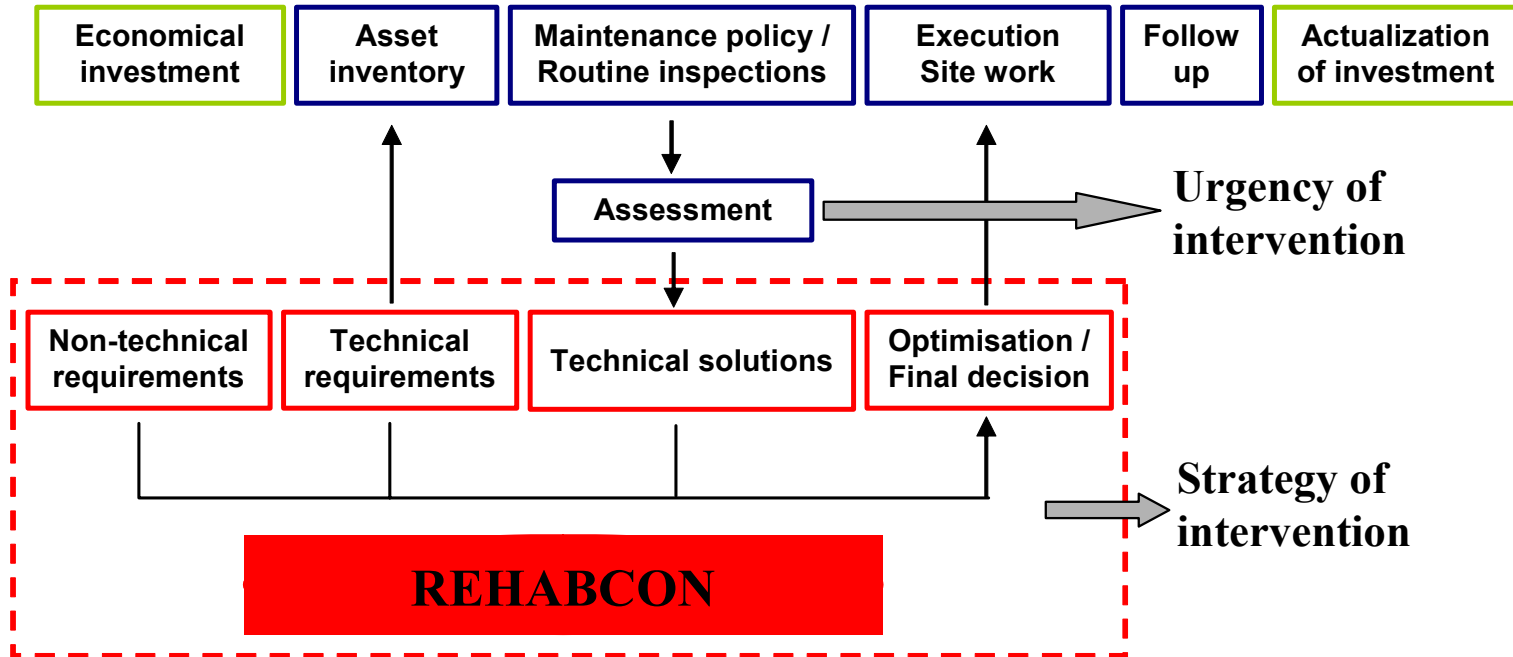


# TOMORROW AND BEYOND FOR CONCRETE REPAIR

## Researcher's Perspective

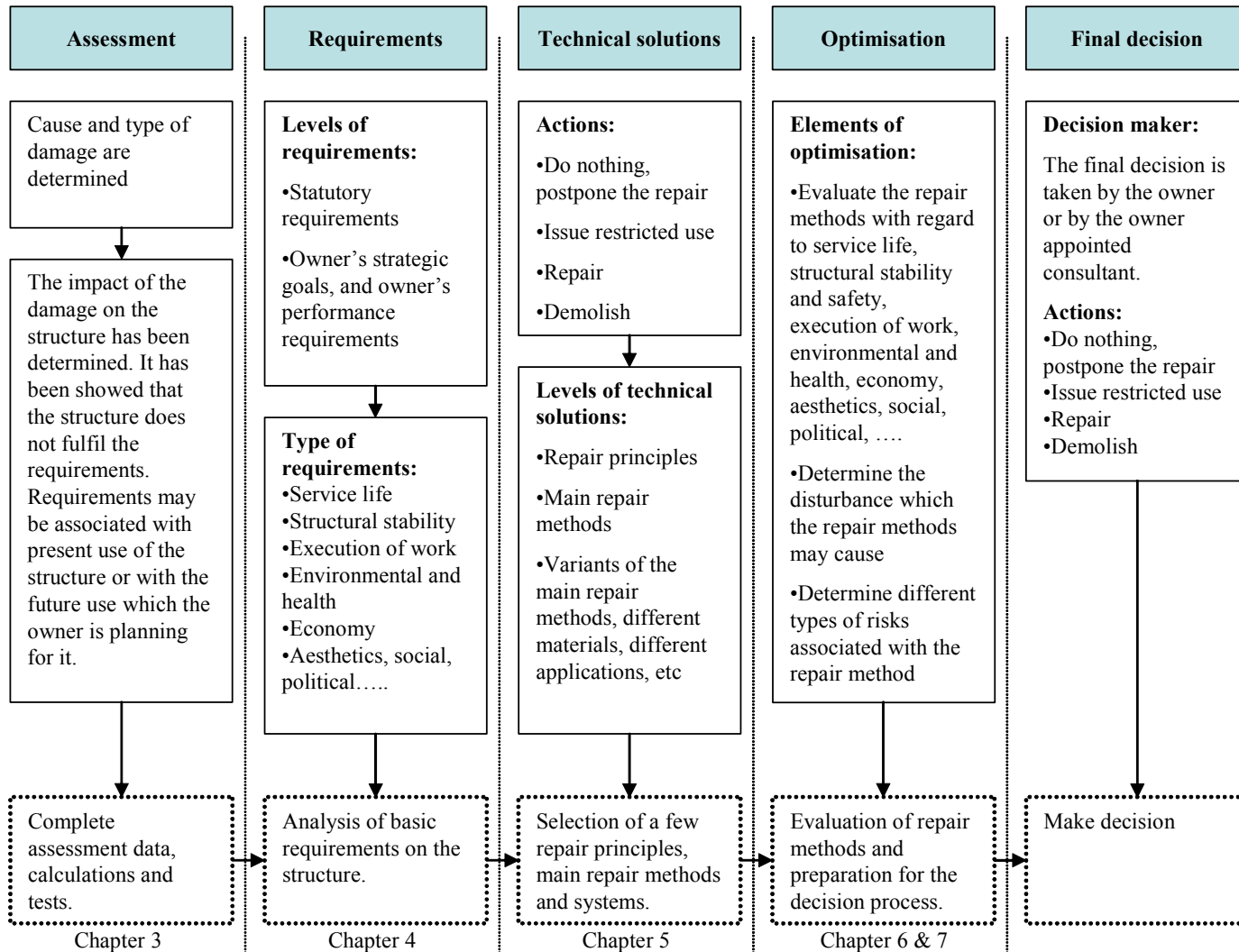
Manouchehr Hassanzadeh  
Lund Institute of Technology

# Elements of an asset management system



A complete management system facilitates follow up and experience feedback which can be used for future assessments of the structure and evaluation of the repair systems.

