

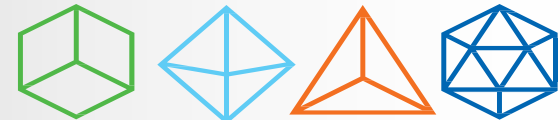
Protecting Cultural Heritage against Earthquake

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Actors influencing protection

- cultural heritage owners & managers
- cultural heritage users
- society/community

- lack of resources
- erroneous use
- neglected maintenance
- harming alterations
- ignorance

- erroneous operation & use
- harming alterations
- ignorance

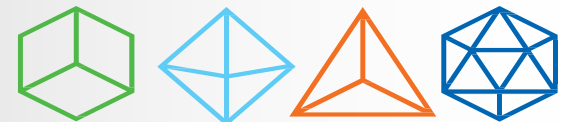
- lack of policy & standards
- lack of knowledge
- lack of resources
- ignorance



Principal protection measures

In accordance with the World Institute for Disaster Risk Management (USA) we recommend four pillars for mitigating adverse natural disaster effects (generally & CH related):

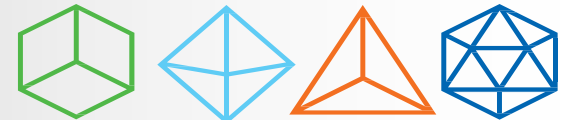
- **improved quality of buildings or construction & land use management**, which for architectural heritage means **regular inspection**, **careful maintenance** and **retrofitting** of the historical stock,
- **education & training**, for CH **raising awareness & regular coordinated training**,
- **incentives & regulations**, including international cooperation and **availability of funding**,
- **enforcement** i.e. **legislative support** for cultural heritage including **modified standards, action**.



NATURAL DISASTERS have COMMON PROBLEMS

Buildings are particularly vulnerable to natural disasters when **no/poor maintenance** has been carried out for years. This frequently happens in the case of vernacular or minor historic buildings. Some examples:

It contributed to the failure poor houses in Haiti or villages around L'Aquila, but also of San Francesco in Assisi, and in windstorms, floods, too.



DISASTER PROTECTION STRATEGY

- **Ranking of structures, elements and situations according to their sensitivity to the effects of natural disasters**
- **Choice of prevention and mitigation strategies and measures against damage**
- **Enforcing necessary measures**

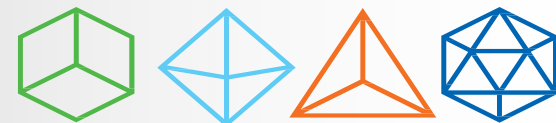


Earthquake Protection Strategy

- Survey and (GIS) inventory of cultural heritage in danger
- **Regular inspection of structural health**
- Long term monitoring of structural health (objects of high value or sensitive materials & structures) / Installation of warning systems
- **Regular maintenance & repair of identified deficiencies**
- Measures decreasing loading or action
- Improvement of environment and surrounding conditions
- **Change of material or structural characteristics** (injection, tuning, ...)
- **Structural strengthening** and/or additional supports of the whole structure – stable or temporary
- Emergency plans and guidelines for situations before (& after) the event



- **Regular inspection of structural health and loading conditions**
- **Discovering of structural weakness or critical problems**
- **Informing relevant stakeholders & decision makers - owners, managers, users, public, authorities**
- **Suggestion of protection strategies & measures**
- **Training & rising awareness activities**
- **Fundraising**
- **Decision on adopting relevant measures:**
 - **maintenance**
 - **repair of various extent**
 - **retrofitting campaigns – “first aid” enhancement**
 - **retrofitting campaigns – systemic & standardized**



- one of the **most important strategies** against damage
- lack of regular maintenance leads to material decay and loss of the structural properties
- maintenance is usually a result of a regular inspection, or
- regularly on a basis of a **maintenance plan**,
- maintenance actions in most cases do not require design work or even engineering supervision.
- they can be left to the skills of properly **trained craftsmen**
- this enables action to be taken **quickly**, and **prevents** a defect developing into **more serious damage**
- a **maintenance guide** is a useful tool, and should combine **tips for inspection** with **recommendations** on how to fix problems that are identified.
- in the seismic protection the work should focus on the state of the **joints**, **masonry integrity**, **material condition**, **resistance**, **overall integrity & stability**.



