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A/CZ0046/2/0013 ASSESSMENT OF HISTORICAL IMMOVABLES

Risk assessment of heritage structures endangered by fluvial floods

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Introduction

Experience from investigations

General framework of probabilistic risk assessment

Concluding remarks



Introduction

- Czech Republic – *fluvial*, flash or urban floods
- Fluvial flooding in **August 2002** overwhelmed most flood protections and damage exceeded 3 milliard EUR
- Severe consequences in the *historic city of Prague*
- Flooded structures - *historic structures*, public buildings and residential houses
- Protective measures considered to reduce consequences of flooding in future – rational basis provided by *risk assessment*
- The present contribution - *general framework* of risk assessment of heritage structures endangered by floods based on:
 - Bayesian networks
 - experience from the investigations in the Prague heritage site.

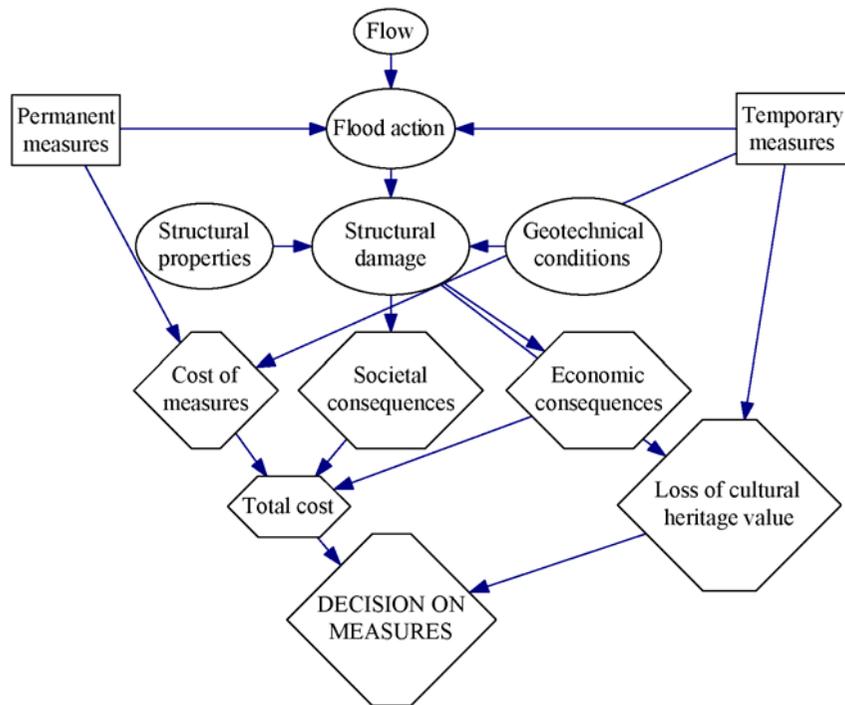
Experience from the investigations

- Principal *flood actions* on structures:
 - Erosion
 - Hydrostatic
 - Debris
- Main *causes of structural damage*:
 - Geotechnical aspects
 - Inadequate structural properties
 - Insufficient communication among responsible authorities
- Adverse effects in interiors of the heritage buildings:
 - long-term *increase of residual moisture* with biological attacks
 - unfavourable *drying effects*



General framework of probabilistic risk assessment

- Protection of cultural heritage endangered by floods
 - *advance planning* (landscape, structures, contents)
- *General guidelines*: The United Nations Disaster Relief Organisation and European Directive 2007/60/EC - no cultural heritage issues
- UNESCO - risks in *monetary terms*
- Difficult for cultural heritage - combination of *quantitative and qualitative criteria* (risk rating matrices)
- *General framework* - all events together with their consequences, scenarios and probabilities described by Bayesian networks



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Concluding remarks

- **Causes of damage** to structures in the Prague heritage site due to the 2002 flooding:
 - geotechnical aspects,
 - inadequate structural properties and
 - insufficient communication among authorities.
- Decisions concerning protective measures - **risk optimisation** considering societal and economic consequences and foreseen **losses of cultural heritage values**.
- **Bayesian networks** - an effective tool for the risk analysis.
- Judgement about the **cultural heritage value** - difficult issue.
- Cultural heritage may be severely damaged by **minor flows**.
- **Journal of Performance of Constructed Facilities** - issue on flood phenomena related to cultural heritage will be soon published.

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Lessons from past experience?



Troubky, 9 July 1997



Troubky, 18 May 2010



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Thank you for your attention.