JCSS

Joint Committee
on Structural Safety

Workshop on Assessment of Existing Structures

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Some Experiences with proof loading of bridges

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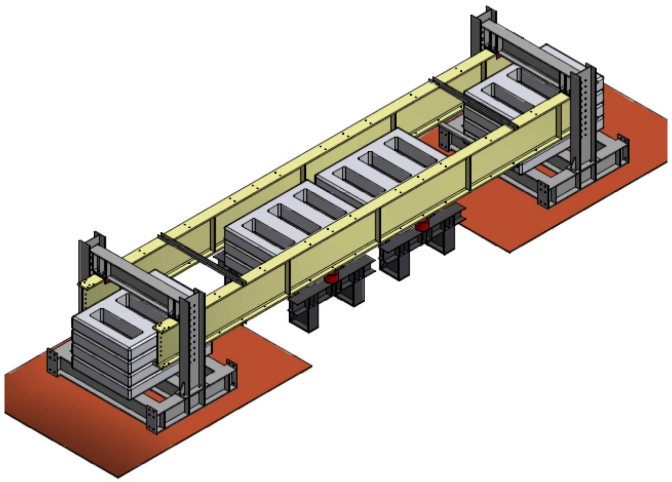
Proof loading of bridges

Participants

- The Danish Road Directorate
- The Technical University in Denmark
- COWI

Proof loading of bridges

- Cradles
- Frames
- Beams
- Dead load
- Jacks

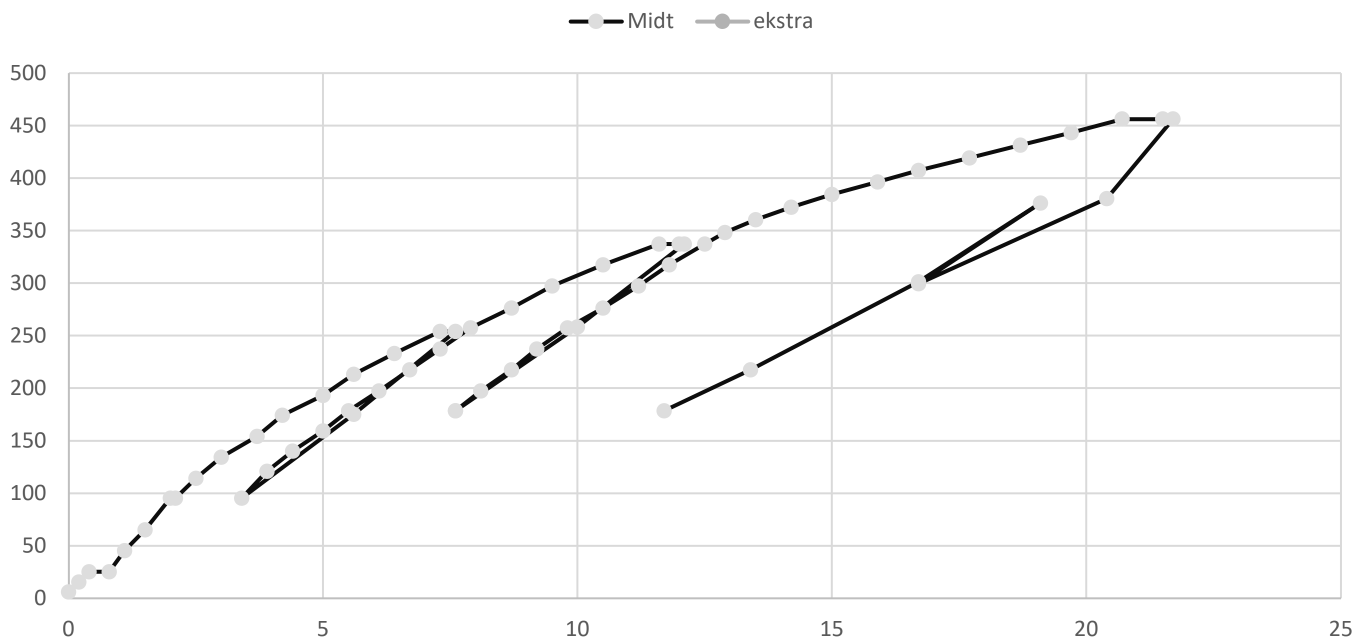


Proof loading

Monitoring

- Surveyer measures the deflection
- Measurements of the deflection by laser
- Fotos of the bridges are analyses using ARAMIS
- Deflections are measured by sensors
- The load is measured using the jacks

