



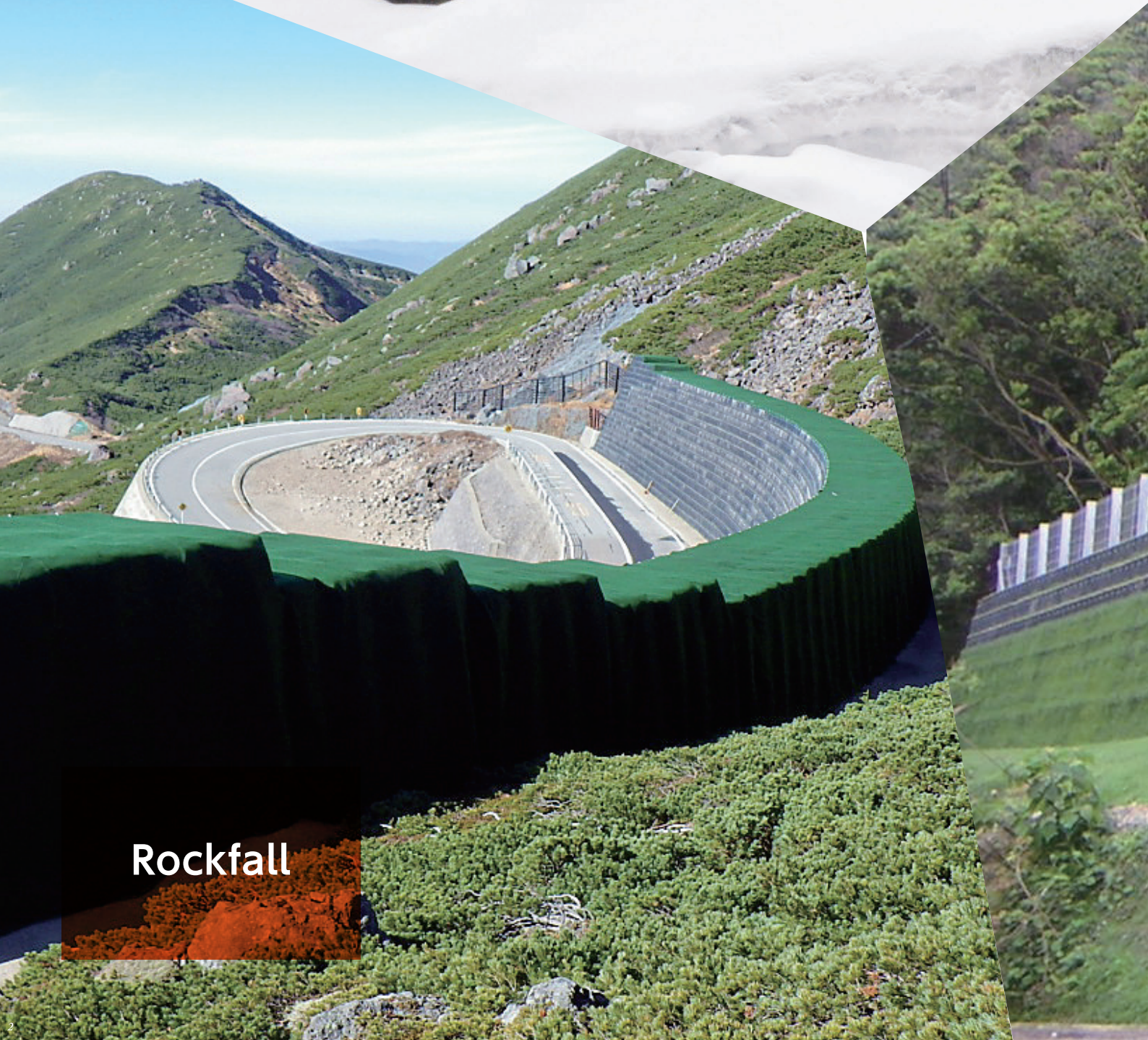
Creation of the Safety

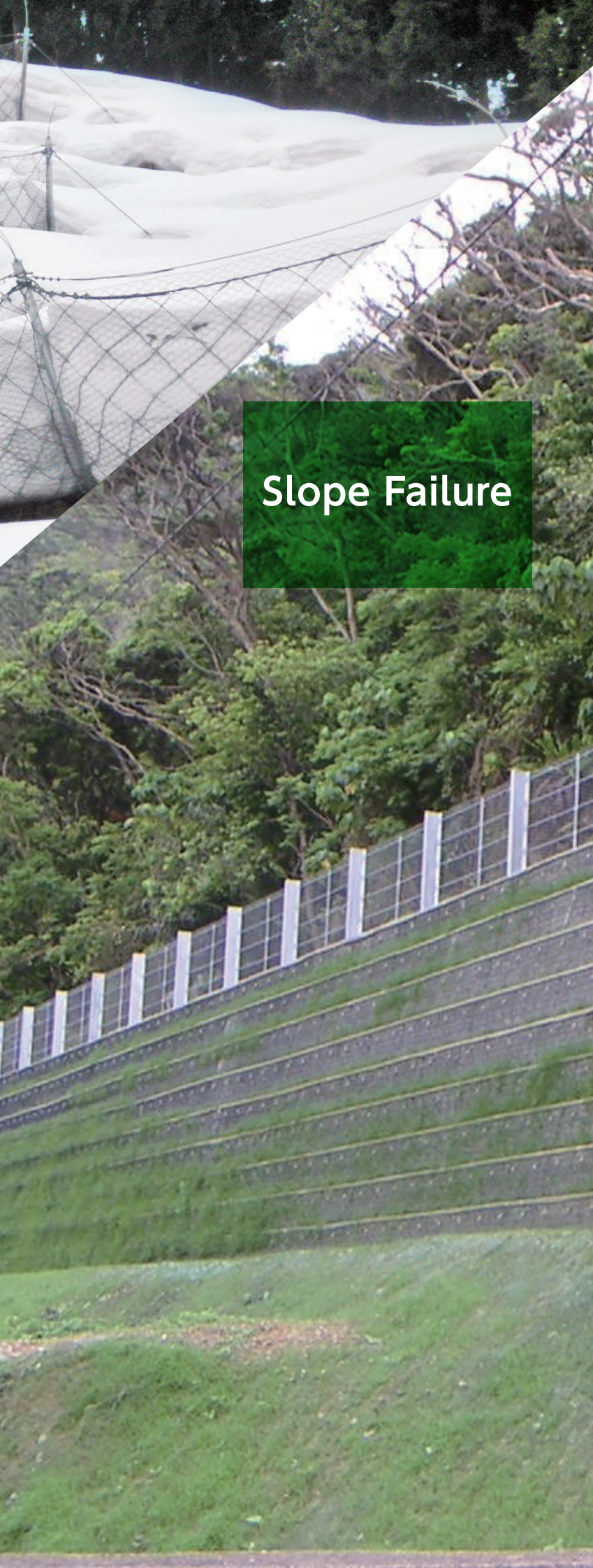
安全の創造

Avalanche



Rockfall





Slope Failure

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PROTEC ENGINEERING is a company that has its own corporate philosophy as “contributing to society through innovations in natural disaster prevention technologies” and its head office is in Japan.

We have researched technologies of countermeasures against natural disasters; particularly rockfalls, slope failures, and avalanches; developed new construction methods and new products in harmony with the natural environment; and contributed to the reduction of damage due to natural disasters. Since establishment of our company, we have achieved numerous experience of construction throughout Japan.

And also we have many results of preventing actual damages at the actual disaster sites. We have an organization that allows us to perform consistently from development to design, manufacturing, sales, and construction, and we take pride that both our response ability and technical capabilities are at the top level in the world. If you are in need of mitigation against disasters, feel free to contact us, PROTEC ENGINEERING, professionals in disasters mitigation.