# Repair process

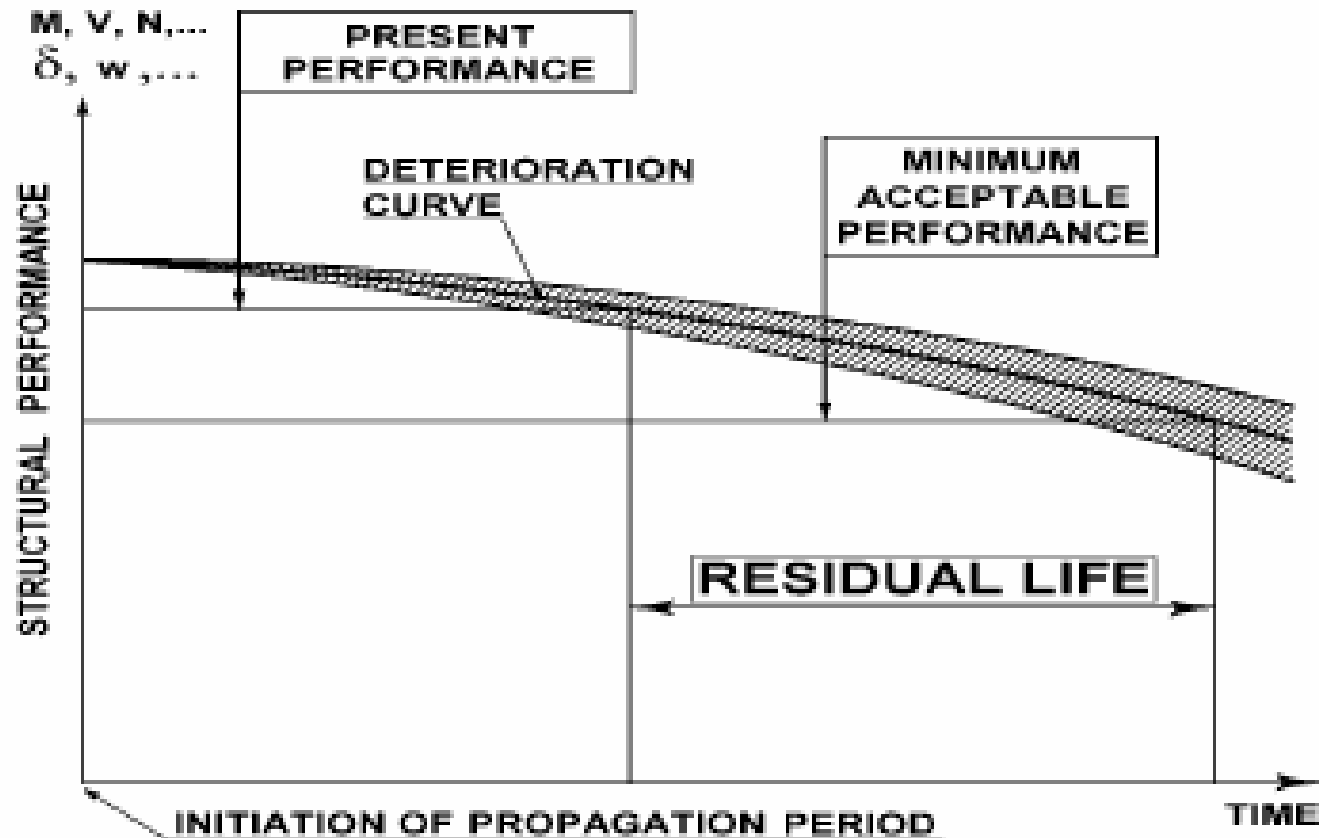


# Structural assessment

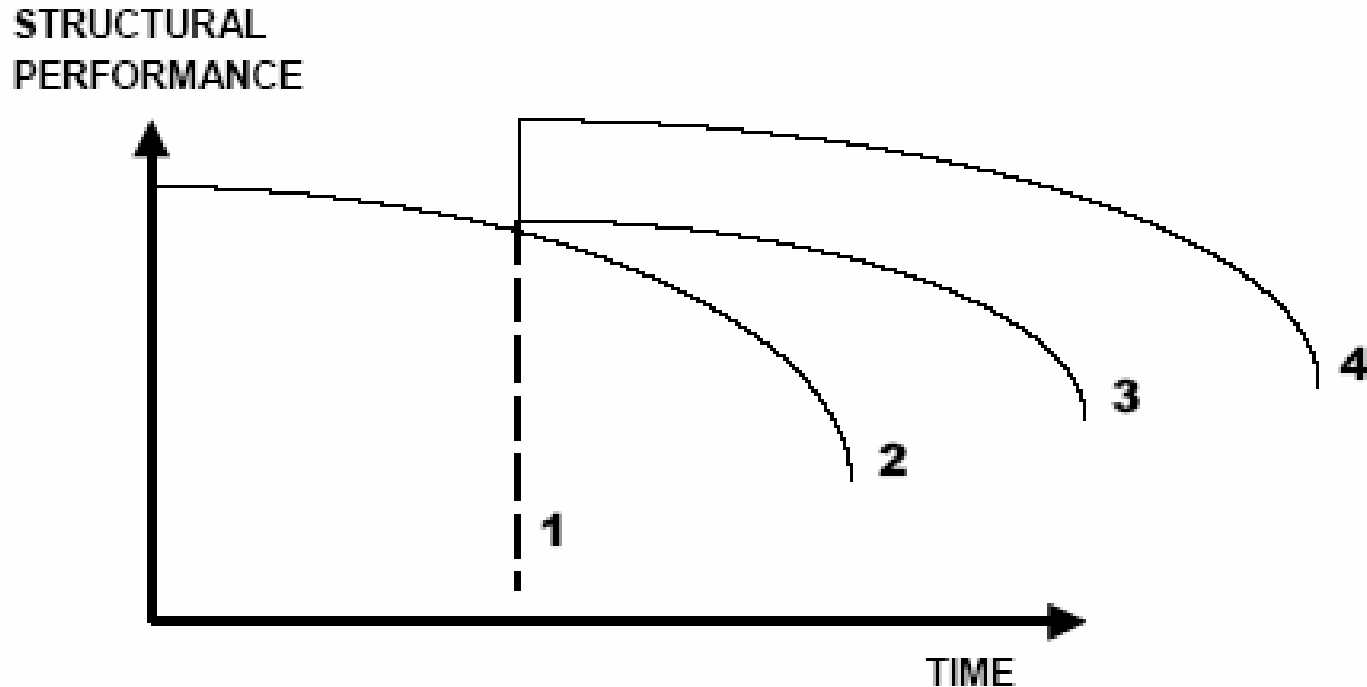
The main aspects of the structural assessment of a deteriorating structure.

1. The need to establish the level of present performance by establishing the type, extent and cause of the damage.
2. The establishment of the average rate of deterioration.
3. The prediction of the loss of the structural capacity.
4. The identification of the minimum acceptance level of performance.
5. The urgency of intervention.

# Deterioration curve



# Alternatives of intervention in a deteriorated structure



Repair interventions can be shown very illustratively, but can we really predict the structural performance?

**Cause of damage/type of damage**  
Based on tests and analysis of the structure

**Functional requirements**  
Defined by  
•Society  
•Owner  
•User

**Selection of repair method and material**  
•Alt 1  
•Alt 2  
•Etc.

**Evaluation of selected repair method and material**

<b>Service life</b>	<b>Structural stability</b>	<b>Execution</b>	<b>Environment</b>	<b>Economy</b>	<b>Other</b>
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**Decision**

Is it easy to make a decision in this way?

# Evaluation of the selected repair method/system

## Different levels of evaluation

### Approved solutions

The evaluation is based on experience from previously executed repair.

### Qualitative evaluation

The evaluation is based on experience from previous repairs, and on “semi-quantitative”, and/or qualitative reasoning.

### Quantitative evaluation

The evaluation is based on service life calculations, “*service life design*”. The methods/models are based on the same principles as the methods/models used for design of new structures.

