# Field Loading Test of Fiberglass Tunnel Model

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## Abstract

In order to ensure that the fiberglass material can meet the needs of large-scale physical model tests, the author carried out field loading test for fiberglass tunnel model. And the deformation behavior of fiberglass material during the loading process was monitored by means of dial gauge, total station and strain gage, in order to verify the performance of fiberglass material.

## Keywords

Fiberglass, Field Test, Deformation Monitoring.

## 1. Test background

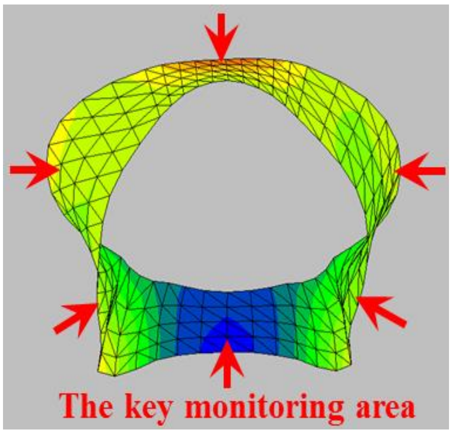
Fiberglass tunnel model of 1m long, which has cross-section size and material thickness consistent with those of the actual model is used to carry out field loading test in order to verify the performance of fiberglass material and to ensure that the fiberglass tunnel model has good strength, stiffness and stability, which can meet the needs of large-scale physical model tests. During the loading test, deformation and destruction of fiberglass material are monitored.

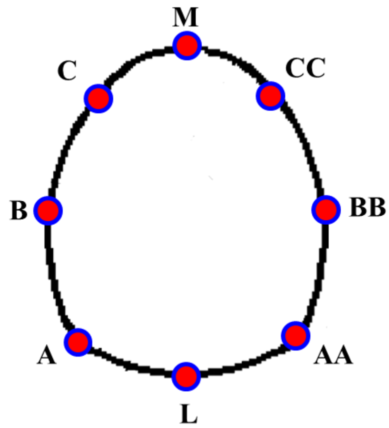
## 2. Test design

Excavate a tunnel about 5.33m long × 1.73m wide ×2.5m deep for placement of the fiberglass tunnel model. Soil layer with depth of 0.3m should be kept between the bottom of the fiberglass tunnel model and the bottom of the pit. Bricks should be used for compaction below the soil layer so as to reduce the sedimentation of the fiberglass model during the loading process. Pile bags of stones on top of the fiberglass model to simulate the stress caused by upper covering soil. Bags of stones are loaded layer by layer in the loading test, covering the rectangular area of 1.73m × 1.0m on the top of the model and the rectangular area of 0.5m × 1.0m at both sides of the model. Only bags of stones which are 1.25m high are put in the area of 0.5m × 1.0m, with the purpose of strengthening lateral confining pressure to the fiberglass, so as to make it closer to the stress state in large-scale model tests.

Through calculation of numerical simulation for the loading test in earlier stage, it is found that the deformation of the shoulder, the middle part and the bottom of the fiberglass tunnel model is serious, which is “indenting in the shoulders, swelling in the middle and shrinking at the feet”. The test employs dial gauge, total station and strain gage to monitor the key parts with obvious deformation.

Fig. 1 Photo of the testing field




(a) Numerical simulation of deformation (b) Monitoring points

Fig. 2 Positions for monitoring deformation

## 3. Test results

Fig. 3 is data of the dial gauge, showing the displacement trends of different monitoring points. Fig. 4 (a) is used for the convenience of analysis.

