

SHOTCRETE GRID BEAM-FREE FRAME

Concrete grid beam installed by shotcreting to protect and stabilize slopes



Shotcrete grid beams are widely applied in Japan to prevent slip failure of slopes. Unstable slopes are effectively stabilized by concrete grid beams with a ground anchor or soil nail installed at the intersection of beams. Free Frame Method is a typical grid beam construction method characterized by unique formwork made of wire net, called Free Form, and shotcrete-based installation technique. Reinforcing bars and the formwork units are assembled on slope and mortar or concrete is sprayed. The wire net formwork also serves as a part of reinforcement. This system enables the grid beam to be installed at height on slope.

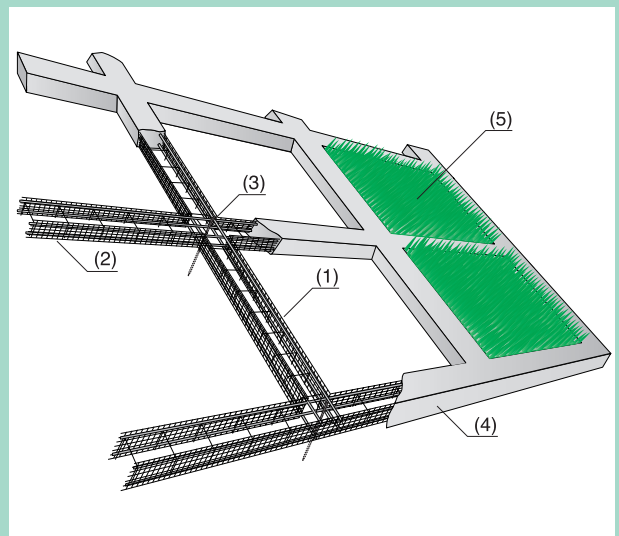
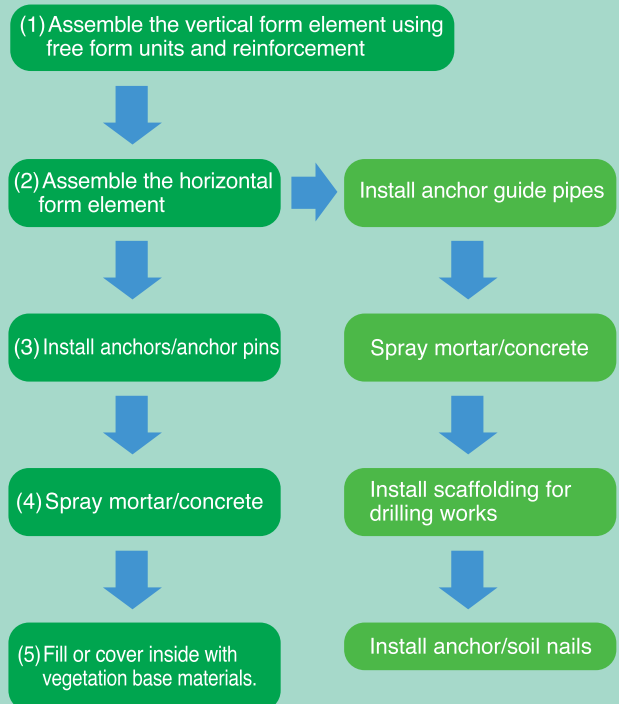
Applications

- (1) Protect and stabilize slopes
- (2) Prevent collapse of steep slopes
- (3) Reinforce open-cut ground
- (4) Reinforce and repair existing structures
- (5) Reinforce levees
- (6) Revegetate soilless slopes

Advantages

- 1 Product is continuous and durable due to cast-in-place installation.
- 2 Product is attached tightly to the slope surface by blasting energy of shotcrete and therefore provides high earthquake resistance.
- 3 Free Form, a special formwork unit serving as a mold and reinforcement, is finally incorporated in the product as a part of reinforcement. No need to remove it later.
- 4 Free Form enables construction of continuous beams on undulated surfaces.
- 5 Quality product. Rebound of shotcrete, which causes product deficiency, is effectively blown out of openings of Free Form.
- 6 No need to pour foundation slab
- 7 Ground anchor or soil nail can be installed at the beam intersection
- 8 Applicable to slope greening on soilless slopes. Various fill materials such as organic soil, vegetation base materials, or sand bags, are installed inside the areas of the grid beams to revegetate soilless slopes.

