

BEHAVIOR OF REPOSITORY TUNNELS SUPPORT

Purpose(s): To compare tunnel support behavior for preliminary design of two potential repository sites.

Client: DBE Technology (Germany)

Date: 2006-2007

Location: Germany

Partners: None

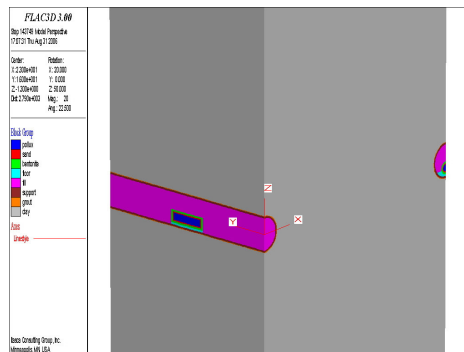
Project executive manager: Daniel BILLAUX

Code used: FLAC^{3D}

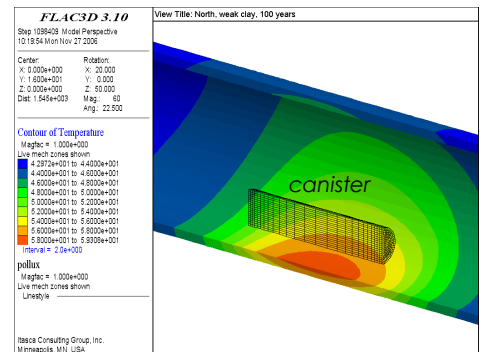
Numerical modeling was used to **compare the support stability** for tunnels in two potential nuclear waste sites; the sites had varying rock properties, emplacement depths and storage geometries.

The tunnels were excavated using a **Tunnel Boring Machine (TBM)**. Because both excavation and **thermal output** are likely to generate sizeable stress increases, the two processes were simulated carefully.

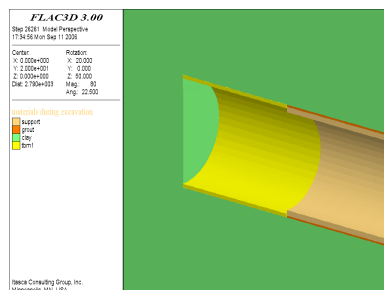
The most significant differences between the sites are their depths, which result in contrasted initial stresses and temperatures, and the clay properties. The southern site is at a depth of 790 m, compared to 330 m for the northern site. Also, the clay in the southern site is weaker, but stiffer, than the one in the northern site. Because initial temperatures were higher in the deep southern site, the thermal power from the canisters is designed to be smaller, and the canister spacing is wider.



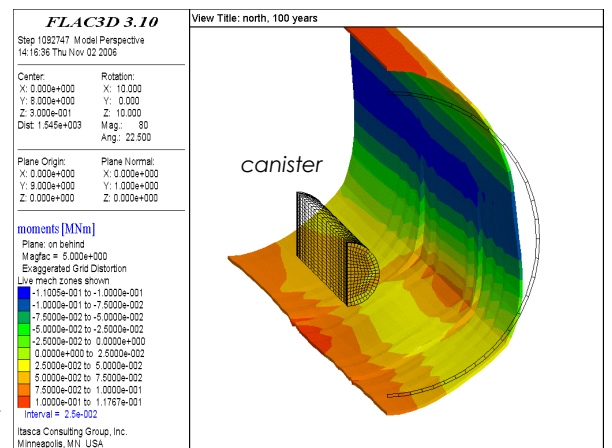
Tunnel (pink) and canister (blue) layout, northern site



Temperatures in the support after 100 years of heating, northern site



Excavation: the TBM (yellow), support, and grout (orange)



Bending moments in the support after 100 years of heating, northern site.

⇒ RESULTS:

The most important difference in behavior between the two sites is the load on the support due to excavation:

- Yielding of the clay produces a very high "simple compression" regime in the support at the southern site. Clay expansion due to long-term heating causes bending moments, and extra compressions in the roof and floor.
- Support at the northern site experiences limited compression and tension, coupled with some bending moments. Clay expansion due to long-term heating causes bending moments that result in sizeable tractions.

These results were included in an overall comparison of the two sites.

KEYWORDS:

- Tunnel support
- TBM excavation
- Thermal mechanical coupling