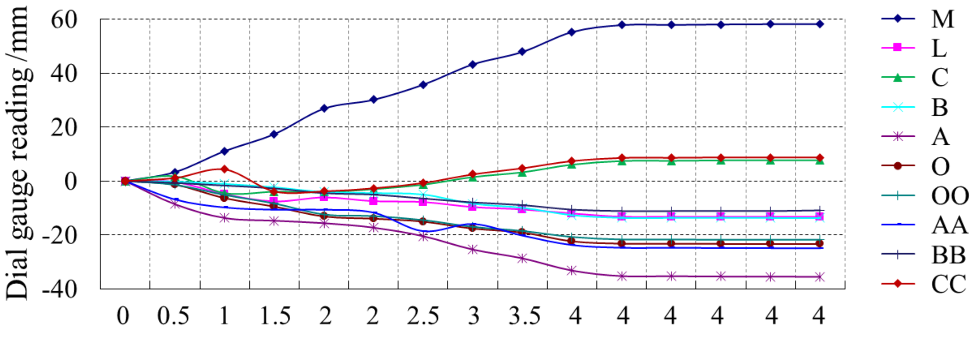
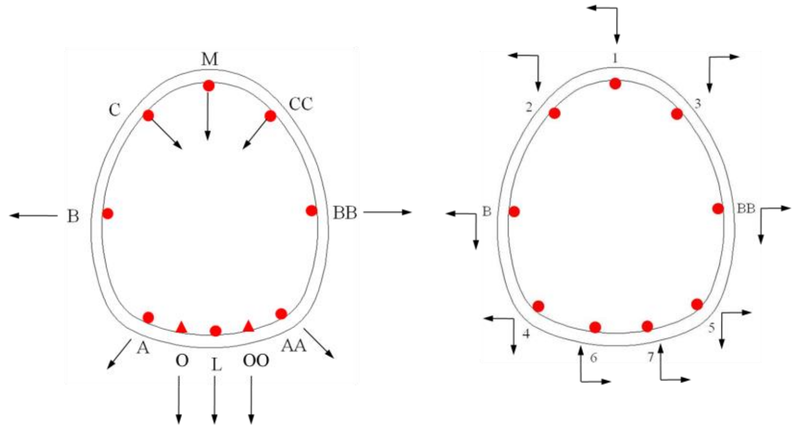



Fig. 3 Displacement change of the monitoring point through dial gauge

Fig. 4 (b) shows the displacement obtained through the total station. Although the displacements shown in dial gauge and total station are not totally the same, yet the trends are very similar, both of which are "indenting in the shoulders, swelling in the middle, shrinking at the feet and protruding at the bottom". The trend is consistent with those in the numerical simulation and in the field test.




(a) Displacement shown in the dial gauge (b) Displacement shown in the total station

Fig.4 Displacement diagram of monitoring points

(a) Photograph before the test (b) Photograph after the test

Fig. 5 Deformation in the field test

During the whole test, the strain value remains in the range of ±3000με. According to the previously measured fiberglass elastic modulus of 2.9GPa, it can be calculated that the maximum stress of the model is 8.1MPa, which is far less than its uniaxial compressive strength of 55MPa. Besides, there is no significant crack on the model during the test, which proves the material strength meets the requirement.

## 4. Conclusion

Through field loading test of fiberglass tunnel model, it is found that the monitoring results of the dial gauge and the total station can reflect the deformation of the model. The deformation of the tunnel model is symmetrical in the left and right direction, and basically the same in the front and rear direction. The strength of the model is able to meet the test requirement, but the deformation is relatively serious. For the next step, non-alkali glass fiber can be used to increase the overall strength and stiffness of fiberglass.

## References

[1] H.P. Wang, S.C. Li, X.F. Zheng, et al. Research progress of geomechanical model test with new technology and its engineering application, Chinese Journal of Rock Mechanics and Engineering, vol. 28 (2009) No. S1, p. 2765-2771.

[2] A.M. Chen, J.C. Gu, J. Shen, et al. Application study on the geomechanical model experiment techniques, Chinese Journal of Rock Mechanics and Engineering, vol. 23 (2004), 3785-3789.

[3] W.J. Wang, X.Z. Cheng, S. Zhang. Study on the technology of displacement surveying by model test, Energy Technology and Management, vol. 3 (2005), 59-61.