



CENSEO

CENSEO Bridge Evaluation Framework

Traffic Engineering

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 COLUMBIA | CBIPS
Center for Buildings, Infrastructure and Public Space

CENSEO: BRIDGE EVALUATION FRAMEWORK

PROBLEM

CLIMATE CHANGE:

Climate change intensifies natural disaster magnitudes. This exacerbation strains infrastructure resilience, urging advanced vulnerability and risk assessments to devise fortified engineering solutions.

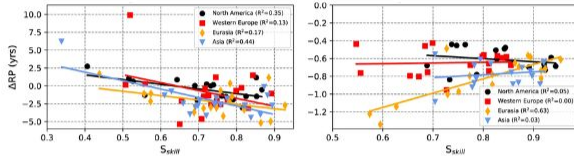


Figure 1: Projected areal mean change in return periods for wet and windy (left) as well as hot and dry (right) disasters.

AGING INFRASTRUCTURE:

Aging infrastructure intensifies natural disaster repercussions due to outdated design standards, deteriorated materials, and lack of modern resilience measures. These factors collectively compromise structural integrity, escalate repair and recovery costs, and pose heightened safety risks.

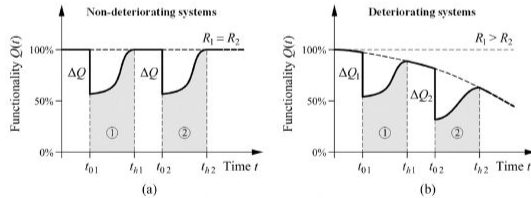


Figure 2: Functionality losses of non-deteriorating (left) and deteriorating systems (right).

CARBON FOOTPRINT:

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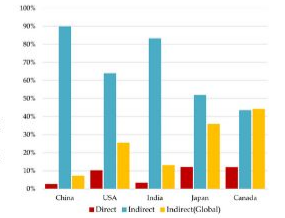


Figure 3: Direct, indirect (regional) and indirect (global) carbon emissions of top construction markets.

ARCHITECTURE

Assesses a structure's cultural significance, aesthetics, and adaptability to future needs.

Key Performance Indicators:

- Significance
- Aesthetic
- Economy
- Adaptability

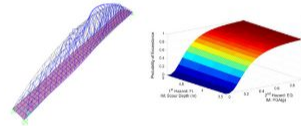


STRUCTURAL

Evaluates safety, durability, and feasibility of interventions under expected loads and hazards.

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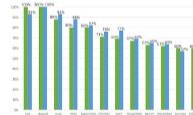


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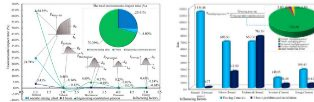


ENVIRONMENTAL

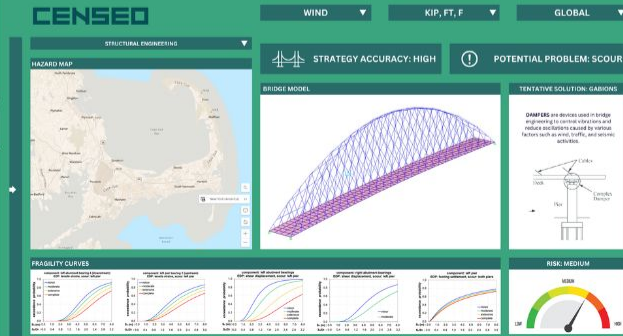
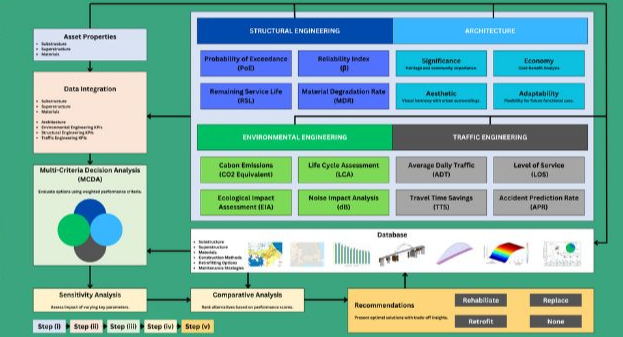
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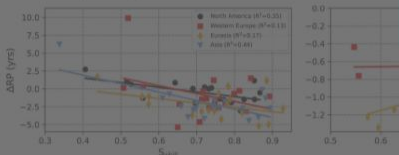


