

# Lateral Spreading Analysis for Single Piles

## PEER Transportation Systems Research Program

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### Objective:

- Create a simplified design procedure for piles subjected to lateral spreading which recognizes the shortcomings of current methodologies and provides more realistic pile bending demands.

### Procedure:

- Develop a 3D finite element (FE) model for lateral spreading case in OpenSees.
- Include nonlinear soil behavior through the use of a Drucker-Prager constitutive model and include three distinct pile designs which are modeled using beam elements and fiber section models. Beam-solid contact elements model the soil-pile interface.
- A parametric study using the 3D model is computationally expensive and inefficient.
- In contrast, a 1D beam-spring model is more efficient in a parametric study, however, it is crucial that the proper  $p$ - $y$  curves are defined for all depths.

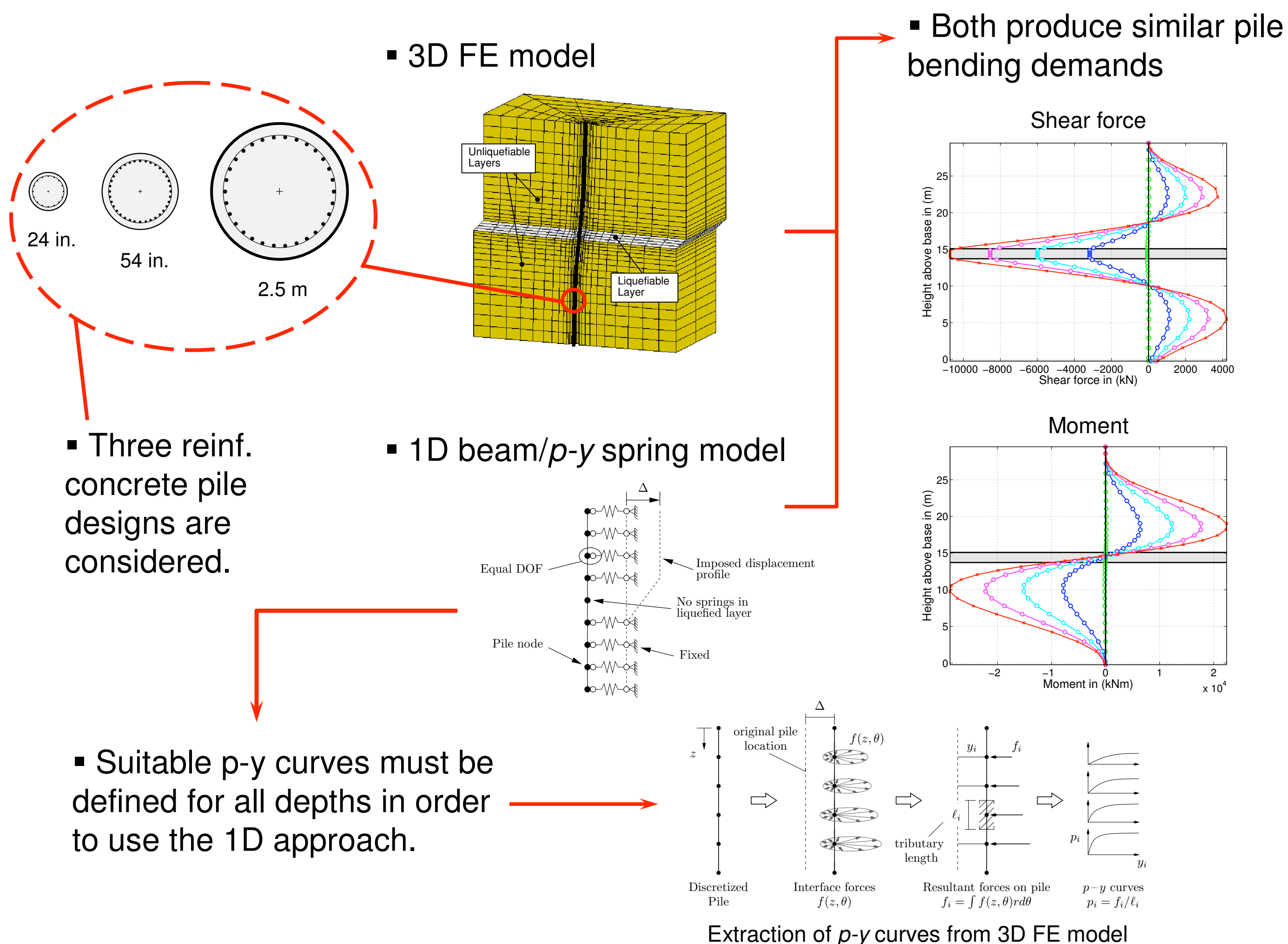
### Progress to date:

