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Date September 20, 2016

Mr. Paul Coutts, PE
Highway Engineer
Carroll County Highway Department
616 East Elizabeth Street
Flora, IN 46929

Re: Retaining Wall Computations for Tippecanoe River Streambank Restoration Project

Dear Mr. Coutts:

Precision Engineering is pleased to submit this summary of engineering calculations performed during the design analysis of the above referenced project. During this design we analyzed the proposed wall and factors of safety relating to bearing capacity, overturning moments and sliding forces. The findings of each analysis is summarized below.

THE PROJECT & NATIVE SOIL ANALYSIS

Precision Engineering completed a civil engineering design and layout for a 34' tall concrete retaining wall utilizing a woven polypropylene fabric. The wall is composed on 8 runs of 4' tall units with a 2' tall unit placed as the top run. The geometric design of the each unit is uniquely crafted to promote stability due to its isosceles trapezoidal shape. Each unit is filled with concrete (assumed to weight 150 pcf). This design allows for a quick construction time frame and is key to addressing the necessary speed of construction due to emergency situations presented by roadway erosion due to unpredictable streams.

Precision personnel performed a simple geotechnical analysis of the native soils found at the project site. The soils were sieved and thus classified as a well-graded sand with 78% passing the #40 sieve. A standard proctor was performed on the soil and a maximum dry density of 124 pcf (pounds per cubic foot) was determined.

BEARING CAPACITY

Using the data collected from the soils analysis we then began calculating the forces in which the wall (and soil) will encounter once completed. Utilizing a Phi angle of 38 degrees (typical for sandy soils), a gamma of 124 pcf, and the Terzaghi Equation we determined the bearing capacity required for the proposed construction is nearly 2,700 psf. Applying further calculations using Terzaghi's Equation we find that the existing native soil will have a bearing capacity of roughly 16,110 psf based on the design parameters shown on the drawings. This creates a bearing capacity factor of safety of 5.97.

OVERTURNING MOMENTS

The overturning moment was calculated using the soil parameters determined during the soil analysis and the characteristics of the proposed retaining wall (including the weight of the wall, setback of the wall, etc.). The earth pressures were calculated and it was determined the Active Earth Pressure was 3,563 lbs/ft while the Passive Earth Pressure was 1,713 lbs/ft. These values creates an overturning moment of 29,930 lbs/ft.

The at-rest moment calculated for the proposed retaining wall is 572,535 lbs/ft; giving a overturning moment factor of safety of 19.13.

SLIDING FORCES

Knowing the active and passive earth pressures as discussed in the above section, the horizontal and vertical pressures were calculated. The horizontal force equals 2,809 lbs/ft and the vertical equals 2,194 lbs/ft. The wall's self-weight equals roughly 19,200 lbs/ft while the earth forces at-rest equals 18,427 lbs/ft. This correlates to a sliding factor of safety of 6.56.

SUMMARY

In summary the proposed retaining wall as shown on the produced drawings is sufficiently designed to withstand the forces encountered at this site. The factors of safety are well advanced beyond the requirements. We have attached our calculation spreadsheet along with this submittal. Please feel free to contact us with any questions or concerns you may have. We appreciate the opportunity to serve you and look forward to performing the project for your benefit.

Sincerely,

PRECISION ENGINEERING, LLC

Stephen R. Harris, PE, PLS
Principal Engineer

