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## Discussion: Observations of lining load in a London clay tunnel

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Davies and Bowers (1996) described the design and installation of instrumentation to measure lining loads in Jubilee Line Extension tunnels. Initial data are now available from the test location under St James's Park.

Figure 1 plots lining hoop stress recorded by load cells against time. Zero load on the graph represents the condition immediately prior to expansion of the lining. Thus the increment due to expansion of the ring during the shove process is clearly apparent from the initial sections of the curves. The data also show that an asymmetric lining loading occurred at axis during expansion and has persisted over time. An adjacent strain gauged lining did not show this difference, suggesting that it was a localised effect.

After expansion, the loads have continued to rise at a lesser rate. The vertical loads (at axis) have risen above the horizontal loads and have reached a mean value just above 50% of overburden at 100 days. The horizontal loads, recorded at crown and invert, reached around 40% of overburden in the same period.

Comparison with data from another London Clay tunnel in Regent's Park (Barratt et al 1994) shows the relationship of horizontal to vertical loads to be similar. However, it is notable that a greater proportion of the overburden load came on to the St James's Park tunnels in the first few days, possibly due to slight differences in the ground conditions.

It is intended that monitoring will continue during the operational life of the new tunnels.

### References:

- Barratt D A, O'Reilly M P and Temporal J (1994) Long term measurements of loads on tunnel linings in London Clay. *Tunnelling '94*. Institution of Mining and Metallurgy, London.
- Davies H R and Bowers K H (1996) Design and installation of special tunnel rings to measure long term ground loading. *Geotechnical aspects of underground construction in soft ground*. City University, London.

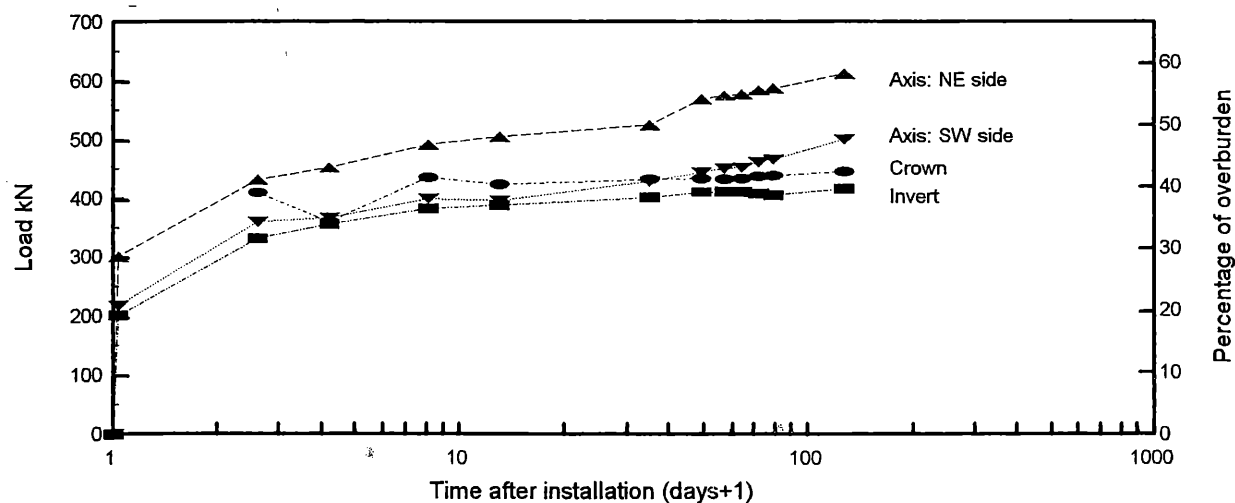


Figure 1 Lining hoop loads, recorded in an instrumented ring in London Clay at St James's Park.