**Are there any models for evaluation and selection of repair methods?**

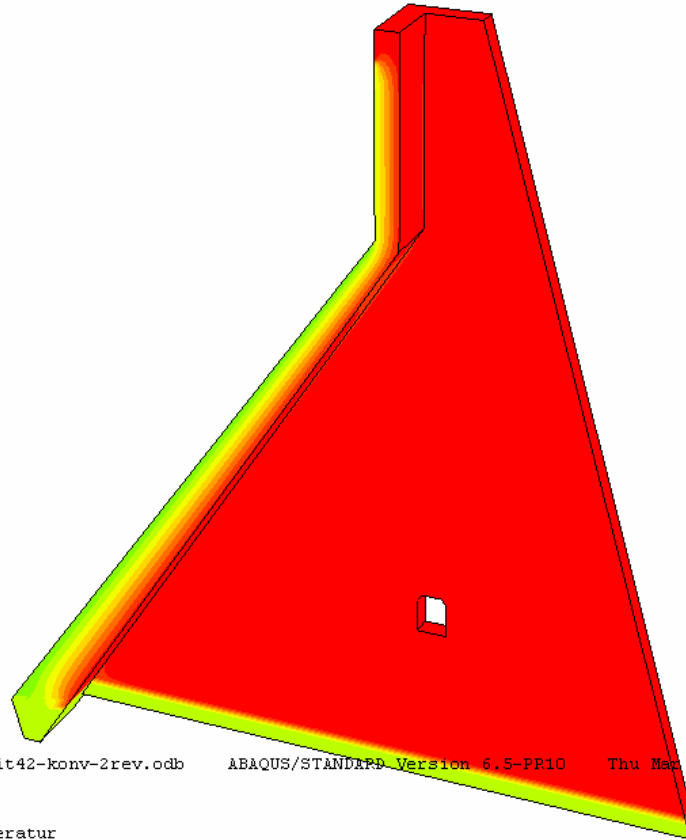
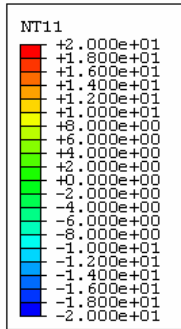
# Future developments?

- Development of asset management systems which include assessment, evaluation, follow up and feedback procedures and instructions.
- Development of condition assessment techniques and improvement of models to predict the structural performance, specially with regard to synergetic effects.
- Development of procedures and techniques to follow up the repairs and feedback of the repair results in order to gain inputs for experience-based evaluation, and data for qualitative evaluation.
- Development of models which predict the long-term structural performance of non-repaired and repaired structures.
- Development of methods to evaluate the repair systems and their impact on the old parts of the structures.
- Development of field measurements techniques, and field test-stations in order to get information and feedback about the deterioration processes, impact of the environment on the repair system and the repaired structure.
- Establishment of the field test-stations in order to verify the qualitative and quantitative evaluation methods.

**EXAMPLE**



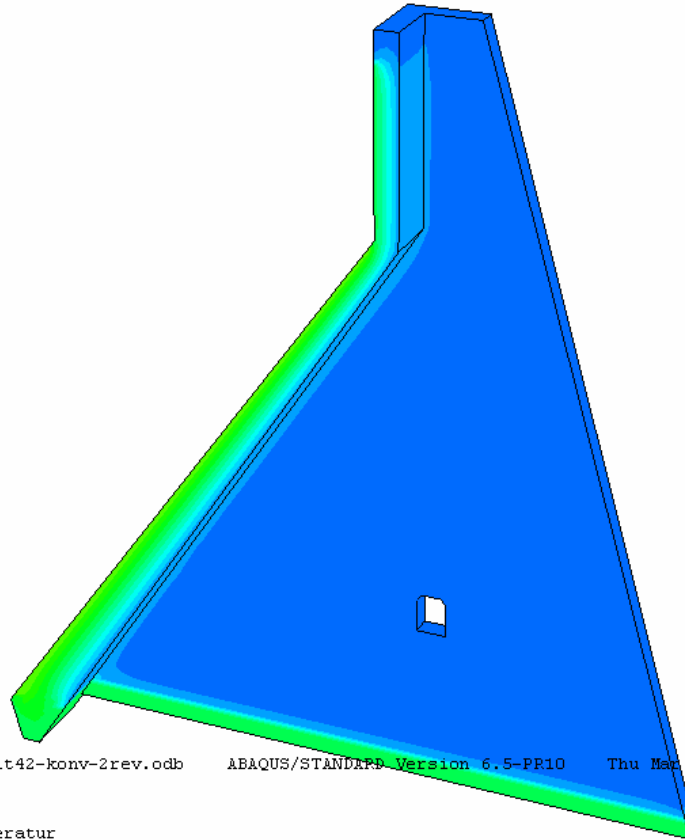
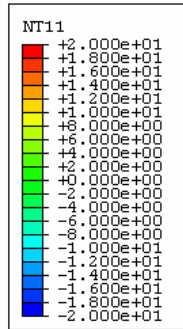
# Temperature during summer



