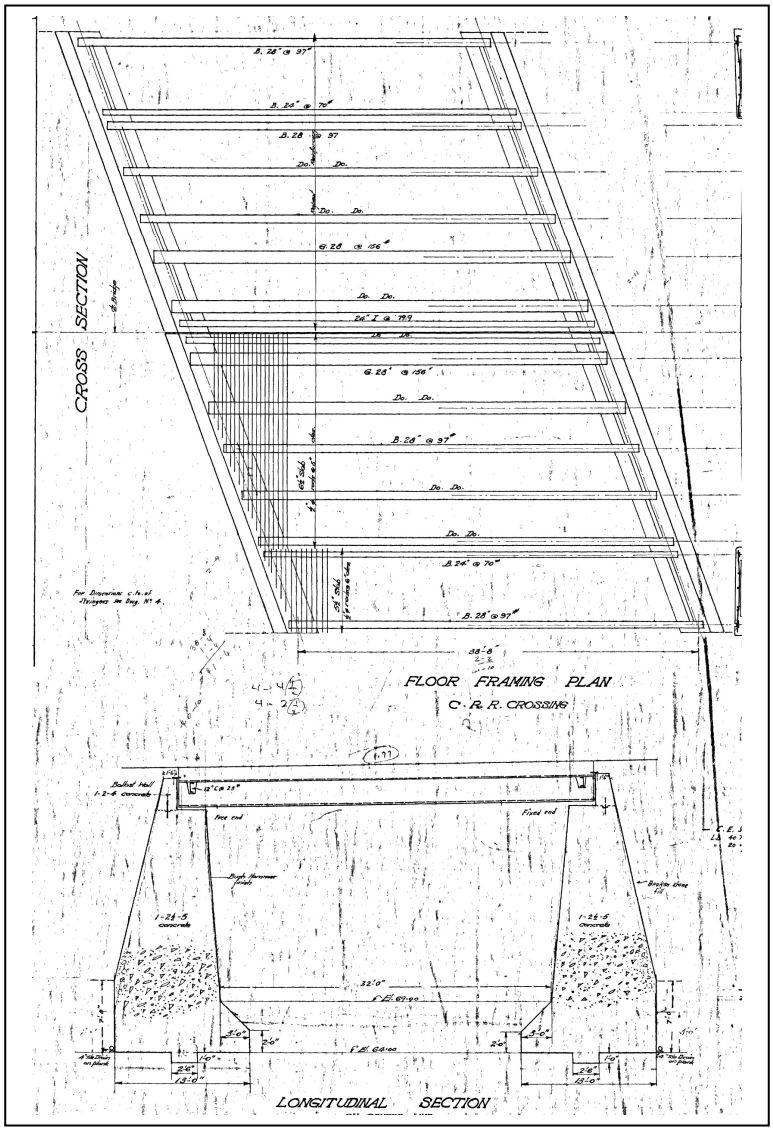

Figure 8 - bridge section

Based on the bridge plans, they considered end bearing piles for the bridge foundation (Figure 9 and 10). As we can see, the distance between each pile is about 3 feet, and they continued below level 50.00. We know that compression stress is controlled by piles, but we want to consider the worst-case scenarios in order to increase our confidence in the design of the shoring. So, we will ignore the effect of piles because without them, stress contour covers a larger area, and this area will be closer to the excavation. If we don't have more that 10% stress closed to our excavation without considering piles and considering the bridge foundation as a simple footing, we will have less stress near the excavation when we consider the piles.

