Protecting Critical Infrastructure: Combined Seismic-Rainfall Landslide Assessment and Advanced Stabilization Technologies for New Jersey Transportation Corridors

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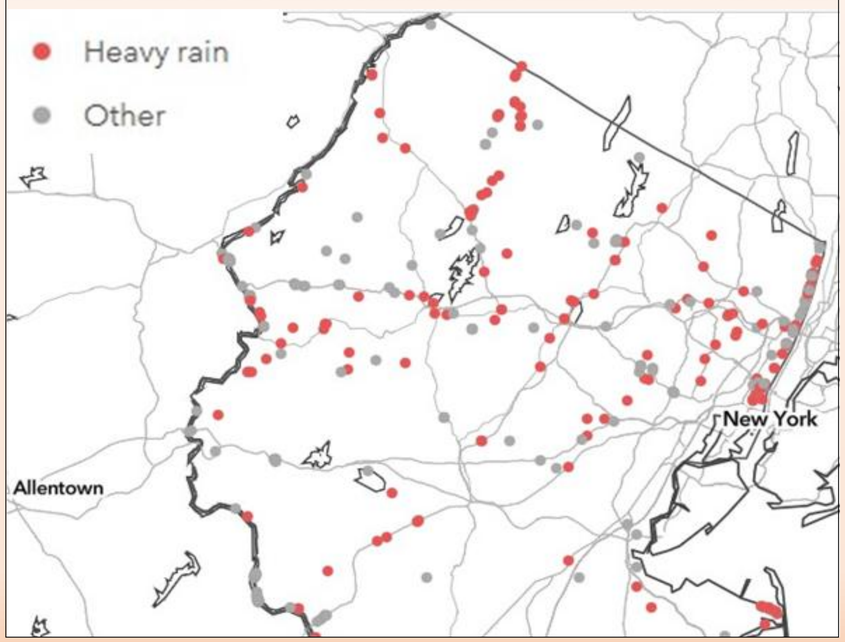
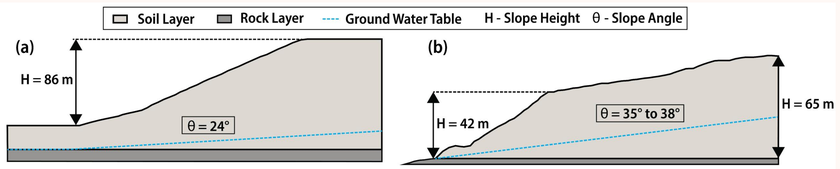
BACKGROUND AND MOTIVATION

- Landslides threaten lives and critical infrastructures.
- Transportation networks face heightened vulnerability to slope failures.
- Climate change intensifies extreme rainfall events in coastal regions like New Jersey.
- New Jersey sits in a moderate seismic zone, often overlooked in slope analysis.
- Combined rainfall-seismic effects on slope stability remain understudied using New Jersey as case study.



