DEVELOPMENT ON THE MORTAR MATERIAL FOR CABLE SYSTEMS IN A DIRECTIONAL DRILLING

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ABSTRACT

In Japan, directional drillings are used to install underground power cable duct in locations where it would be difficult to dig and bury it. After the tunnels are run, cable duct is installed in the tunnel duct and infill is used to fill in any dead spaces. In some cases, increases of infill thermal resistance interrupt cable heat dissipation and consequently result in breakdown. Therefore, we developed a new infill with low thermal resistance and the ability to be pumped into long tunnel ducts and then applied it under field conditions.

KEYWORDS

Tunnel duct, Infill, Thermal resistance

TUNNEL DUCT OUTLINE

In Japan, directional drillings are used in places where burial of cable duct by drilling from above is difficult, such as heavily-traveled main roads, rivers, and places where there are railway tracks. The basic directional drilling method consists of establishing shafts at both ends of the tunnel, drilling horizontally with an excavator, and then pressing concrete pipes into the drilled holes from the back end with a hydraulic jack.
After the tunnels are run, cable duct is installed and any dead space is filled with infill to produce a tunnel duct (refer to Fig.1).
The main purposes of filling the dead space with infill are to prevent sand from entering the tunnel duct, which would cause a depression in the ground if the tunel ducts became damaged, and to secure the cable duct in place for cable installation.

CABLE BREAKDOWN DUE TO INFILL INFLUENCE

A mortar material (hereafter referred to as air mortar) is normally used as the infill; this material is easily procured, low in cost, and about 50% air, and it can be pumped into long tunnel ducts.
Cable breakdown has occurred when air mortar is used in conjunction with heavy loaded transmission line (refer to Fig. 2). Estimation of the temperature of the cable using the cable insulator's heat history indicated that abnormal overheating of the cable occurred.
Therefore, the air mortar in the tunel duct was examined, and the main breakdown area was located in an air gap on the upper side of the tunel duct. Furthermore, separation of the air mortar material was confirmed. Notably, the air mortar around the cable was dry and brittle and contained plenty of air bubbles. Measurement of the thermal resistance of the air mortar indicated that it was extremely high (about 16 K·m/W) compared with the value of normal soil (about 1 K·m/W). We believe that the high thermal resistance of the air mortar inhibited cable heat dissipation; the cable then overheated, and this resulted in breakdown.

Figure 2: Cable breakdown in a tunnel duct

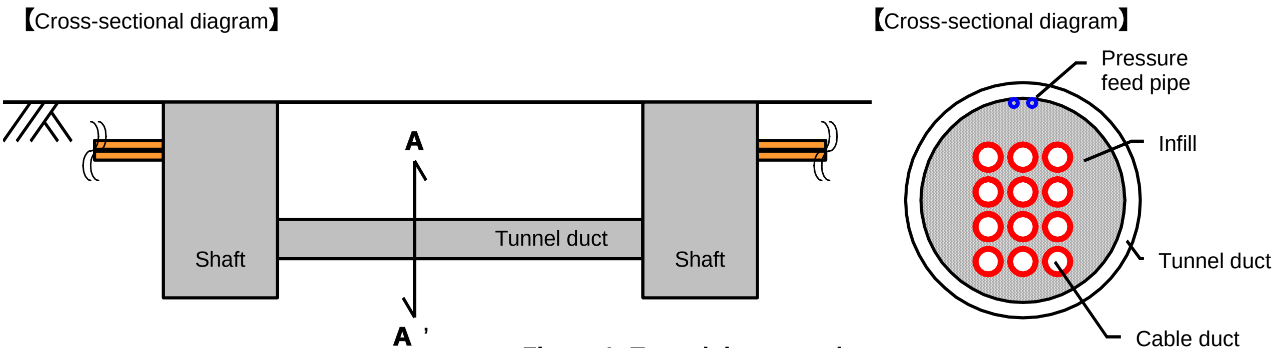

Figure 1: Tunnel duct overview