Wells and caprocks direct shearing

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Task Description/Goals/Outcomes

Understanding coupled hydromechanical behaviors of wells and caprocks during direct fault shearing is crucial for estimating their failures during earthquakes. This study aims to identify key hydromechanical parameters of wells and caprocks through numerical simulations to simplify the fragility estimation process. Results show that the key parameters are fault angle and fault core width for wells and fault zone permeability for caprocks.

Introduction

The objective of this study is to conduct a sensitivity study on wells and caprocks. Details of the numerical models are provided below.

Model

Figure 1 shows the numerical model for wells, created using the FLAC3D software simulating geomechanics. Fault shearing was directly modeled for wells. Figure 2 shows the conceptual model for caprock leakage. A numerical model using iTOUGH2 software was used to simulate the leakage amount caused by fault shearing, which was assumed an instant process.

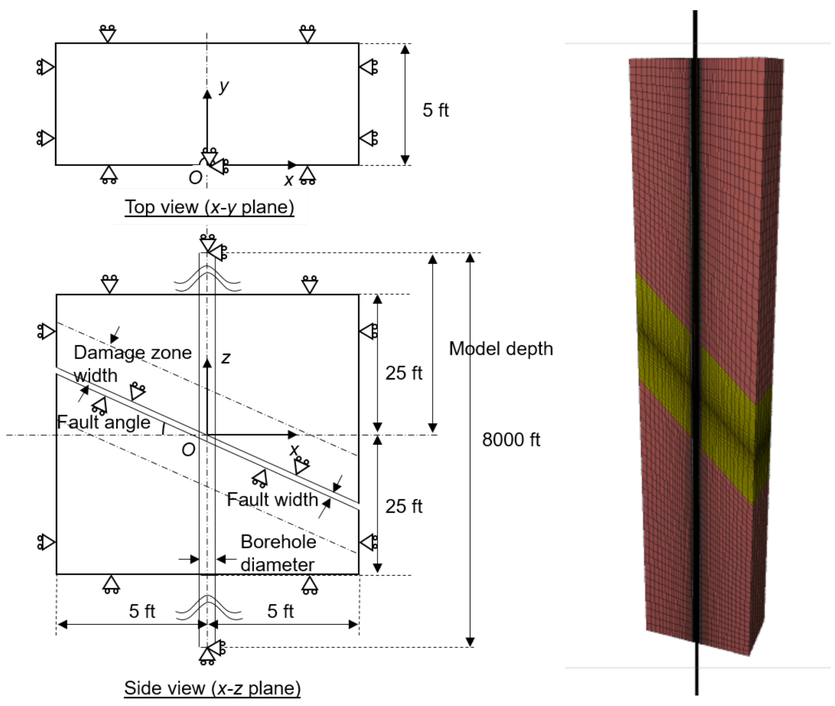


Figure 1. The geometry and an overview of the FLAC3D model for wells.