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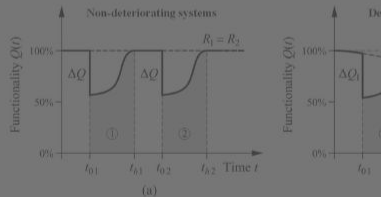


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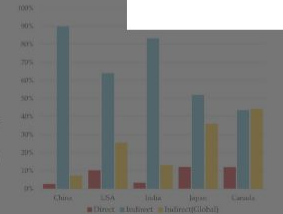


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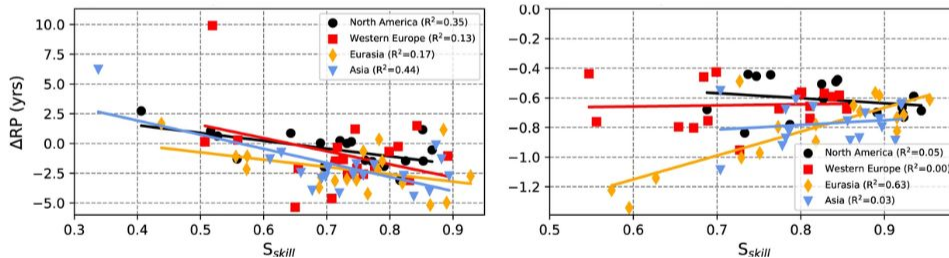


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REAL-TIME DATA INTEGRATION



STRATEGY SUITABILITY



DECISION IMPROVEMENT



PROBLEM IDENTIFICATION

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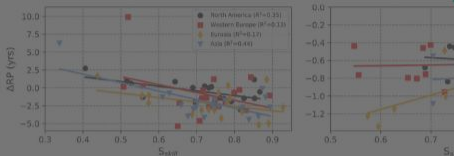


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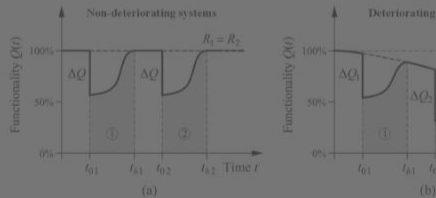


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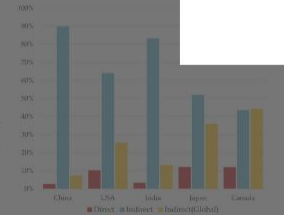


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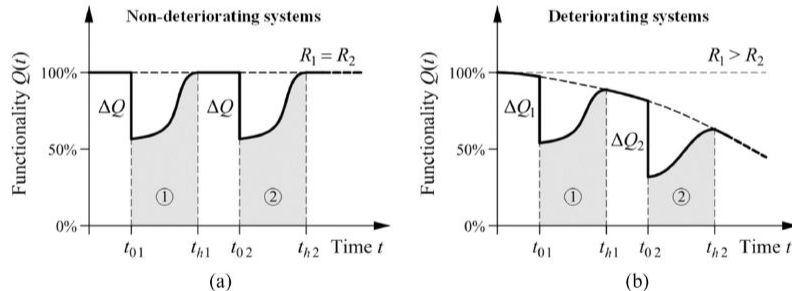


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ALYTHICAL FORECAST

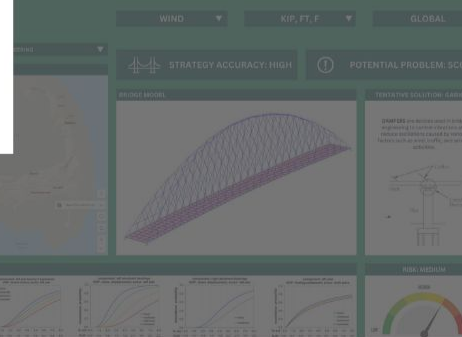
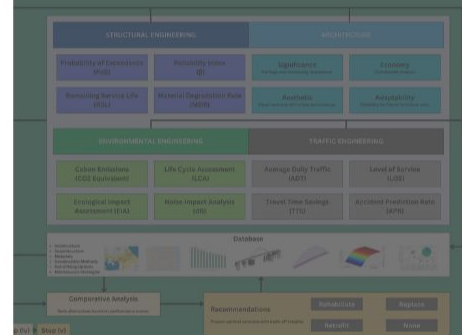


DECISION IMPROVEMENT

RISK ASSESSMENT



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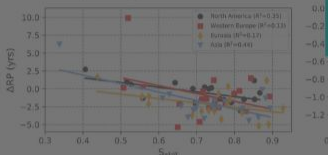


Figure 1: Projected areal mean change in return as well as hot and dry (rigid).