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Step: Temperatur  
Increment 916: Step Time = 3.9436E+07  
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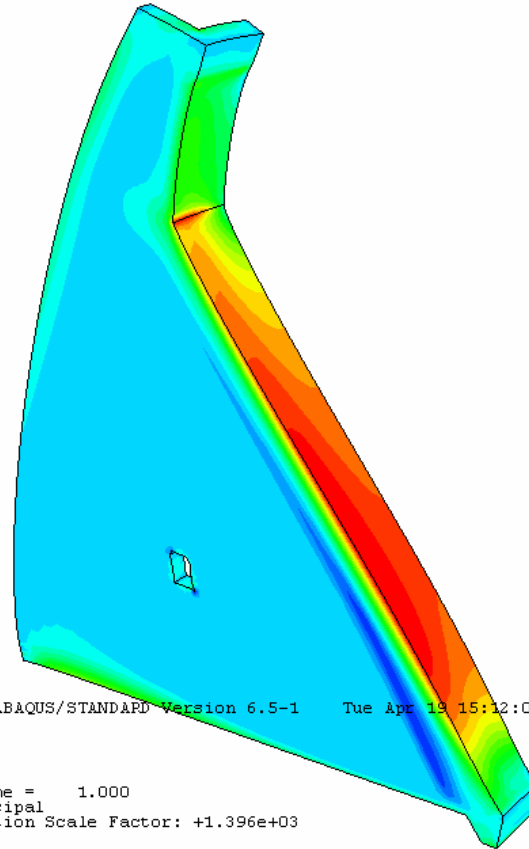
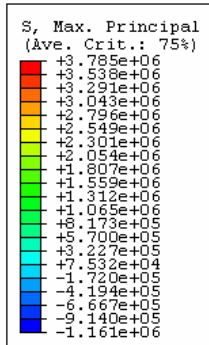
# Temperature during winter



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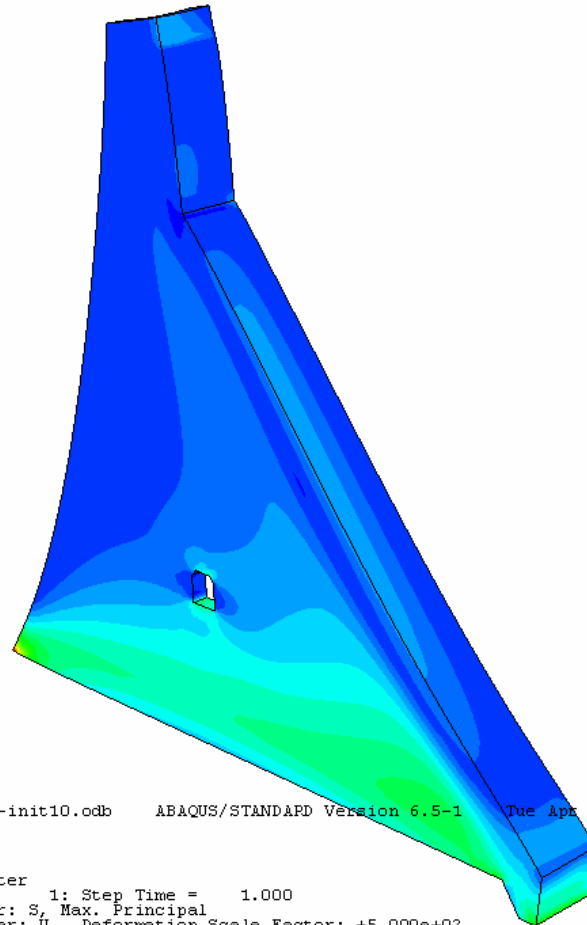
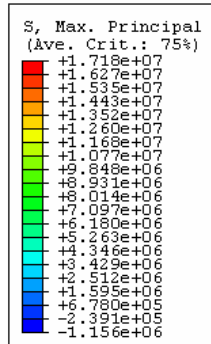
# Deformed shape during summer



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Deformed Var: U Deformation Scale Factor: +1.396e+03

# Deformed shape during winter



ODB: elast-init10.odb ABAQUS/STANDARD Version 6.5-1 Tue Apr 19 15:12:05 W. Europe Daylight Time 2005

Step: Twinter  
Increment 1: Step Time = 1.000  
Primary Var: S, Max. Principal  
Deformed Var: U Deformation Scale Factor: +5.000e+02