General Construction Process



Shotcreting

Wet mortar or concrete is delivered by compressed air through high-pressure hoses to an installation point on slope. The material is then blasted onto the surface and compacted itself by the energy of high velocity materials

Standard Mortar Mix

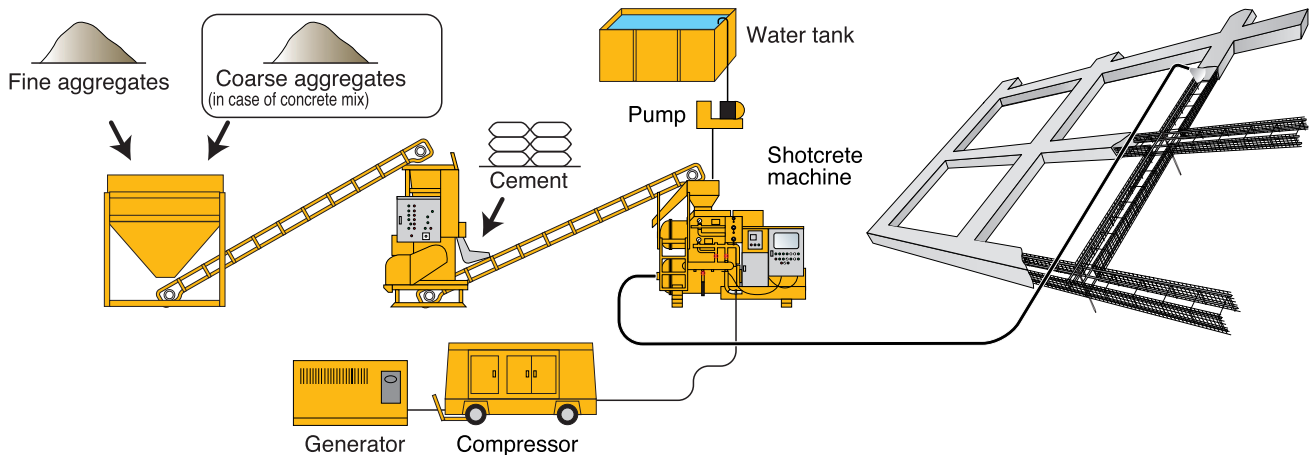
| Cement | Sand | Water |
|--------|------|-------------|
| 1 | 4 | 0.6 or less |

Standard Ratio of Concrete Mix

| Cement | Sand | Gravel | Water |
|--------|------|--------|-------------|
| 1 | 4 | 1 | 0.6 or less |

Maximum size of aggregate: 15mm

Standard configuration of equipment



Wide-range Application and Reliable Construction

① Grid Beam of Type F150 - F300 for Slope Greening

Slope greening is often desired to apply to road-side cut slopes as protection from surface erosion and weathering. Revegetated slopes harmonize with the surrounding area, improve landscaping, and prevent car noises from echoing. Shotcrete grid beams with a small section (150mm to 300mm square) are used for this purpose. As vegetation base, sand bags may be installed inside the area of grid beams on the slopes less than 45 degrees (1:1.0) in gradient. If the gradient is steeper than this, it is desired to spray specially-mixed vegetation base materials using the same shotcrete equipment.

② Grid Beam of Type F200 - F400 for Both Greening and Stabilization.

Whether a slope is stable or not can generally be determined from its geological features, rock quality, slope gradient, groundwater conditions and effluent treatment. Although the slope itself stands stable in general, the following risks still remain especially for long or weathered slopes:

- Potentiality of partial collapse due to unconformities
- Potentiality of surface failure

The shotcrete grid beams with a 200 to 400mm square section are installed to protect from partial collapse and surface failure as well as to serve as a foundation of replanting.

③ Grid Beam of Type F400 - F500 With Ground Anchor Installation

The grid beams with a larger section (a square of 400 to 500mm or more) are installed with ground anchors to stabilize cut slopes or to prevent moderate-scale landslides. The installation of the shotcrete grid beams is a suitable measure to prevent landslides because the blasting energy of shotcrete ensures a tight contact of beam with the slope surface. Inside the area of grid beams is often covered with sprayed mortar or concrete.