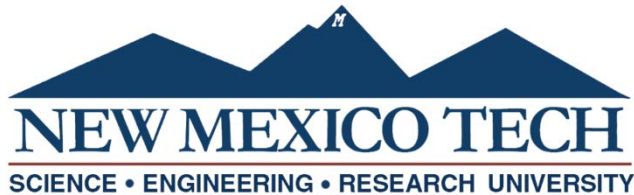


Validating Common Collapse Conjectures in U.S. Bridges

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Outline

- Introduction
 - Databases
 - Definitions
- Data Analysis
 - Structural Deficiency
 - Scour Critical Rating
 - Age & Condition Ratings
 - Improved Design Specifications
- Conclusions

Introduction

- Databases
 - NYSDOT Database
 - NBI Database
 - Compiled-collapse Database
- Definitions
 - Total Collapse
 - Partial Collapse

NYSDOT Database

- 428 bridges that have collapse between 1992-2014
- Database contains descriptive-collapse information
 - Cause of Collapse
 - Year of Collapse
 - Comments that further describe the collapse

NBI Database

- Inspection data for more than 610,000 bridges from 1992 to 2014
- In-service population from NBI 2014 serves as control data
- Contains bridge descriptive information
 - Type of bridge, material type, and year built
 - Bridge Components Conditions

Compiled-collapse Database

Collapsed Bridge
Database



Project Data

National Bridge
Inventory

Total Collapse



Partial Collapse



Data Analysis

- Structural Deficiency
- Scour Critical Rating
- Age & Condition Ratings
- Improved Design Specifications
 - Bridge Geometric Characteristics
 - Operating Rating

Structural Deficiency



Structural Deficiency

	Failed Bridges	In-service Population
SD Bridges	197 (46.0%)	53,354 (8.7%)
NON-SD Bridges	231 (54.0%)	557,073 (91.3%)
Σ	428	610,427

Structural Deficiency per Collapse-type

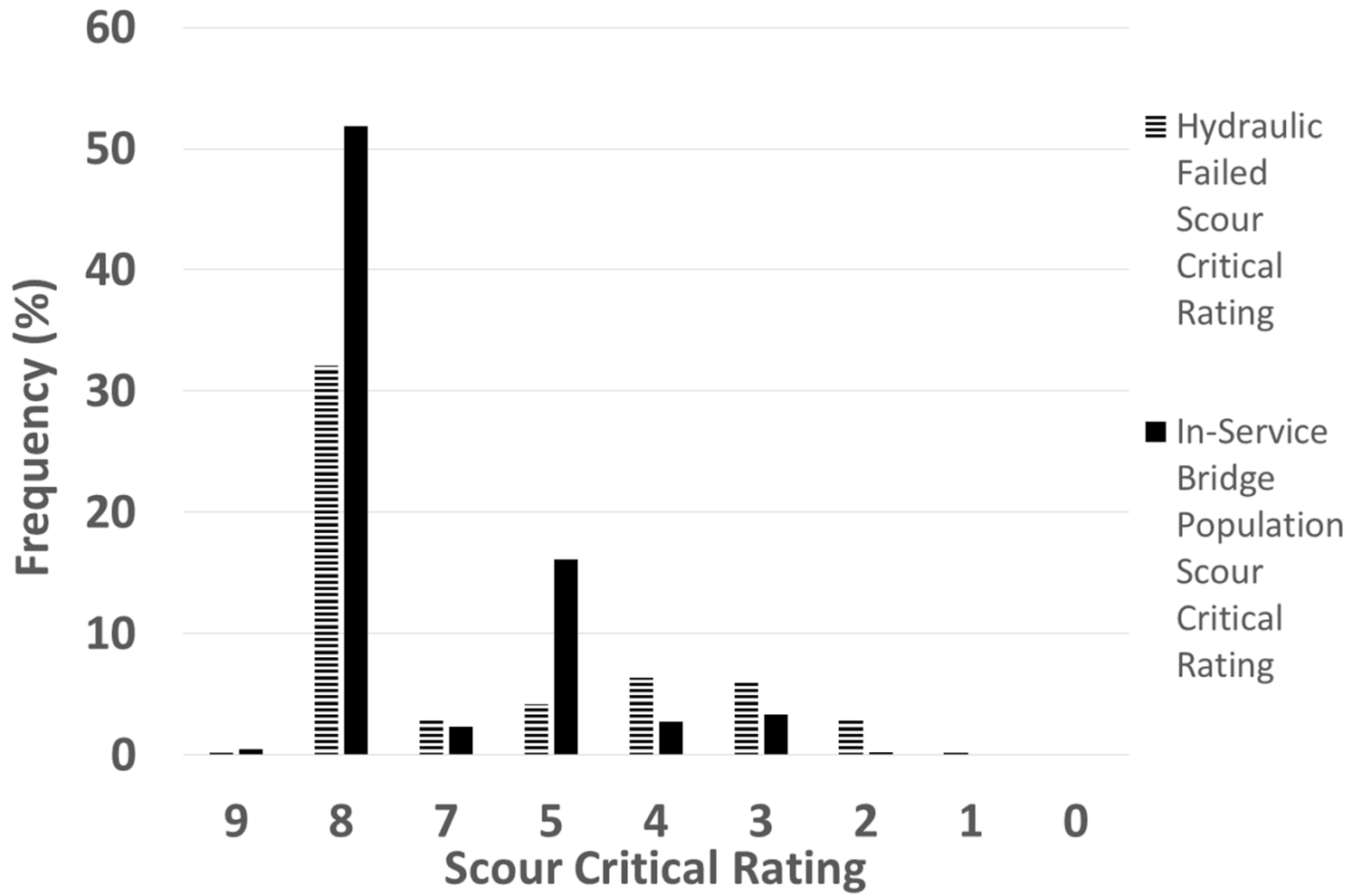
Type of Collapse	SD Deck	SD Superstructure	SD Substructure	Median Age
Overload	14 (23.3%)	32 (53.3%)	25 (41.7%)	68
Hydraulic	38 (16.0%)	48 (20.2%)	77 (32.5%)	54
Deterioration	12 (33.3%)	14 (38.9%)	14 (38.9%)	48
Collision	6 (7.3%)	14 (17.1%)	13 (15.9%)	43
In-service Population	4,968 (0.8%)	22,264 (3.6%)	29,189 (4.8%)	41