- Have a working 3D finite element model of lateral spreading problem and can extract suitable  $p$ - $y$  curves for all depths for a given soil profile from this model.
- Have identified problems with the use of conventional  $p$ - $y$  curves in context of lateral spreading.
- Have verified that 1D simulations produce results which are reasonably similar to 3D modeling effort.

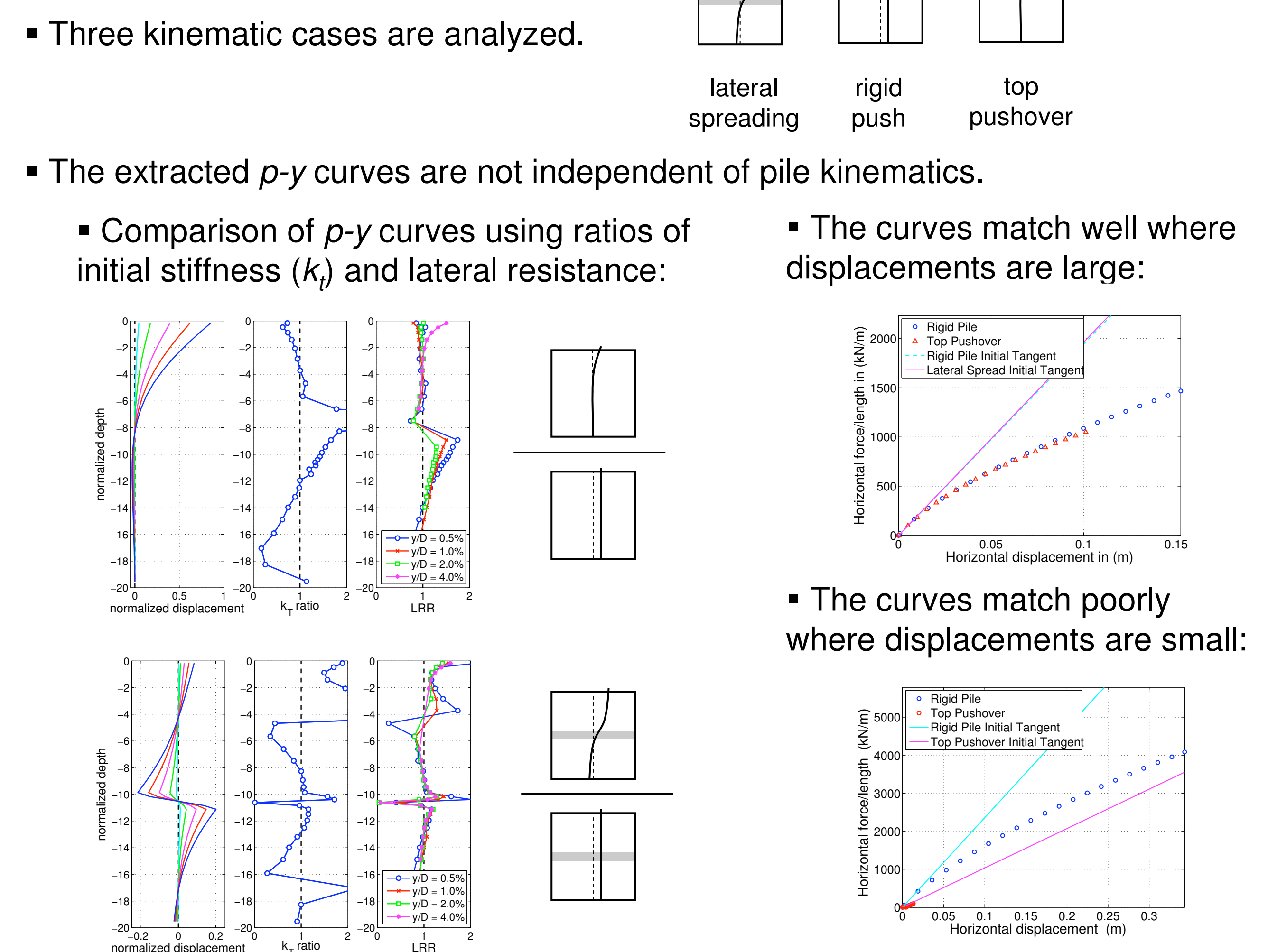
### Future Work:

- Use 3D model to obtain a set of suitable  $p$ - $y$  curves for various soil profiles.
- Perform a parametric study of the lateral spreading case in 1D to determine maximum pile bending demands for a variety of soil/pile combinations.
- Use results of 1D parametric study to establish a simple lateral spreading design procedure which can return realistic pile bending demands applicable to most practical applications.

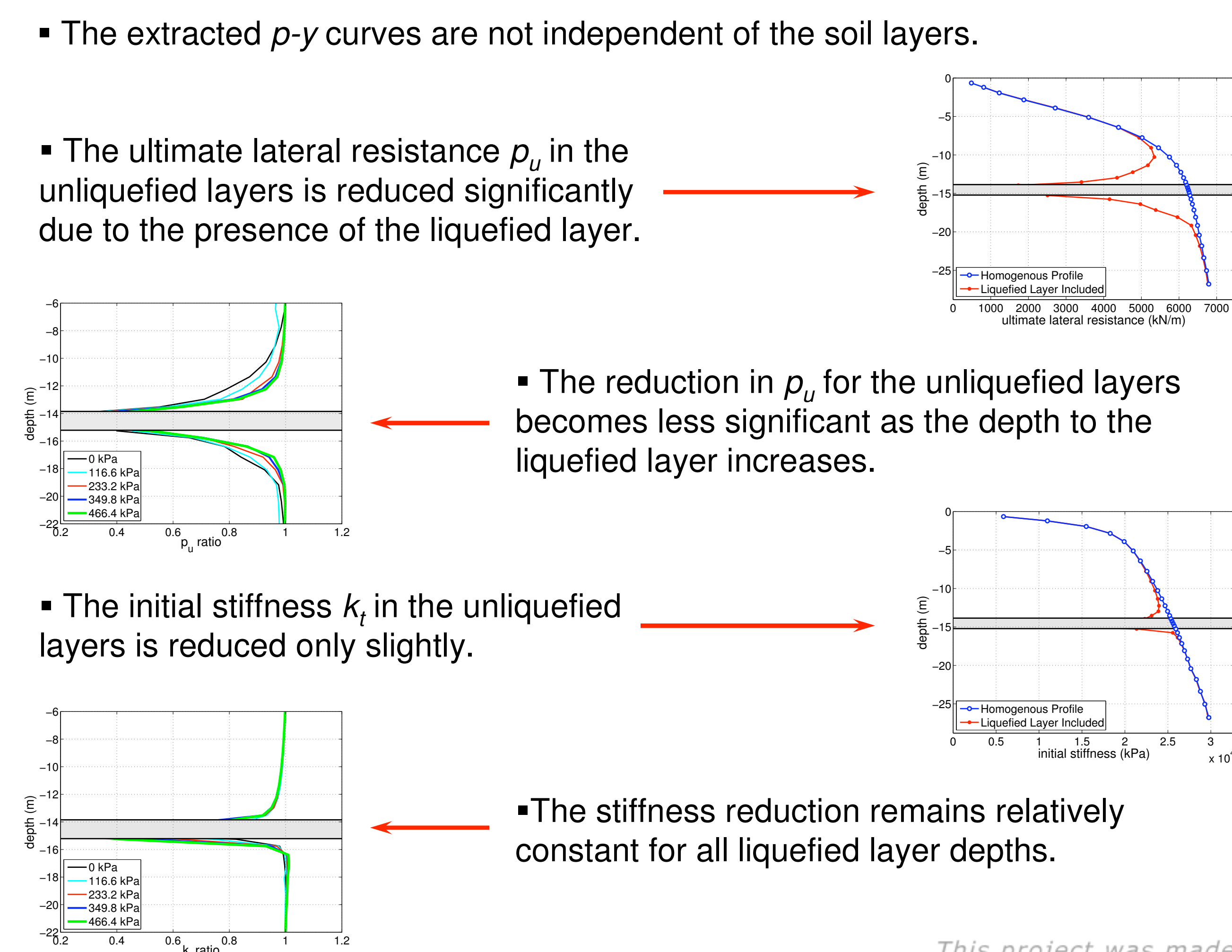
### Modeling Approach:



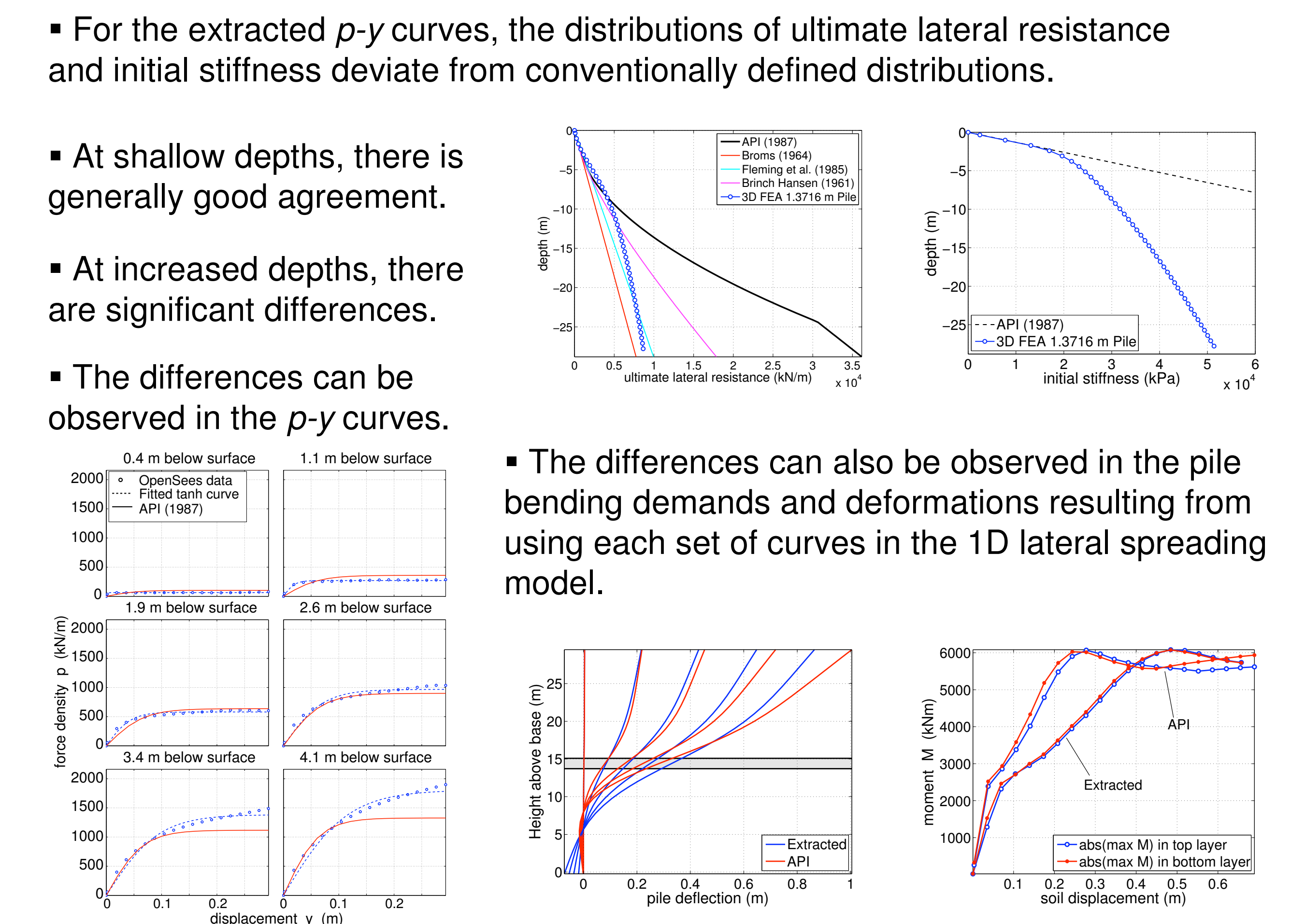
### Kinematic Effects:



### Liquefied Layer Effects:



### Conventional vs. Extracted $p$ - $y$ Curves:



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