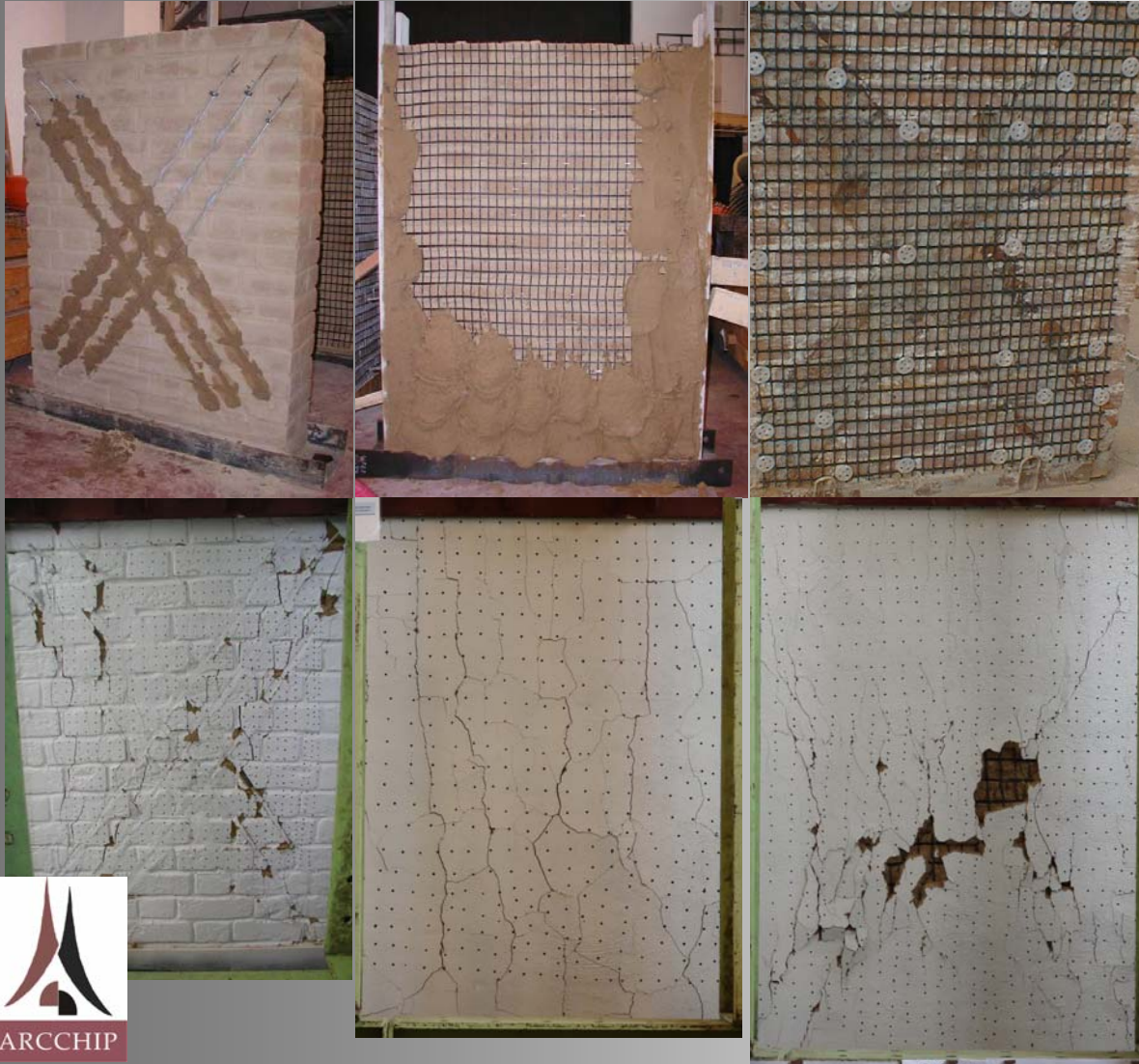
“FIRST AID” RETROFITTING PROBLEMS

- conservation policy limits – sympathetic solutions
- adequate & appropriate response assessment - survey
- understanding to materials and structural concepts – considerate interventions
- lessons from traditional historical solutions
- lessons from errors & failures in seismicity protection
- affordable & feasible technologies