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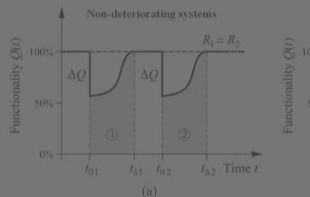


Figure 2: Functionality losses of non-deteriorating (a).

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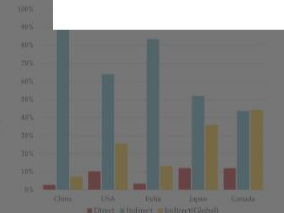


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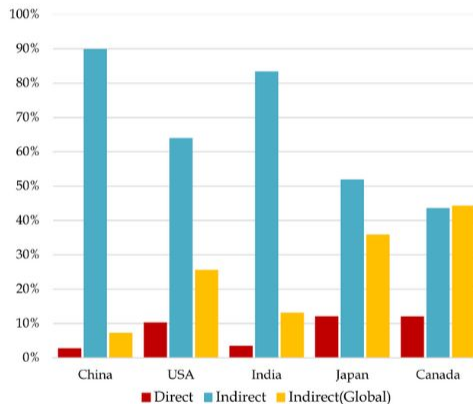


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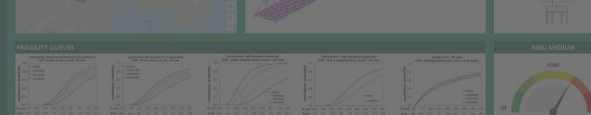
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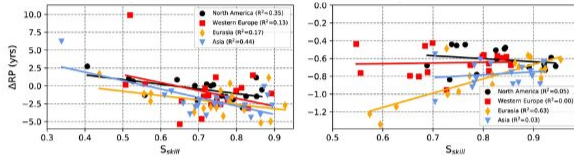


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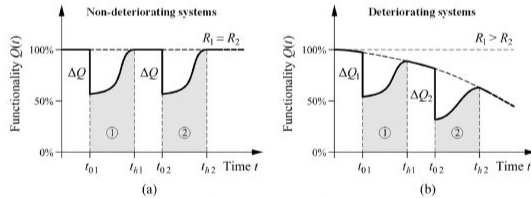


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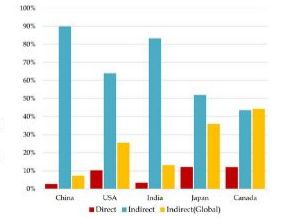


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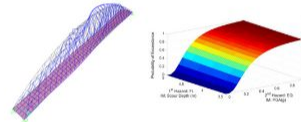


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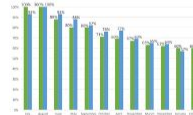


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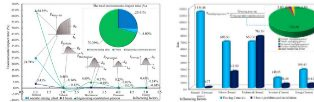