Company Profile

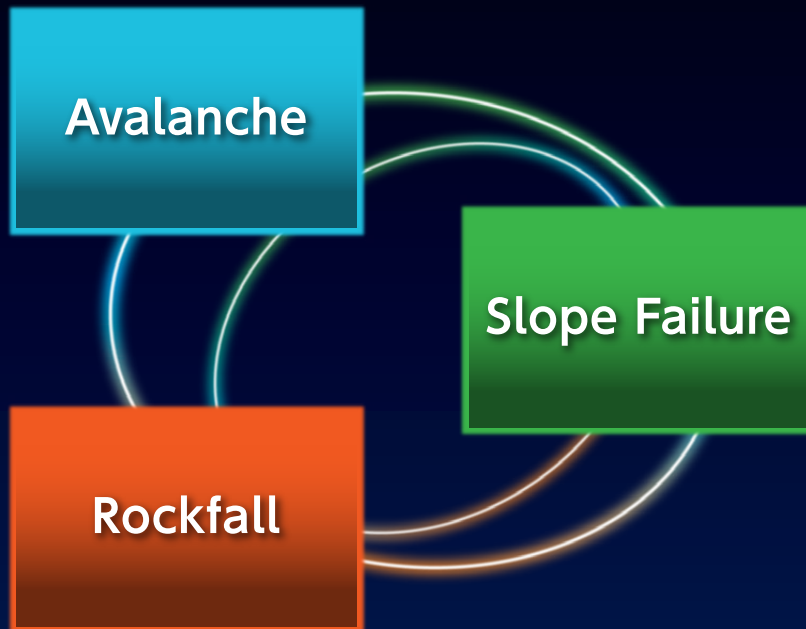


Trade Name: PROTEC ENGINEERING, INC.
Head Office: 5322-26 Oaza Hasugata, Seiro-machi,
Kitakanbara-gun, Niigata, Japan
TEL +81-25-278-1551
Established: May 21, 1998
President : Toshimitsu Nomura
Capital : 99.7 million JPY



Business summary

Contributing to society through innovations in natural disaster prevention technologies.



Our main business is development, manufacturing, sales, and construction of products for slope disaster mitigation, such as rockfalls, slope failures, and avalanches.

We are producing new construction methods that match to situation of the sites, and proposing best solutions.

These methods are roughly divided into two types. One is 'prevention method' to prevent disasters and the other one is 'protection method' to protect buildings, roads, and human life from disasters.

Examples of new construction methods and new products that we have developed include a construction method for Mechanically Stabilized Earth walls for rockfall and avalanche using soil as the main material, flexible rockfall barriers, snow net, which also effective for rockfall protection, and slope failure protection fence utilizing high-performance main posts.

Against natural disasters occurring in the world, we will continue to pursue technological innovations aiming at a society in which people can live in peace.



Geo Rock Wall protected the elementary school against rockfalls of estimated 5000 kJ. Also after collisions with falling rocks, no change in state was found on the bank body.

Slope Guard Fence Type LE caught soil of slope failure caused by a heavy rain. This fence has special structure for the easy maintenance, so sand and soil at the back side of the fence was smoothly discharged. After all it contributed to early restarting of passage after the disaster.

Efforts towards Creation of the Safety



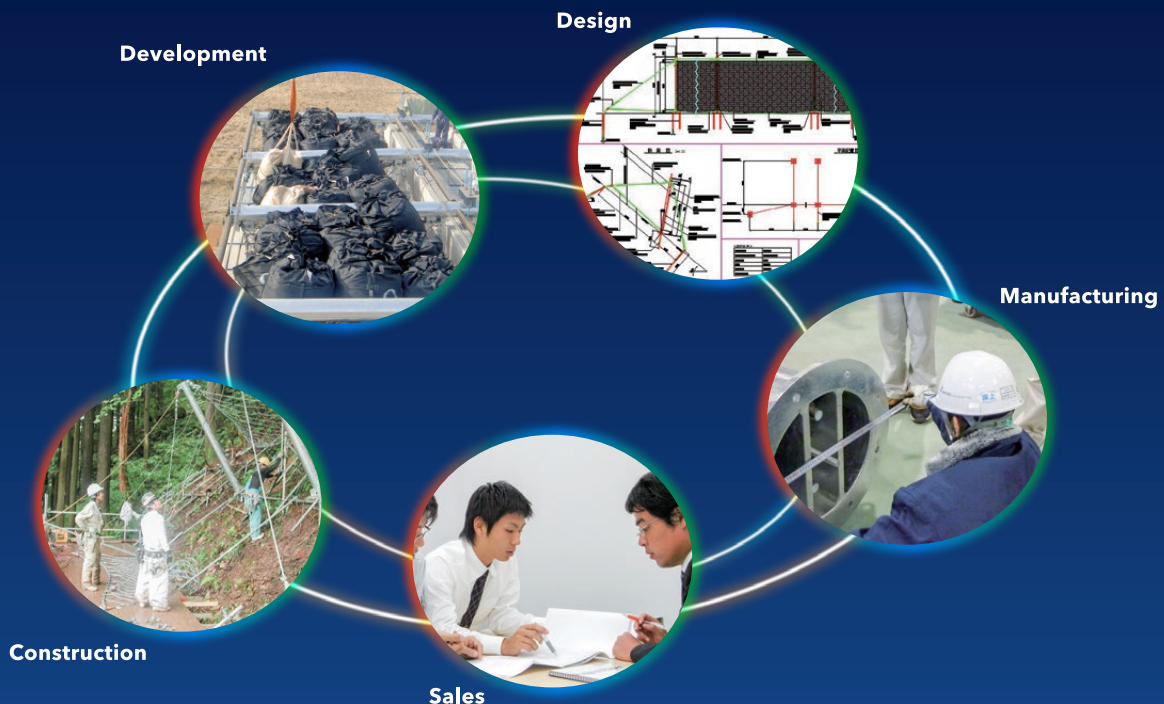
What we are manufacturing is not a mere iron fence and soil retaining wall.