Definition of Scour



Scour Critical Rating

	Hydraulic Failure	In-service Population
Scour Critical '3-0'	22 (16.8%)	22,387 (4.8%)
Non-Scour Critical '9-4'	109 (83.2%)	448,572 (95.2%)
Σ	131 (100%)	470,959 (100%)



Possible Solutions

Require more Underwater Inspections

- **19,267 (3.2%)** bridges in the in-service population
- 16 (6.8%) hydraulic collapse bridges

Revise the current Inspection System

- Improve the rating descriptors
- Account for the probability of floods
- **112 (47.3%)** of hydraulic collapsed are caused by floods

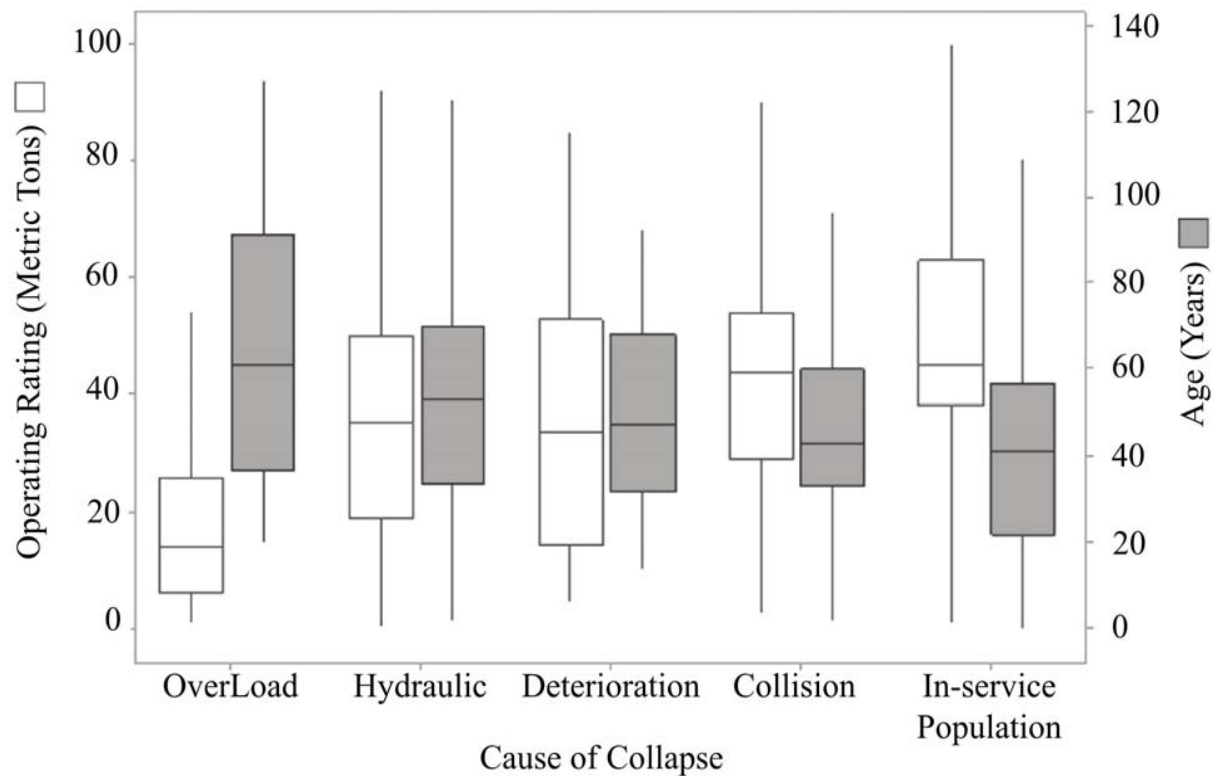
Bridge Collapse, Age, & Condition Ratings

Cause of Collapse	Age (Years)	Deck	Superstructure	Substructure
Collision	43.0	6	6	6
Deterioration	47.5	5	5	5
Hydraulic	53.5	6	6	5
Overload	68.0	6	4	5
In-service Population	41.0	7	7	7

Improved Design Specifications: Bridge Geometric Characteristic

Category	Median Minimum Vertical Clearance
Collision-caused Collapse	4.9 m (16.1 ft)
In-service Population	5.1 m (16.9 ft)

Improved Design Specifications: Operating Rating



Conclusions

- Structural Deficiency (46.0%) and collapse are associated
- A discrepancy is noted with the scour critical ratings, bridges are typically rated as scour stable (46.4%) for hydraulic collapse
- A unique third variable causes an accelerated deterioration for each cause of collapse
- Improvements to design specifications are increasing bridge longevity with higher design loads and higher vertical clearances

Future Work

- Further Investigate third variables that cause an accelerated deterioration
- Underwater Inspections
- Investigate bridge-collapse trends for bridges on the NHS

Questions?