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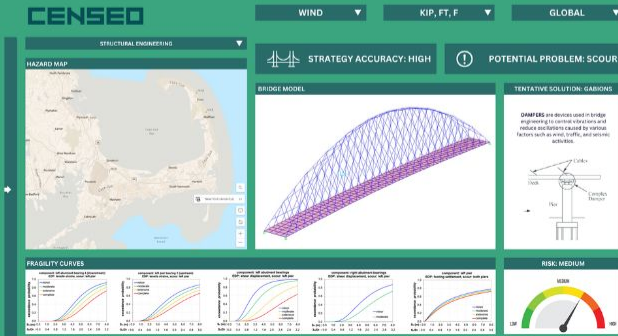
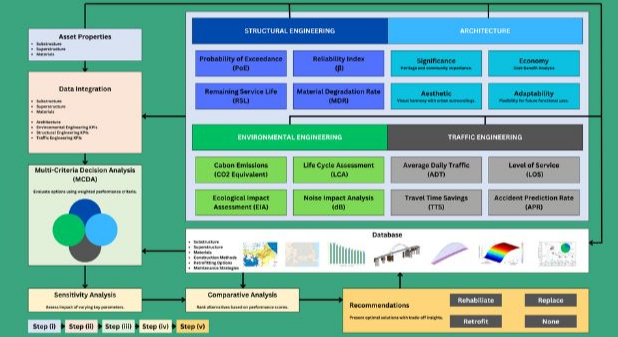
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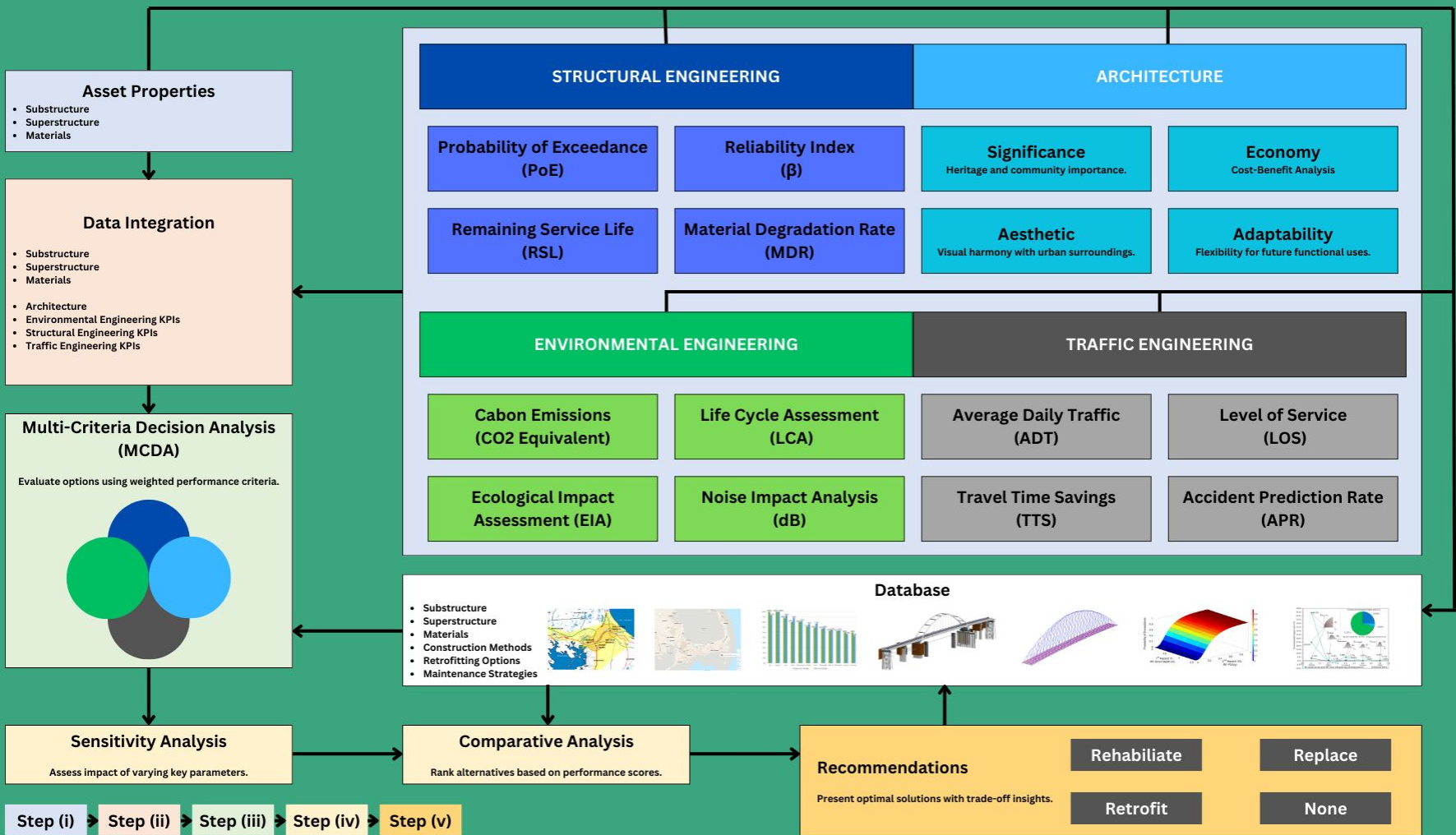
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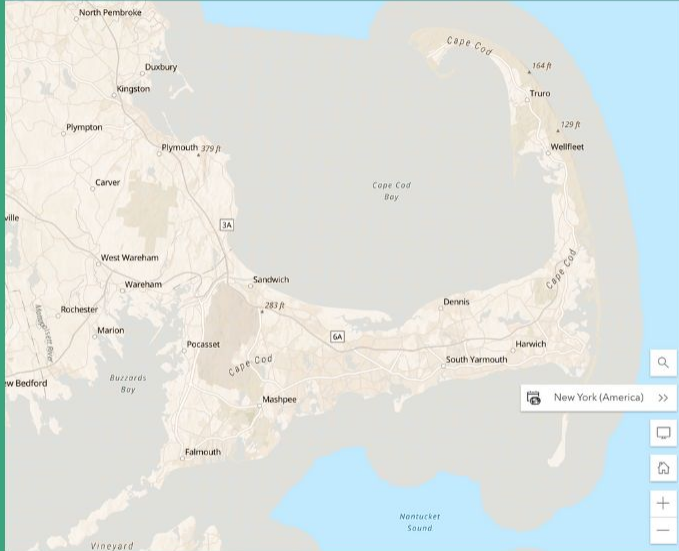
FRAMEWORK