We are creating safety for people's lives by supplying our products. "Creating Safety" -in the mind of this concept, each

employee of PROTEC ENGINEERING is striving to work at the site today.

We will introduce our efforts towards "Creation of the Safety."

Consistent organization from development to construction



We have established our organization that performs consistently from the development of products to their design, manufacturing, sales, and construction.

By handling all processes concerning products, we are able to accurately correspond to the problems appeared in each section of our company and also we are able to perceive the

needs or requests from our clients, and to respond to them in a timely manner. In addition, we will be able to further brush up our products and lead to an improvement of our response capability.

The value of experience accumulated from such a consistent organization will bring forth more advanced safety technology.

Performance verification and product development through testings



We carry out demonstration testings by full-scale model and computer simulation at the stage of product development and has been verifying performance. We have test fields and are able to carry out actual impact tests using a heavy weight and to check workability on the test slope. Furthermore, we also prepare test equipment for proving of materials strength in our own factory. As the products dealing with natural disasters, we are using right technology and accurately checking safety before supplying them.

Thorough quality control in our own factory



We have our own factory and are manufacturing many of our products there. Furthermore, for improvement of safety and efficiency, we are also manufacturing in-house jigs used in product processing and construction. Because our plant is linked to our head office, close communication with the site is possible, and so we are able to manufacture products accurately and timely according to requirements. Equipment

in our factory is thoroughly organized, and safety management in the manufacturing process and quality improvement of products have been duly realized.

* ISO 9001 Certification Registration No.09345 (Design/ manufacture of protection and prevention barriers for rockfall, snow avalanche and slope failure)

Flexible Rockfall Fence

ARC Fence



General Description of Method

ARC Fence is a barrier against rockfalls, consisting of steel posts, cables, wire mesh, anchors, and energy dissipator installed in place. ARC Fence has the structure to absorb the energy of a rockfall from the friction produced between the energy dissipator and cables. ARC Fence withstands the rockfall energy up to 100 kJ.

Moreover, ARC fence does not impair the surrounding scenery because of the wire mesh structure. Additionally, they can be laid between trees. Therefore, cutting of the trees can be minimized.

Two types of ARC fences are available. Type N (Normal Type) has the wire mesh on the

mountain side. Type P (Pocket Type) has the additional function to prevent a rockfall from rolling out from the fence at the end of the wire mesh.