Results



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20
25

Challenges

- The actual structural behavior of bridges is different from the one predicted using our computational models
- It is difficult to formulate a limit state function defining a failure criterium
- Reliability updating using Bayesian statistics is in general not possible
- The response of the bridge may be difficult to determine with sufficient accuracy
- There may be a risk of brittle failure

Recommendations

- Use a load configuration that represents the actual loads acting on the bridge
- Determine the target load such that the probability that the load is exceeded within a given period of time corresponds to the acceptance criteria (no information regarding the structure is taken into account). This is a conservative approach overestimating the target load.
- Identify stop criteria that are measurable (crack width and deflection)
- Use Monitoring methods with a high level of accuracy (compared to the stop criteria)
- Avoid brittle failure

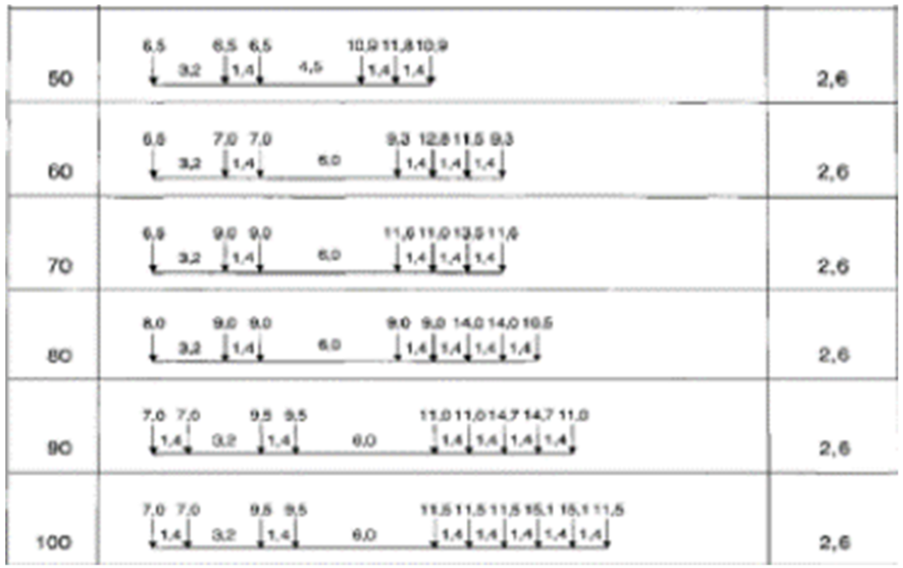
Planning proof loading

- What is the relevant failure mechanism(s)?
- Is brittle failure a concern?
- Where should the load be placed?
- How large a load should be applied?
- When do we stop the test?
- How do we measure the relevant parameters?
- How do we interpret the test results?

Probabilistic model

The probabilistic model most reflect

- The legislation
- The administration
- The degree of control



Probabilistic model

Parameters

- The weight of vehicles
- The axle loads and the correlation between individual axle loads
- The geometry of vehicles
- Traffic intensity
- Dynamic amplification factor
- Model uncertainty

How large a load should be applied?

Determine the target load such that the probability that the load is exceeded within a given period of time corresponds to the acceptance criteria (no information regarding the structure is taken into account)

$$g = \eta \, S_d - \big((1-\alpha)G + \alpha Q\big)$$

G	permanent load
Q	maximum annual variable load
α	models the ratio between variable and permanent loads

Future work?

- Develop a probabilistic model
- Determine the relevant model parameters
- Develop a guideline for proof loading

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