STRUCTURAL ENGINEERING ▼

HAZARD MAP

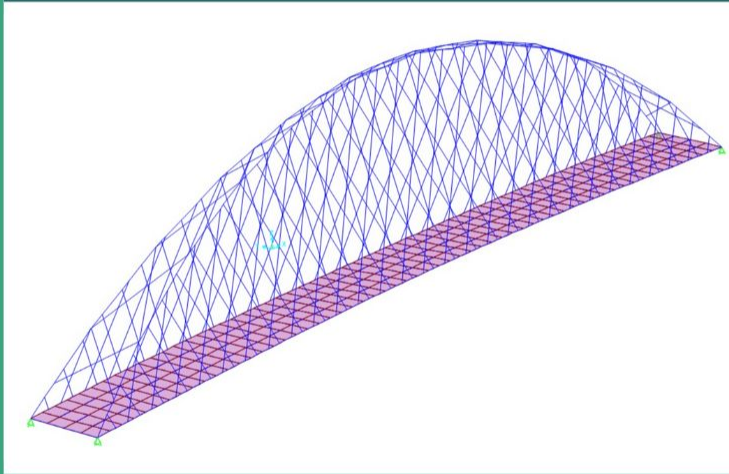


STRATEGY ACCURACY: HIGH



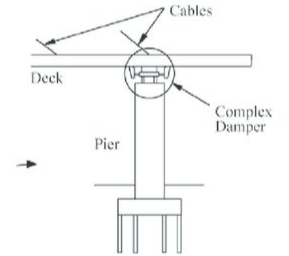
POTENTIAL PROBLEM: SCOUR

BRIDGE MODEL

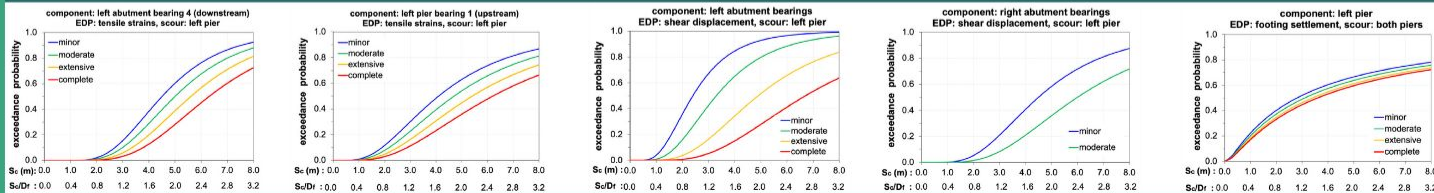


TENTATIVE SOLUTION: GABIONS

DAMPERS are devices used in bridge engineering to control vibrations and reduce oscillations caused by various factors such as wind, traffic, and seismic activities.



FRAGILITY CURVES



RISK: MEDIUM





THANK YOU

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Center for Buildings, Infrastructure and Public Space

Resources

- Andrić, Jelena M., and Da-Gang Lu. "Risk assessment of bridges under multiple hazards in operation period." *Safety science* 83 (2016): 80-92.
- Argyroudis, Sotirios A., and Stergios Aristoteles Mitoulis. "Vulnerability of bridges to individual and multiple hazards-floods and earthquakes." *Reliability engineering & system safety* 210 (2021): 107564.
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- Ji, Jun, Amr S. Elnashai, and Daniel A. Kuchma. "An analytical framework for seismic fragility analysis of RC high-rise buildings." *Engineering Structures* 29.12 (2007): 3197-3209.
- Jhong, Bing-Chen, Jung Huang, and Ching-Pin Tung. "Spatial assessment of climate risk for investigating climate adaptation strategies by evaluating spatial-temporal variability of extreme precipitation." *Water Resources Management* 33 (2019): 3377-3400.
- Khan, Saiful Arif, et al. "An integrated framework for bridge infrastructure resilience analysis against seismic hazard." *Sustainable and Resilient Infrastructure* 8.sup1 (2023): 5-25.
- Kim, Hyunjun, et al. "Flood fragility analysis for bridges with multiple failure modes." *Advances in Mechanical Engineering* 9.3 (2017): 1687814017696415.