

Seismic Risk Assessment of Highway Bridges

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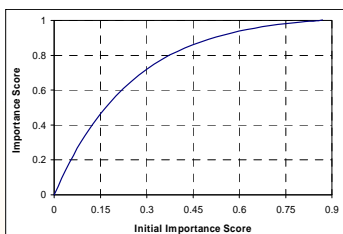
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Background/Objectives

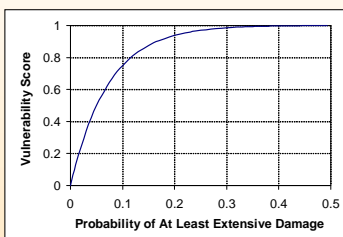
- Bridges affect communities both socially and economically on a daily basis.
- Perform a two part risk analysis of highway bridges and prioritize bridges according to risk score.
 - Vulnerability Assessment: Use FEMA's HAZUS-MH to evaluate the structural capacity of bridges.
 - Importance Assessment: Score bridges according social and economical significance.
- Clark County, Nevada was the selected study area. More than 1.7 million people live in Clark County (2006).



Study Region



Utility Functions for Importance



Utility Functions for Vulnerability

Procedure

- Identify Site Soil Conditions
 - Site class and water table depth was identified using a database of well logs and measured shear wave velocities.
- Bridge Classification
 - Bridges were classified according to year of construction, number of spans, superstructure material, span type, bent type, and abutment type.
- Assess Bridge Importance
 - Quantifies bridge importance using, life safety, detour length, lifelines, defense route, and historical significance.

$$I'_i = w_S S + w_D D + w_L L + w_Q Q + w_H H$$

- Assess Bridge Vulnerability
 - A fragility curve is a log-normal cumulative distribution curve with parameters of median spectral acceleration, spectral acceleration, and dispersion coefficient accounting for randomness and uncertainty.

$$F(D \geq ds_i | S_a) = \Phi \left[\frac{1}{\beta_c} \ln \left(\frac{S_a}{A_i} \right) \right]$$

- Fragility analysis is performed for ground shaking and ground displacement.
- Overall vulnerability combines damage probabilities due to both ground shaking and ground displacement
- Evaluate Overall Bridge Risk Score

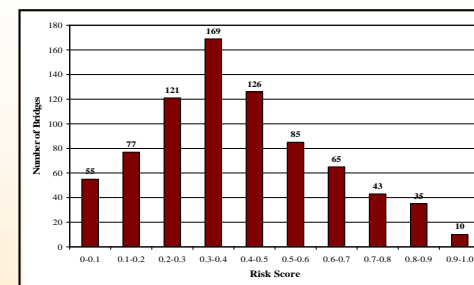
- Utility function used to better control the initial vulnerability and importance scores.
- Bridge Importance and Vulnerability were combined to find bridge risk scores.
- Risk scores were used to put together a bridge priority list.

Results/Conclusions

- High risk bridges have characteristics of bridges that have been damaged in previous earthquakes, and these bridges will affect a large number of people.

Rank	Bridge Number	Vulnerability Score	Importance Score	Risk Score
1	H 942S	0.985	0.964	0.973
2	H1443	0.993	0.952	0.968
3	H 948	1.000	0.945	0.966
4	G1064	0.979	0.958	0.967
5	H 942N	0.952	0.966	0.961
6	H1460	0.943	0.913	0.925
7	G 947	0.806	1.000	0.923
8	G 805N	0.918	0.923	0.921
9	G 805S	0.918	0.923	0.921
10	B1448	0.893	0.912	0.904
11	H1449	0.846	0.934	0.899
12	I 956	0.995	0.812	0.885
13	B1455	0.814	0.908	0.870
14	H 946	0.689	0.990	0.870
15	I 947	0.667	0.973	0.851
16	I 937	0.667	0.968	0.848
17	H1446	0.685	0.953	0.846
18	H1211	0.618	0.995	0.844
19	G 953	0.797	0.873	0.843
20	I2139	0.771	0.890	0.842

Top 20 High Risk Bridges



Risk Score Distribution

- The results should be treated as estimates of behavior.
- Considering the serious consequence of bridge collapse, future geophysical and structural investigation are in order to validate the results.
- Outcome of this research will better prepare the valley's citizens and civil infrastructure for the threat of earthquakes and benefit its economic stability.

