

Framework for systematically evaluating the resilience and sustainability of highway bridges

Incorporating sudden loss of capacity and slow deterioration simultaneously

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Motivation

Slow deterioration processes such as rebar corrosion degrade the long-term performance of highway bridge components and increase their vulnerability to extreme events such as earthquakes, hurricanes, and vehicular impacts

Objective

Investigate the combined effects of corrosion and seismic hazard on bridge components and develop a framework to simultaneously assess resilience and sustainability of corroded bridge components exposed to seismic hazard

Research significance

Collapse caused by corrosion



Genoa bridge collapse (Italy, 2018)

Collapse caused due to earthquake

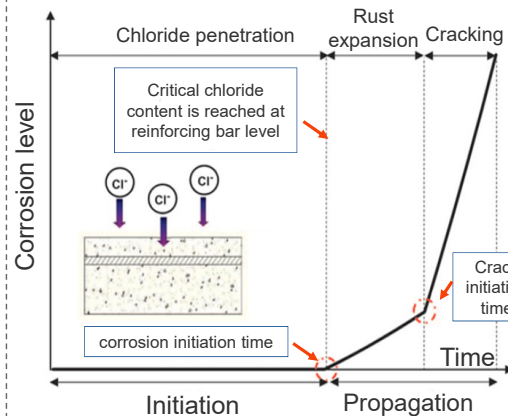


Highway bridge collapse (Sylmar, California, 1994)

<https://goo.gl/BsUfkD>
<https://goo.gl/Hhphbp>

Framework development

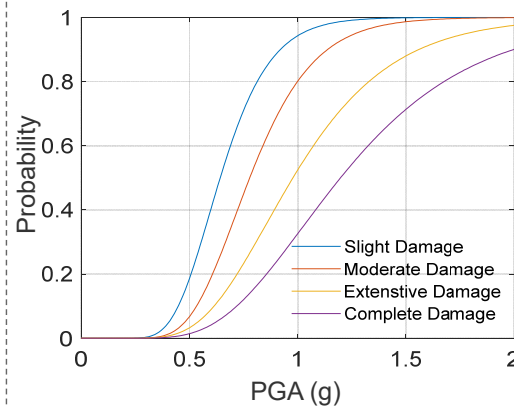
Corrosion progress



- Chloride ion ingress is the major reason for corrosion in highway bridges
- Loss of rebar area happens during the corrosion propagation phase

Seismic fragility curve

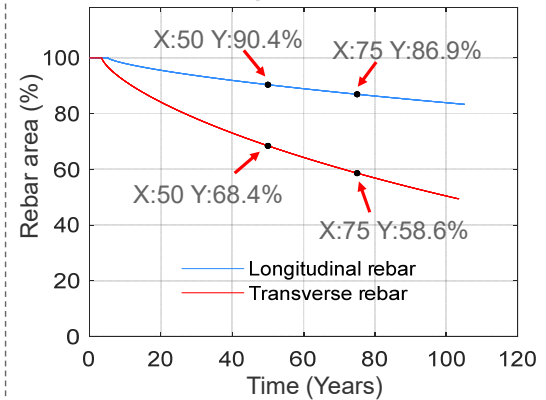
Seismic fragility curve provides the probability of exceeding a given damage state as a function of an engineering demand parameter that represents the ground motion (e.g. Peak Ground Acceleration [PGA]).



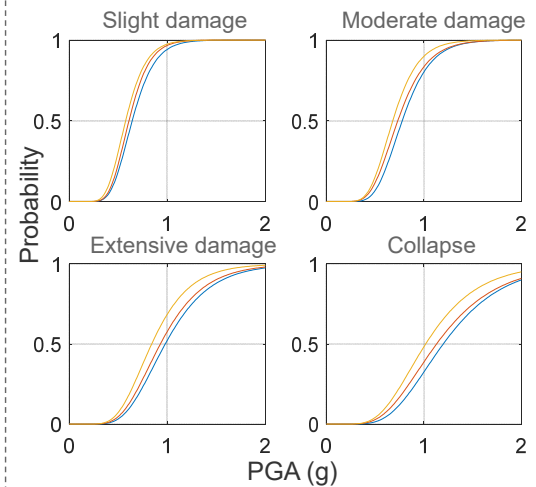
Evaluation framework =
 Corrosion progress +
 Seismic fragility curve

Corrosion of reinforcement

Time-dependent rebar area



Conclusion: Corrosion effect on fragility



— After 75 years — After 50 years — Intact bridge column

- As corrosion of reinforcement increases over time, it makes the bridge column more vulnerable to seismic damage
- The increase in probability of exceedance due to corrosion is larger for higher damage states
- The effect of longitudinal reinforcement corrosion on the fragility of the bridge column is more significant than the effect of transverse reinforcement corrosion

References

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