Energy dissipator

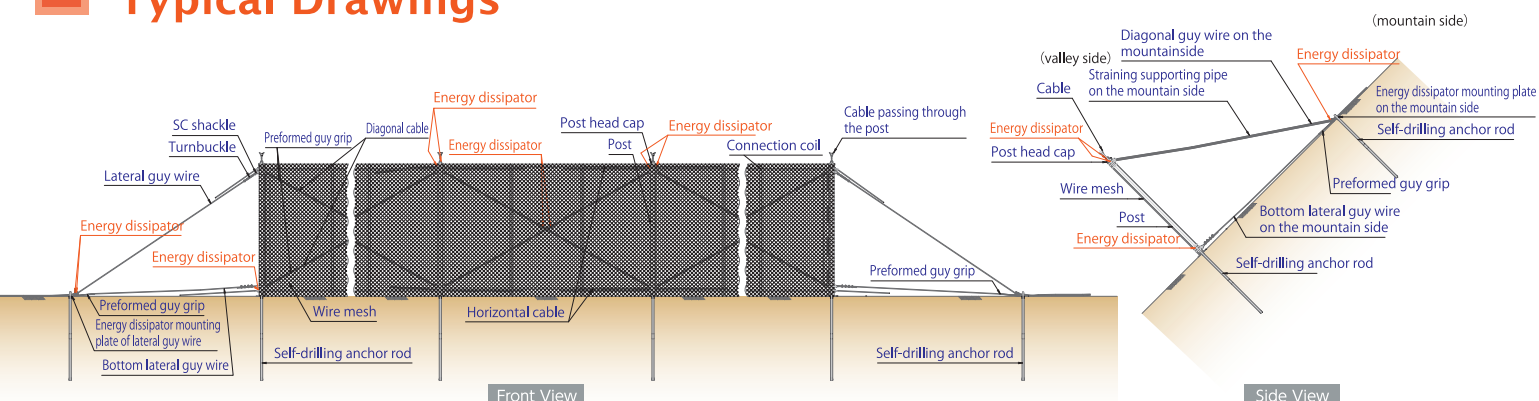


Type P

Type P can catch the rockfall near the knick line securely.



Typical Drawings



Front View

Side View

Applicable Location



- * A location where potential rockfalls present over a wide area and taking a measure against the individual rock is not practical.
- * A location where a sufficient space to build a protection structure such as a fence is not available between an object to be protected and a slope.
- * A location where a margin for the deformation of the wire mesh is available between an object to be protected and the fence (5 meters at maximum).
- * Capacity of energy absorption: 100 kJ



By adjusting the span length and the layout, ARC Fence can be installed between trees and therefore cutting trees can be minimized.



The components of ARC Fence are the right weight. Thus, heavy machinery is not necessary to install ARC Fence. Because of this feature, ARC Fence can be installed in a location where access to the location is limited, such as the back of a house.



Construction Procedure



1. Anchor drilling

Make a hole by using a rock drill and a self-drilling anchor.



2. Grouting

Inject cement paste into the drill hole. Check whether the paste overflows from the hole.



3. Anchor testing

Test the anchor whether it has the prescribed pulling force.



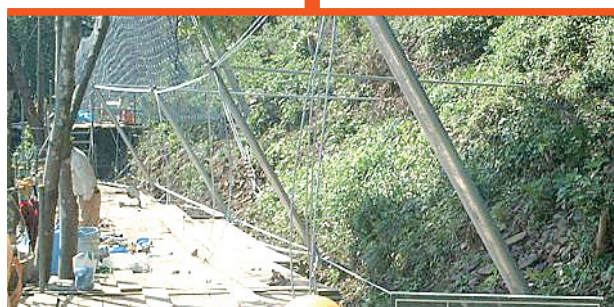
4. Installation of the posts

Pass the cables through the posts. Then, insert the posts into the base plates. Attach the energy dissipator on the post head.



5. Installation of the cables -1

Set up the cables between the post and anchor.



6. Installation of the cables -2

Set up the cables between the posts and then place the energy dissipator in positions.



7. Installation of the wire mesh

Set up the wire mesh between the posts and connect the wire mesh with the cables.



8. Completion

Construction Examples



Construction Example on roadside



ARC Fence can be installed as close to the object to be protected as possible within the deformation distance of the wire mesh.



ARC Fences is also effective as the rockfall protection along a railway.



ARC Fence is able to conform to the landform.



Scaffoldings are used to install ARC Fence.



Because the foundation for ARC Fence is the anchors, it can be installed on a slope face on which the frame works are constructed.

Flexible Rockfall Fence

SPARC Fence



General Description of Method

SPARC Fence is a rockfall barrier which is installed on the slope. SPARC Fence, without using any plastic deformable components such as energy dissipators, flexibly absorbs rockfall energy with a cable net and special post.

Because the structure does not use an energy dissipator, SPARC Fence eliminate the needs of replacement of energy dissipators after receiving falling rocks and makes it possible to catch repeatedly the maximum scale of falling rocks supposed in design.