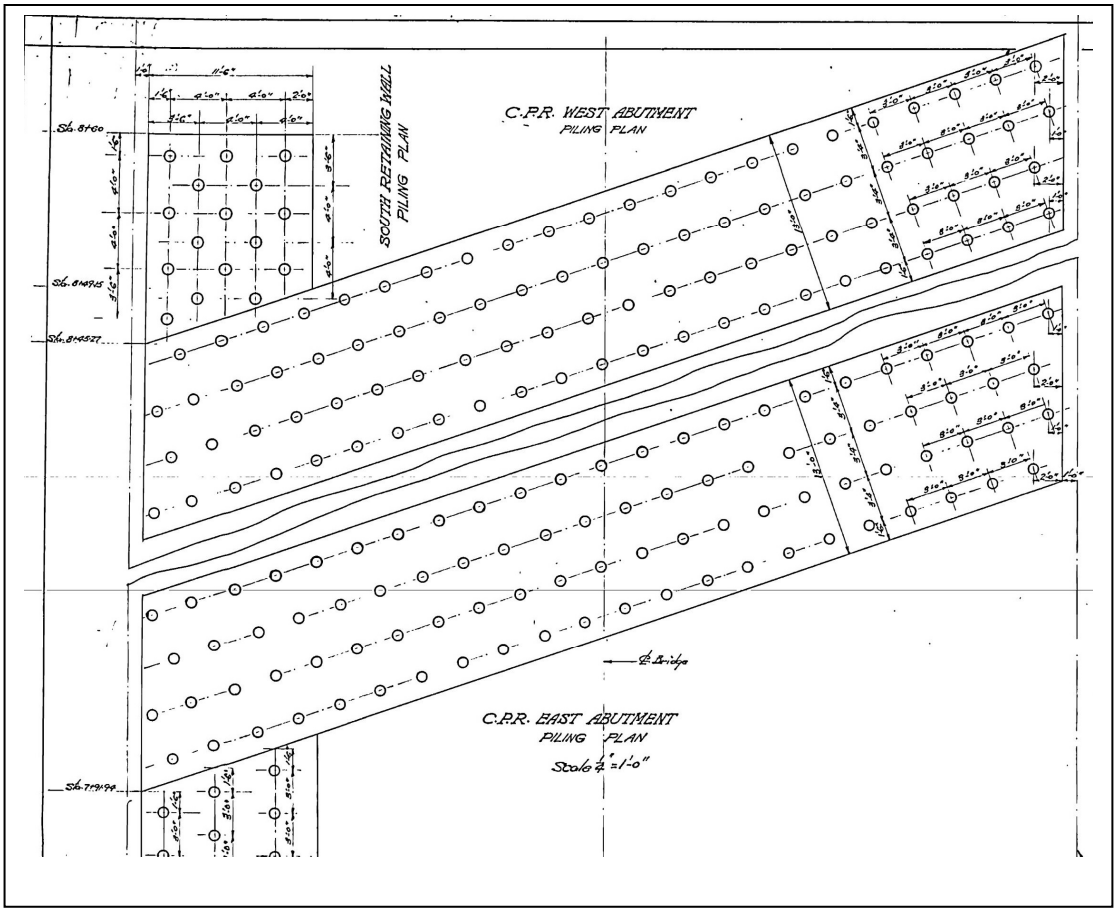

Figure 9 - Pile plan of bridge near the 1040 Somerset

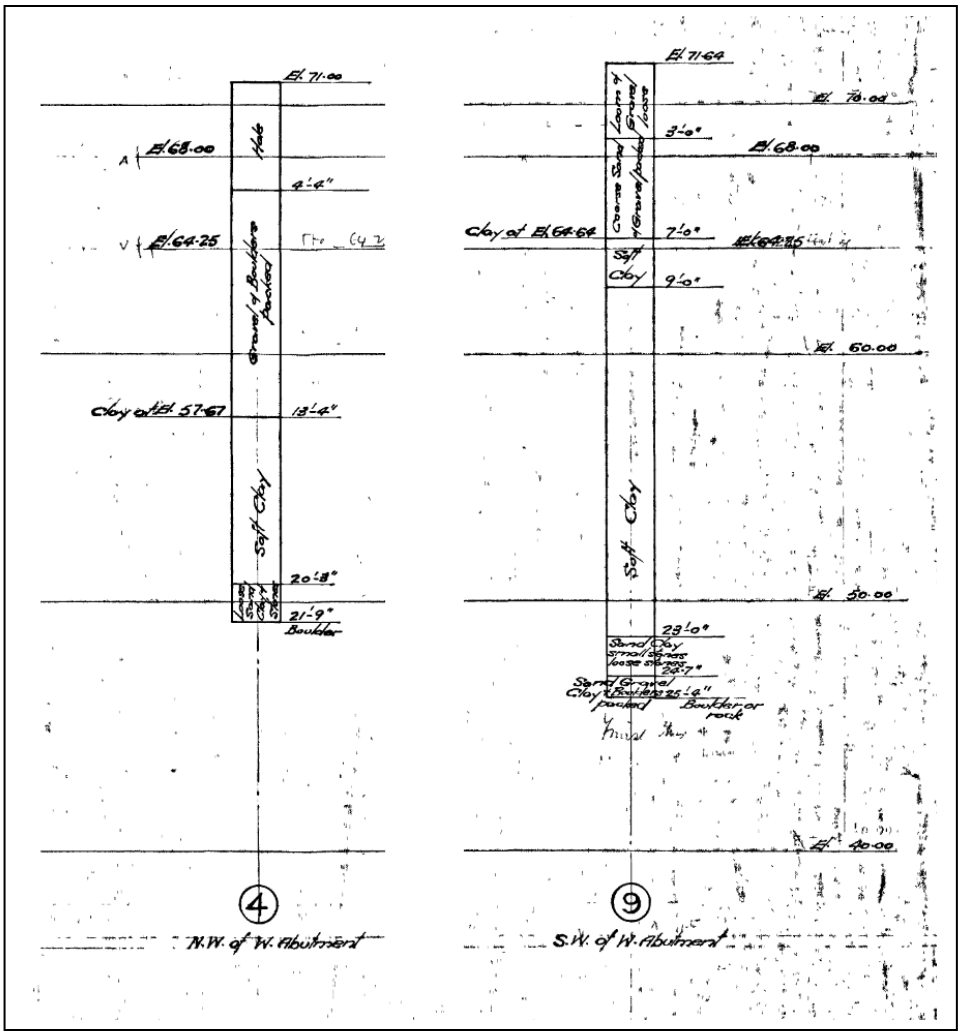

Figure 10 - Pile Sections

So with available information and assumption of bridge foundation as a footing, we can see stress contour based on Boussinesq research. (Figure 11)

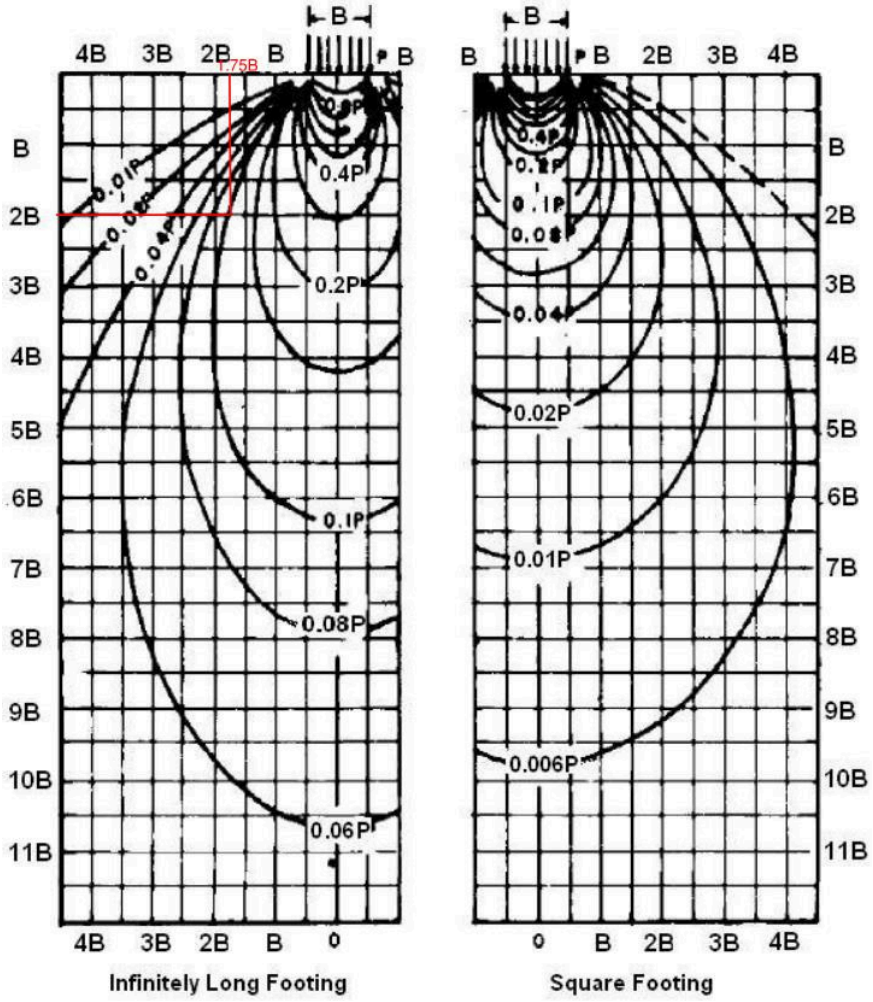

Figure 11 - Boussinesq Stress Contours Under Strip and Square Footing NAVFAC Design Manual

According to Boussinesq Stress Contours under strip footing (NAVFAC Design Manual) (Figure 11), we can ignore the settlement of footing in the soil around footing if it is less than 10 percent of stress under the footing. As it is shown in Figure 12, we can see the 10% Stress Contour in the 1.75B(B=13 ft = 3.96m) from the footing center in the depth of 2B(B=13 ft = 3.96m) that happens in the corner of Somerset excavation. So, we can ignore the effect of bridge compression stress in the excavation. However as is shown in Figure 12, we must not ignore the effect of shear stress that can happen based on the Soil Friction Angles in the different layers mentioned in the Geotechnical Report. This issue has been seen in the tieback design and

it seems the place of tieback is preventing this type of failure. Even with this conservative approach, there is no risk for the structure of the bridge.

