# UNIRAP SYSTEM HIGH-HEAD MATERIAL DELIVERY FOR SHOTCRE GRID BEAM CONSTRUCTION



Since 1960's shotcrete-based grid beam structures have been increasingly installed as one of the major slope stabilization methods in Japan. As the number of projects increased, demands to install beams of higher strength at higher places prompted improvement of conventional spray gun based installation system. UNILAP system was developed by Raito Kogyo to respond to the demands by combining pumping delivery with shotcrete operation.

# **UNIRAP Method**

## High strength mortar/concrete

Using newly developed mix propotion with special admixtures, grid beams with a designs strength of 24MPa are constructed.

## e High quality mortar/concrete

This system minimizes the rebound which causes material loss and product deficiency.

## **3** Deliver materials to 135m in height or 660m in distance

Using high-head pump and special materials, this system can deliver wet mix to 135m vertically or to 660m horizontally.

#### **4** Unique formwork made of wire mesh

Special formwork units help to construct the product being firmly attached to the slope surface.

## Automated plant for reliable quality control

The material preparation process, including scaling, mixing and pumping, is fully automated to achieve high product quality.

Resin-coated hose

# **Delivery System**

In contrast to the conventional shotcreting which uses air to deliver materials from the plant, UNIRAP uses a high-head pump to deliver to a shotcrete point. Pressurized air is added at the Y-branch near the nozzle. Then the materials are blasted into the forms as in normal shotcrete operation. The air pressure is properly controlled with regard to fluid dynamics to prevent turbulence and dispersion of the material.

Pump

Compressor



Nozzle

# **Material**

UNIRAP uses plastic mortar/concrete to facilitate pumping delivery. Compressed air is added at the Y branch near the shotcrete nozzle. Several admixtures, including special RSA agent and high-range AE agent, are added to avoid material segregation during delivery and to increase rheopectic property to prevent sagging/sloughing after placement. Due to the combined effect of the admixtures, the fresh mortar/concrete loses flowability immediately after shotcreted, to be of medium slump.





Fresh mortar before delivery

## **Product Quality**

As shown in the photos, a sliced section and core samples of placed mortar/concrete are fairly homogeneous and least intervened by defective rebounds. The high strength property of product has also been demonstrated from compression tests and steel-concrete bond strength tests.



Sliced section

Core samples