Slope Failures in New Jersey due to Rainfall

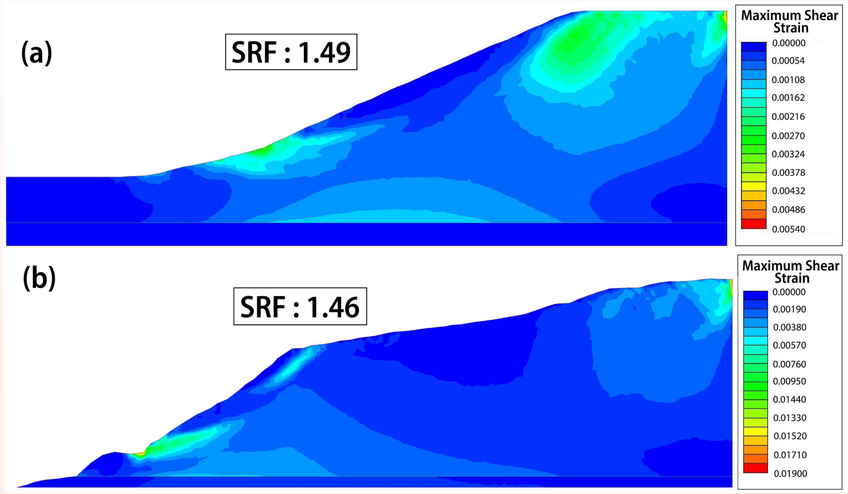
MATERIALS AND METHODS



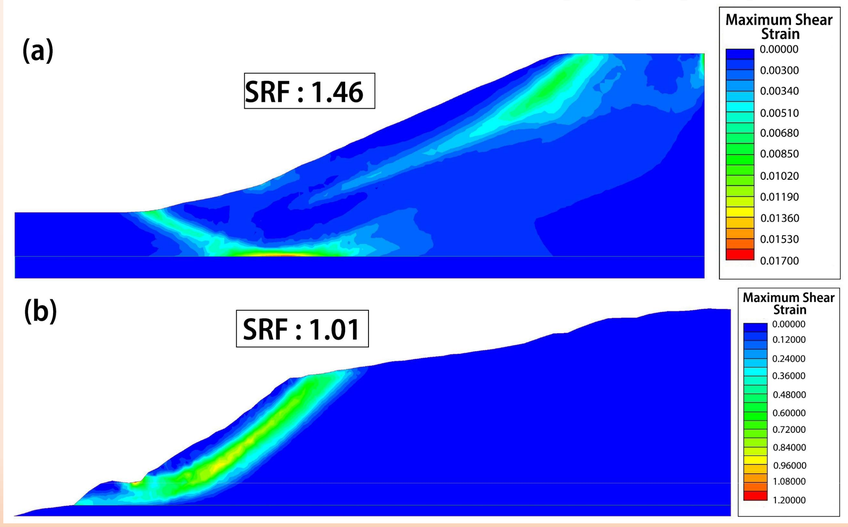
Geometry of studied slope

- Slope stability analysis of two unique slopes in New Jersey area
- Effect of Rainfall and Seismicity on these slopes using Finite Element Modeling (FEM).

RESULTS & DISCUSSION

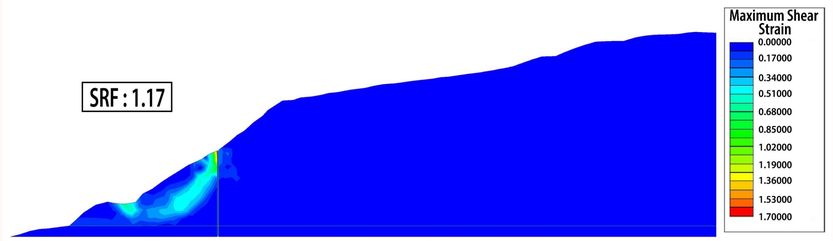


Maximum shear strain developed (Before)



Maximum shear strain developed (After)

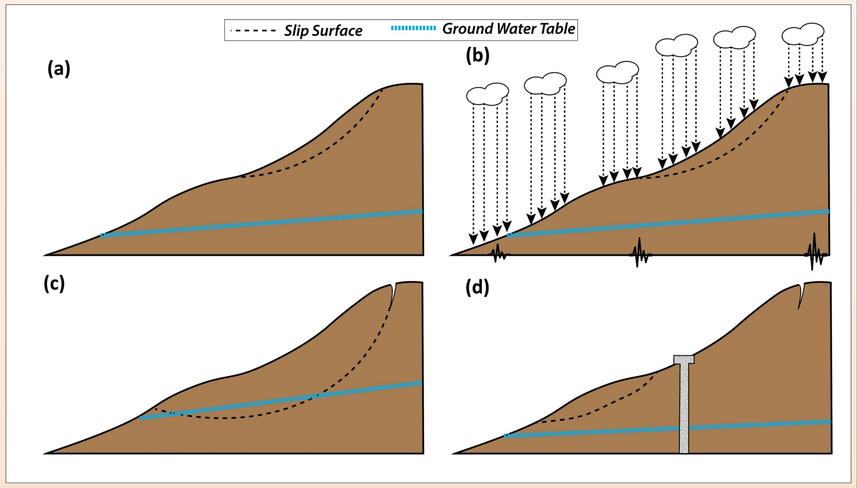
- Higher saturation of soil mass due to water infiltration leading to reduced soil strength
- Combined earthquake and rainfall can accelerate the slope failure process.



Maximum shear strain developed (After installing Pervious Concrete Pile)

CONCLUSION

- Proposed method for slope protection works yielded an improvement in safety factor of up to +16% along critical New Jersey transportation networks.
- For the weaker slope adjacent to major highways and rail lines, change in safety factor can be substantial (up to -31%) under extreme weather conditions, threatening transportation network reliability.
- Combined seismic-rainfall landslide assessment should be adopted to mitigate hazards that can disrupt and destroy the transportation network.



Schematic representation of the proposed slope stabilization method