“FIRST AID” RETROFITTING COMMENTS

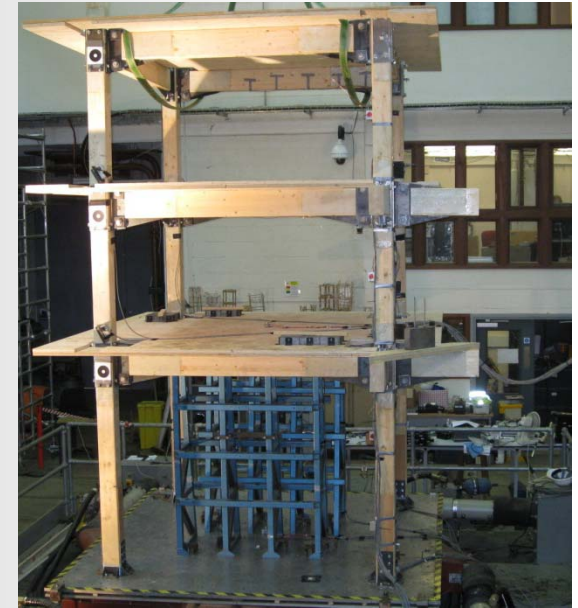
Adobe walls reinforced with thin steel ropes & PE geonets, timber joints etc.



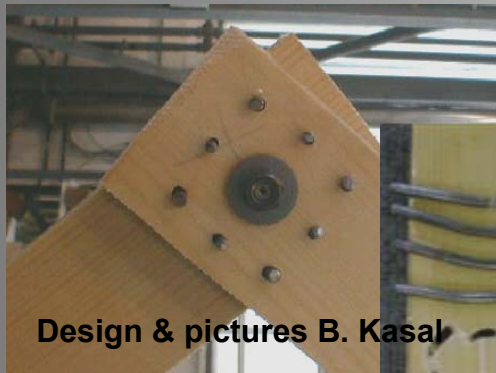
Picture Will Clark NZ



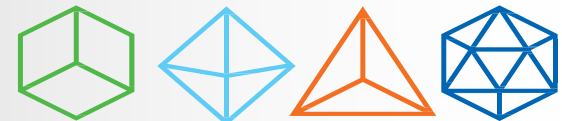
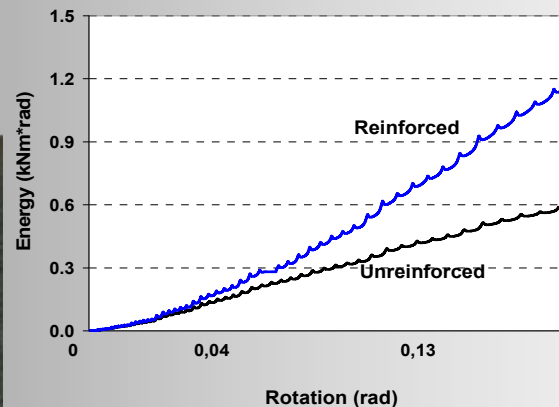
Reversible interior strengthening of historic buildings an effective protection tool



Affordable & easy assembled timber frames with dissipative joints or even self aligning behaviour



Design & pictures B. Kasal



CONCLUSIONS

Seismic protection of historic buildings – listed or non-listed can be substantially enhanced by means of a **mass and affordable retrofitting campaigns** including:

- ❖ improving structural conditions of the stock at risk based on **regular qualified inspections**, and **early repair** of identified deficiencies
- ❖ regular maintenance supported by **maintenance plans** and **maintenance manuals**
- ❖ materialization of feasible and affordable structural measures – repairable or reversible material and structural **“soft retrofitting” adaptations** in order to improve the building response to seismic loads
- ❖ exploitation of **well trained and skilled craftsmen** work provided with **verified typical solutions**

