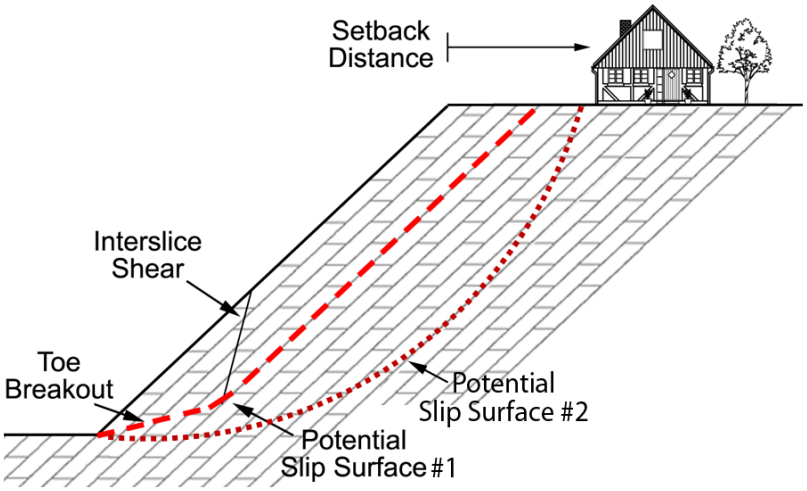
Open-Ended Design Problem #2

Note – For this design problem, please form groups of two (or three with TA permission). Also, please, bring a rough draft of your group report for peer-review to next week's lab (Peer Review Lab). A grading rubric will be provided for this design problem but only after we go over it during next week's peer-review lab session.

High-density residential development within Southern California is becoming increasingly difficult for a number of reasons. The geology of the area is tectonically disturbed (folded and faulted), and seismically is very active. Civic reviewing agencies are becoming more and more stringent in their requirements for building permits behind the crests of steep slopes because of the public's willingness to bring legal action. Yet the publics' demand for high-end residential developments (with a view) motivates developers to maximize the amount of developed land above steep slopes.



A residential development consisting of 375 single-family residential lots has been proposed on a 230-acre site surrounding a golf course. Given the value of the land, you have been asked to provide recommendations for the minimum setback distance behind the slope crests; i.e. how close to the slope crest may development proceed, balancing issues of public safety and maximizing land use. The design factor of safety is 1.5 (1.1 pseudo-static).

The geology consists of shallow-dipping (35°), but non-daylighting beds of weak, weathered sandstones and siltstones (GSI=25-30). Field estimates of intact rock strength show the rock can be easily fractured and indented with a hammer blow. Lateral release joints, also orthogonal to bedding, are spaced along the slope (i.e. in the out-of-plane direction). The slope is coincident with bedding and reaches a maximum height of 60 m. The friction angle of the bedding planes in the siltstones is estimated to be 25° (zero cohesion).

Two potential sliding mechanisms of equal likelihood have been identified, as shown above. The weight of the homes being developed is 40 kN/m^2, evenly distributed across the footprint of the building, which is 20 x 20 m. Although the climate is semi-arid, heavy rainfalls do occur. It is also expected that lawns will be watered frequently.