On the latest revision of the shoring, we have notice that dimensions have been added to show the location of the closest tie back in regard to the bridge foundation. The distance of 3.6 m is largely enough to prevent any damage to the bridge structure. The use of the corner braces are a good approach to prevent the use of tie back closer to the bridge structure.

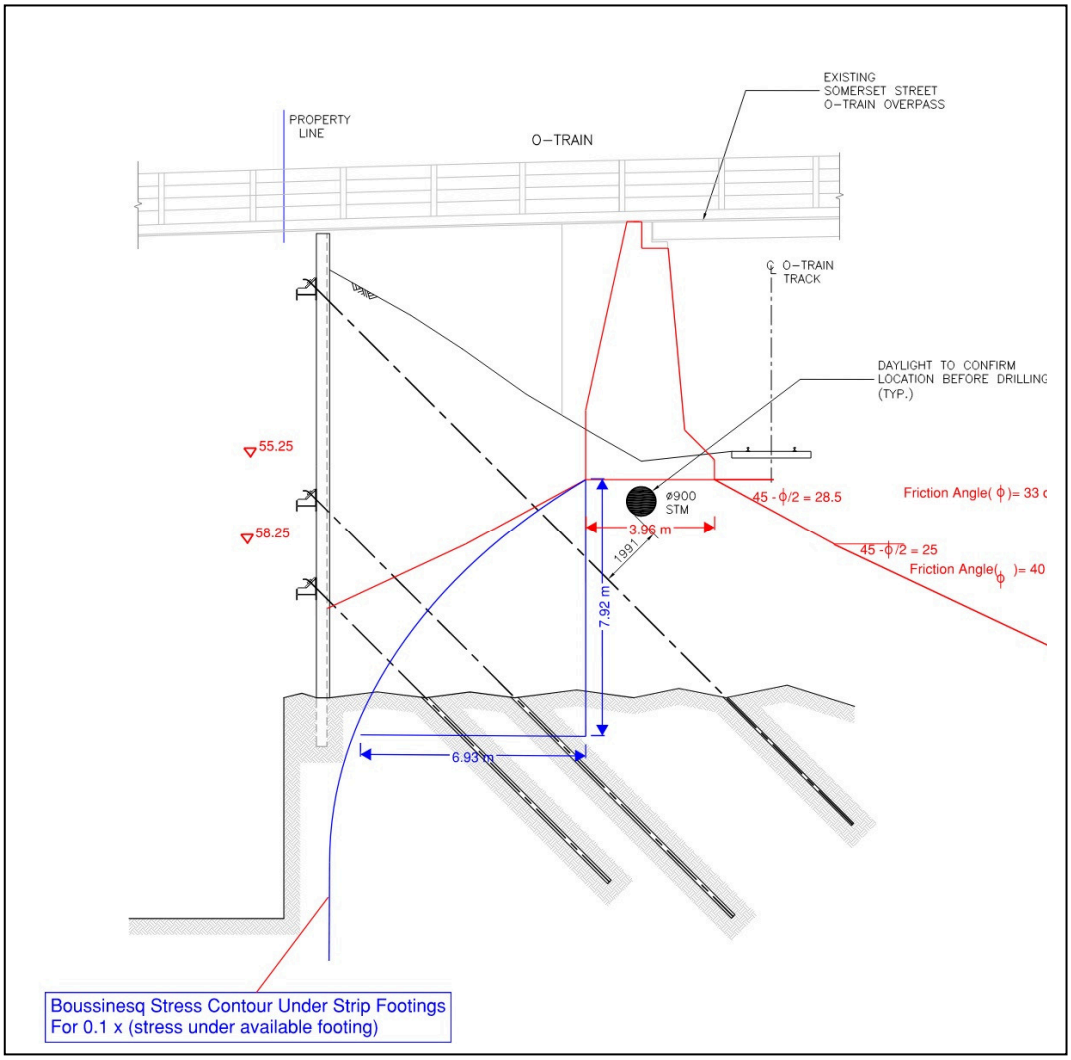

Figure 12 - Boussinesq Stress Contour and the Soil Friction Angles

Conclusion

In conclusion, according to our review of the temporary shoring including tiebacks and logical assumptions, the effect of excavation near the bridge is negligeable. However, for safety reasons, it is recommended to use subsidence control sensors on the bridge body and carefully check the changes in the bridge at each stage of excavation.

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