Recommendations for implementation of counter measures

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Content

- What are the most important factors to take into account during the planning, implementation and maintenance of counter measures?
  - Geographical settings
  - Risk acceptance: Design criteria
  - Cost/benefit
  - Efficiency (residual risk)
  - Human factors
  - Influence on landscape
  - Short and long term considerations

Main questions

- What is the current risk?
  - Hazard and vulnerability evaluation
- What risk is accepted?
  - Design criteria
  - The interest of exposed people and the local/national societies may not be congruent
  - Political decision

Main questions (cont.)

- What kind of counter measure to select?
  - Relocation of construction
  - Non-physical measure
  - Physical measure
- Where to locate the physical measure
  - Release zone
  - Track
  - Run out zone
- Include all hazards

Basic natural conditions

- Topographical conditions
  - Accessibility
  - Available space for constructions
- Geological conditions
  - Foundation
- Geotechnical conditions
  - Soft ground
  - Quality of filling material
- Hydrological conditions
  - Surface and subsurface drainage

Important factors to consider

- What kind of counter measure is most adequate?
  - Cost-benefit considerations
  - Efficiency (residual risk?)
  - Human factors (acceptance)
  - Political prioritizations
  - Influence on landscape
  - Short term and long term considerations

Cost elements

- Direct costs
  - Planning costs
  - Access roads
  - Drainage systems
  - Establishment costs
  - Maintenance costs/running cost
- Indirect costs
  - Compulsory acquisition of land
  - Relocation of houses, roads, drainage systems etc.
  - Socioeconomic factors

Benefits

- Saving of human lives
- Avoidance of damage to buildings/constructions
- Increasing the value of land
- Reducing human stress/fear

Efficiency

- Design limitations
  - Loads, velocity, volume
- Storage capacity (several slides)
- Limited physical understanding of processes
  - High kinetic energy/magnitude
- Residual risk
  - What will happen if it fails to work?

Acceptable residual risk

- Roads can tolerate higher residual risks than human settlements
- If the consequence is high, low residual risk is acceptable

Human factors

- After fatal accidents the society will demand higher level of safety
- People being affected will also have stronger demands
- Natural hazards and risk reduction is often a matter of conflict between the experts, the political authorities and the people directly exposed to the risk
- One should aim for acceptance by the people affected by the measure
  - Often not congruent with the most cost-efficient measure

Political prioritizations

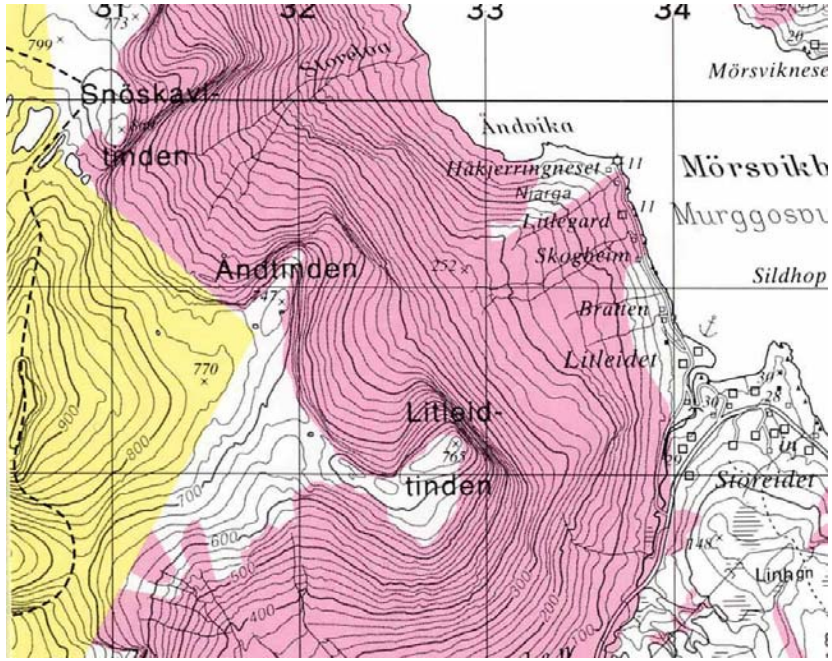
- Not always in accordance with technical/expert opinions
- Decisions by politicians will often be influenced by the public opinion
- Politicians may choose inexpensive solutions that are not the best in the long term perspective

Influence on landscape

- Visibility
- Esthetical considerations
- Possibility of regrowth of wall sides
- Use of materials (concrete, steel, wood)
  - Durability vs. esthetics

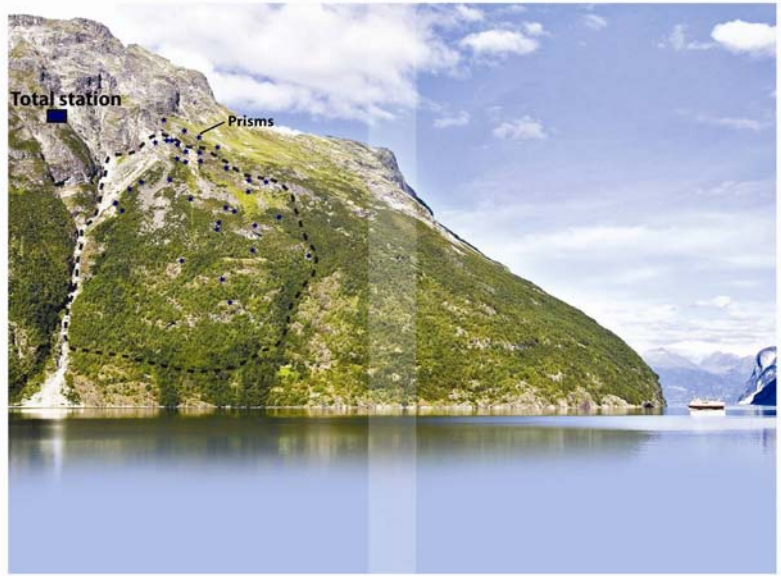
Short and long time considerations

- Preliminary counter measures
  - Immediate actions to reduce risk until planning of permanent measures are in place
  - Inexpensive countermeasures may be expensive in the long term
  - Running and maintenance costs may be high in the long term
- Long term considerations
  - Low maintenance and running costs
  - Hazard/risk mapping to avoid new buildings to be erected in hazardous areas



Non physical measures

- May be preferable in the following cases
  - Infrequent occurrence
  - Spatially fuzzy and difficult to predict
  - Low risk objects (e.g. roads)
  - Risk space is great as opposed to point risks
  - High kinetic energy that is hard to predict
- Will only reduce personal risk



Physical measures

- Preferable when
  - Frequent occurrences
  - Possible large consequences
  - The measure will in use for a long time

Conclusions

- Non physical measures:
  - Early warning systems normally have lower reliability than physical measures
  - Early warning systems also have higher annual running expenses
  - Sufficient time for evacuation is necessary
  - Early warning systems may be appropriate for roads and for infrequent and disastrous rock avalanches
  - Hazard and risk mapping is a good investment in the long term perspective
- Physical measures are normally preferable for settled areas
  - Design is complicated: Expert decisions
  - Optimal solution in the long term perspective


Thank you for your attention!