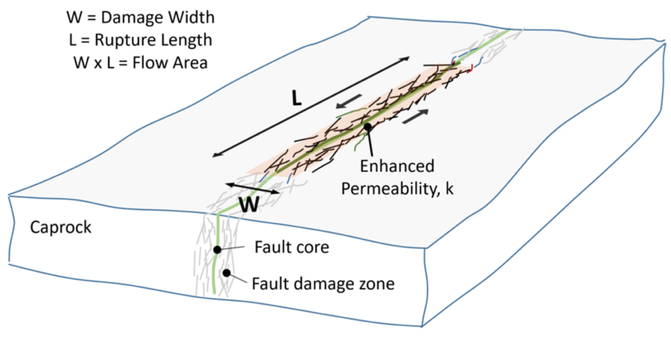
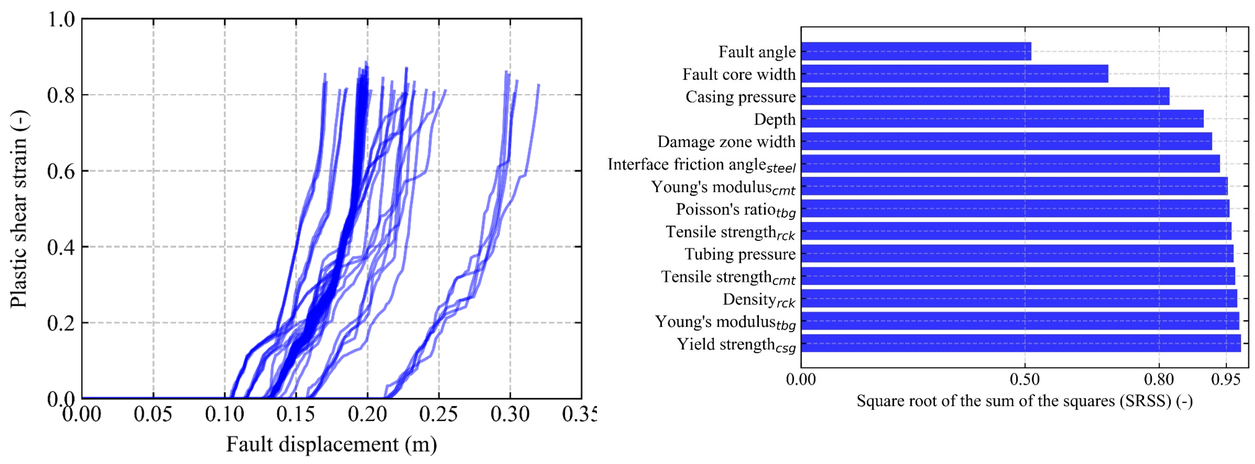


Figure 2. Conceptual Model of Flow Area of an Activated Fault Crossing a Caprock

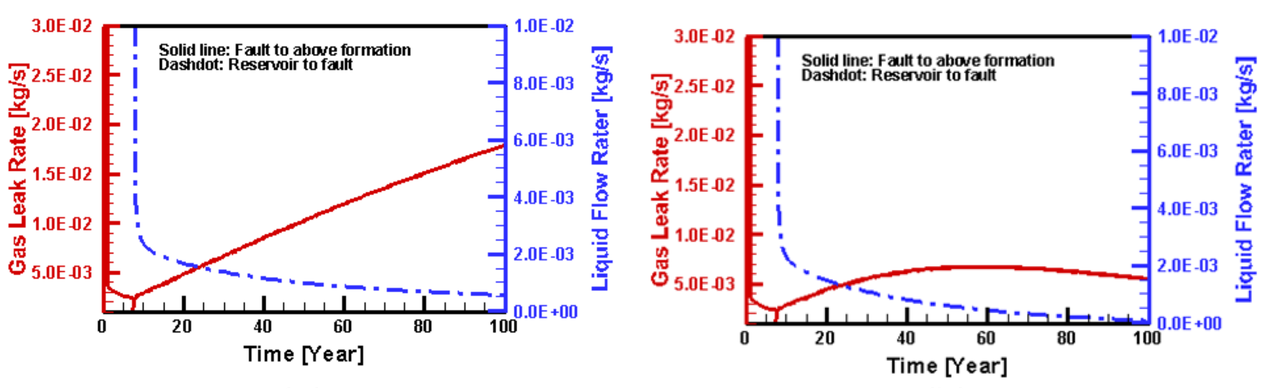
Results

Figure 3a shows plastic strain curves for the well tubing during fault shearing when model parameter values were varied ± standard deviation. Figure 3b shows that the fault angle and fault core width accounted for over 70% of tubing sensitivity. Figure 4 shows gas/liquid flow rate from caprocks. Gas leak rate continues to grow when the above formation has open boundaries, whereas it reaches a maximum rate when the above formation has closed boundaries. Monte Carlo simulations (not shown here) shows fault zone permeability is the most influential parameter on the leakage.



(a) (b)

Figure 3. (a) fault disp. vs. plastic strain in tubing; (b) parameters sensitive to plastic strain in tubing.



(a) (b)

Figure 4. Gas leak rate and liquid flow rate for scenarios (a) the above formation has open boundaries; (b) the above formation has closed boundaries.

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