



Regional-scale numerical stress model of the Stockholm area

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Stockholm is growing









78 000 new homes







ITASCA



Metro expansion







Metro to Nacka and Southern Stockholm

- Three critical areas identified at an early stage of the project:
 - Tunnel under the Saltsjön Bay
 - Sofia Metro station
 - Gullmarsplan metro station
- Need of analyzing the initial stress state in the central and southern areas of Stockholm









Objectives

- 1. To create a regional-scale model to study the *in situ* rock stress situation in the Stockholm area.
- 2. To investigate if the *in situ* rock stress situation is affected in a large scale by the topography and/or the major faults.
- 3. To study in detail the rock stress levels at the identified critical sections and at the new tunnels depth.
- 4. To verify the design of two new underground stations.







Regional-scale numerical









Regional-scale numerical model











Regional-scale model Saltsjön Bay









Regional-scale model Rock stress measurements







Regional and Local models

















Regional model vs Local model Gullmarsplan station









Conclusions (I)

- The model has improved the knowledge of the *in situ* rock stress situation in the Stockholm area.
- The regional scale model behaves less stiff than the local models, i.e. the regional model allows larger stress redistributions.
- The rock stress measurements have helped to validate the numerical model.
- The dip and dip direction of the faults are the key factors that affect the *in situ* stresses, rather than the material properties.







Conclusions (II)

- The *in situ* rock stress levels at the depth of the new lines are within the expected intervals, but stress jumps and reorientations occur next to faults.
- The major faults dipping 70° experience tensile stresses in the "hangingwall" side.







Acknowledgements

Extended Metro Administration



JL Stockholms läns landsting

