TECHNICAL NOTE

The Accuracy of Spile to Model Pile Group Foundations in SASSI
May 19, 2014
MTR & Associates

Pile foundations are often required to support large and heavy structures by transferring the weight of the structure to more competent materials at depth and to minimize foundation settlements.

Dynamic response analysis of pile-supported structures in SASSI is relatively complex and requires proper modeling and knowledge of pile-soil-structure interaction. The previous technical note presented the results of a benchmark study to examine the accuracy of beam elements to model pile foundations in SASSI. The study revealed severe deficiencies in the beam elements for such applications. For example, it was found that the single pile solution obtained using beam elements in SASSI deviates significantly from Spile as well as other available solutions that use more rigorous modeling procedures.

This technical note examines the accuracy of Spile for modeling pile group foundations in SASSI. Spile uses the point load solution of an axi-symmetric pile model to obtain accurate solutions for the dynamic response of a single pile in a horizontally layered soil system. In order to extend the Spile procedure to pile group foundations modeled in SASSI, the pile-soil-pile interaction effects are essentially ignored. This approximation is found to be insignificant for small pile groups such as 2x2 or 3x3, particularly in the lower frequency range. However, when applied to larger pile groups, severe deficiencies in the Spile results are revealed.

Figures 1 and 2 show comparisons of axial dynamic stiffness and damping of a 6x6, fixed-head, floating pile group in a layered soil system calculated using Spile and a new pile element that has been developed and currently being tested in MTR/SASSI. The new pile element results are preliminary at this time. However, they are used as a target solution since they provide comparable results to other available solutions that use more rigorous analytical methods to derive pile group foundation responses. As can be seen in the below figures, the Spile results depart significantly from the target solution. In particular, the Spile results are shown to exhibit a significant amount of negative damping generated in the response under axial loading (see shaded zones in Figure 2), which is not physical.

As a result of this benchmark study, the use of Spile has been discouraged in MTR/SASSI and its use limited to a single pile solution.

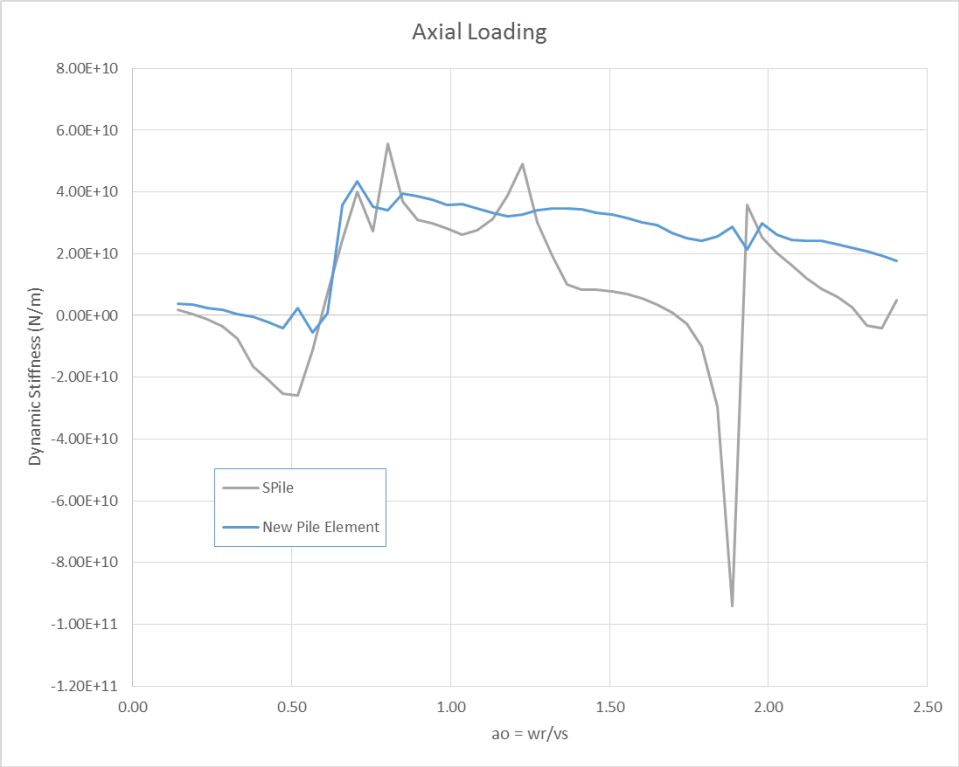

Fig 1 – Dynamic Stiffness of 6x6 Fixed-Head Floating Pile Group in Layered Soil, Axial Loading

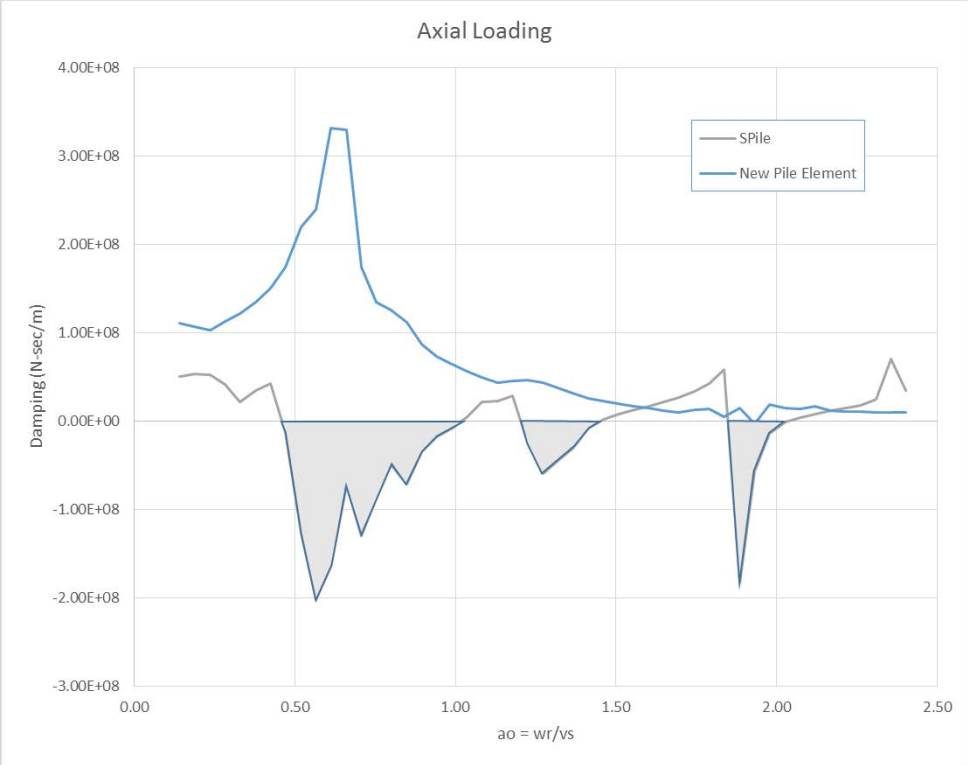

Fig 2 – Damping of 6x6 Fixed-Head Floating Pile Group in Layered Soil, Axial Loading