DETAILS OF INTERESTING CLAIM

No: DOIC 51

Type of Insurance:

CAR-ALOP

Description of damaged item:

Metro tunnel damage

Cause of Loss:

(3) Faulty design

Claim Cost:

The repair works cause a delay of 47 months.
No amount was stated.

Description of Incident and Loss Prevention Measures initiated:

Description of project:
The Metro system comprises twin tubes excavated by a TBM with an external diameter of 6.2 m. The distance between the tunnel centre lines is 11 m. The total length of the project is 22 km. The project includes the construction of 17 stations. The incident giving rise to this claim occurred within the section of the project between two stations. The distance between these stations is 2 000 m. 440 m of the tunnels lie below the river. Both tunnels have been constructed at the same depth, with the deepest section having 37.7 m of cover. At a point approximately 50 m from the river is a ventilation shaft above a cross-tunnel connecting the two main tunnels.

Loss occurrence:
At the time the incident occurred, both main tunnels had been completed between the stations. The box section of the ventilation shaft had also been constructed and work was ongoing on the construction of the cross-tunnel between the main tunnels. Ground freezing had been undertaken to provide a workable medium through which the cross-tunnel was being excavated by traditional mining methods from the downstream tunnel to the upstream tunnel. As the excavation works had reached the upstream tunnel and the concrete rings of the main tunnel had been removed to allow the connection of the cross-tunnel into the main tunnel, there was a sudden flow of water and soil into the tunnels. This flow could not be stopped and within a short period of time extensive catastrophic damage had been sustained to the tunnels and to third party properties on surface.

Outline the interesting or unusual aspects of this claim or problems experienced during settlement:

Possible development/Worst-case scenario:

The insured and the municipal authorities were faced with a catastrophic situation. The incident occurred at around 3.00 a.m. and by 6.10 a.m. the authorities had appointed to coordinate the efforts of numerous experts in response to the evolving risk. The worst-case scenario was considered to be that the damage to the tunnels could extend to the two neighbouring stations. 2 000 m of tunnels could be totally damaged between the stations.

Mitigations measures implemented:
The following measures were implemented:

- Cut off the tunnels and inject water into them in order to equalise soil and water pressure
- Reduce extra loads and prevent thrust and vibration to the ground
- Prevent water from the river flowing in and increasing damage to the tunnels
- Stabilise the ground
- Provide support services to secure works and ensure safety

These measures were implemented within 15 days. Nature and extent of damage Although the most severe settlement at ground level was recorded at 4 m, the greatest settlement of the tunnels occurred directly below the ventilation shaft where 9 m of settlement was recorded. In total, a 250-m length of each tunnel was discovered affected by the subsidence, of which approximately 50 m were beneath the river.
Seven buildings had to be demolished and nine others had to be repaired. The 120-m-long flood protection wall was severely damaged, a 60 m section collapsed entirely. Nearby roads, a pumping station and public utilities were affected to varying extent.
The accident was caused by the combination of faulty workmanship together with the breakdown of the ground-freezing equipment a few days before, allowing the ground to start thawing. Shortly before the accident occurred, an order was given to remove a wooden sealing board from the excavated face and drill a hole of 0.2 m diameter into the face with a pneumatic drill.

Repair works
The planning of the repair works took place during 11 months. After considering different alternatives (including a new route), the less expensive and less time-consuming method was chosen. The repair works are to be executed in open trenches including the section beneath the river, where a river cofferdam platform is to be built. This will be done in two phases to minimise disturbance of traffic on surface.

The repair works cause the longest delay (47 months) encountered in tunnel construction loss history. It can be summarised as follows:

- Two weeks of mitigation and emergency measures
- 11 months of planning followed by
- 36 months of repair works

Lessons learned: Why is the delay so high?
Generally speaking, when a collapse occurs during tunnel construction the first step is to prevent an extension of damage to third-party property on the surface. This is mainly achieved by pouring all kind of materials (concrete, earth, rock) into the crater and sometimes by flooding part of the tunnel too. These mitigation measures have to be taken very rapidly and are only intended to minimise damage on the surface. This means that first it will make the access to the damaged section more difficult, thus delaying the assessment of the extent of the underground damage, and then the removal of all the materials that were hastily poured in will make the repair works more difficult and more time-consuming.

These mitigation measures are always taken before it is even possible to hazard a guess at the cause of the accident. It will then take a long time to assess the extent of the damaged area and the cause of the collapse. In most cases, additional soil investigations are then necessary to determine the cause of the loss and to plan the repair method.
Very often the repair method differs from the original method, making the repair works more costly and time-consuming. As a tunnel is nothing but a void, the underground repair of any given collapsed section will first have to restore and stabilise a “new soil” through which a new void will have to be re-excavated. The stabilisation measures can include grouting, ground freezing, compressed air. All these additional measures are very time-consuming. If an underground repair is not possible, an open cut or trench has to be dug from the surface. In exceptional cases, a repair will not be possible so that a new route has to be chosen, making the overall delay even longer. Otherwise as in EAR, especially when the loss occurs during testing, there is no way of reducing the delay by means of extra charges for speeding up the delivery of spare parts or of new machines.

Information was taken from IMIA WGP 48, Page 11
http://www.imia.com/downloads/imia_papers/wgp48_2006.pdf