This is a construction method reducing time and cost in maintenance. Furthermore, because it is designed so as to match the pressures of snow and sediment, it is usable as a combined-use

fence for measures against rockfalls, avalanches, and sedimentary sand/soil.

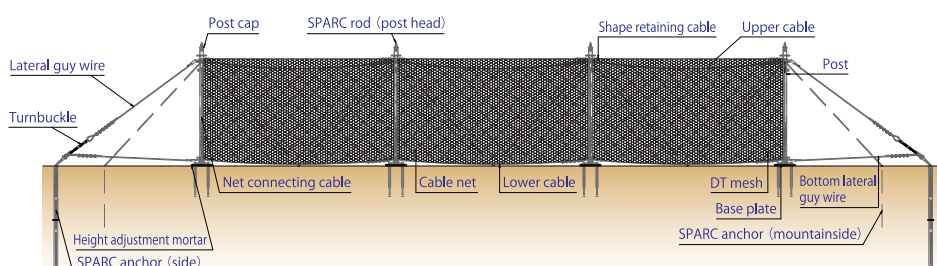


Net structure blending into scenery

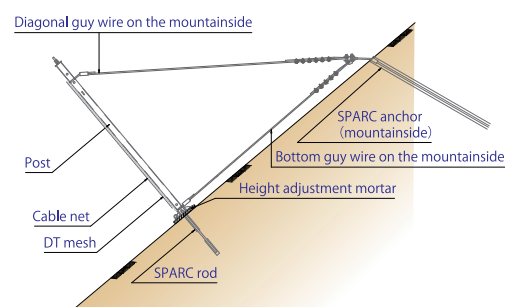


Structure of the post head part

Typical Drawings



Front View



Side View

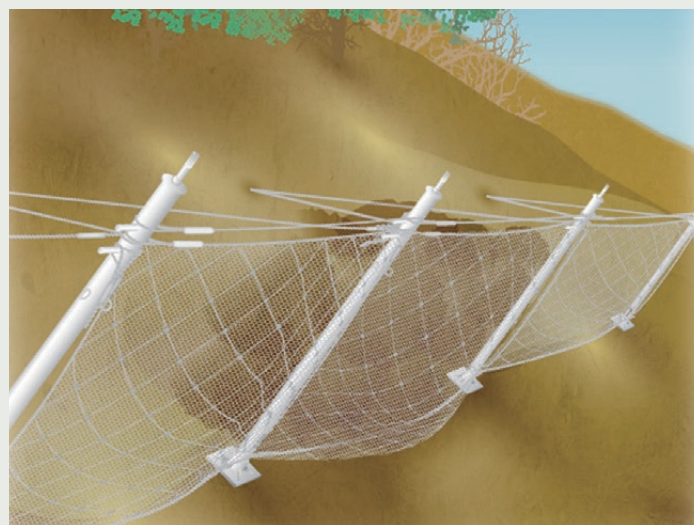
Applicable Location



- * A location where potential rockfalls present over a wide area and taking a measure against the individual rock is not practical.
- * A location where a sufficient space to build a protection structure such as a fence is not available between an object to be protected and a slope.
- * A location where a margin for the deformation of the net is available between an object to be protected and the fence.
- * Capacity of energy absorption: Up to 200 kJ



Because it is possible to meet snow cover up to 3.0 m, SPARC Fence is effective for both rockfall mitigation in cold, snowy area and avalanche defense in places at risk for rockfalls.



Because it is designed to meet the static load of sediment, SPARC Fence is usable as a temporary barrier for rockfalls and sand/soil sedimentation in cut slope work.



Construction Procedure



1. Anchor drilling

Drill mountainside and side anchor by using a boring machine and post anchor by using a rock drill.



2. Grouting

Inject grout into the hole. Check whether the grout overflows from the hole.



3. Anchor testing

Test the anchor whether it has the prescribed pulling force.



4. Installation of the post

Set the base plate and build the post on the plate.



5. Installation of the cables

Set up the cables between the posts and between the post and the anchor.



6. Installation of the net panel

Set up the cable net between the posts by drawing the cables.



7. Installation of the wire mesh

Set up the wire mesh on the mountainside of the cable net and connect them.



8. Completion

Construction Examples



Possible to respond also to snow slope



For rockfall mitigation in snowy area



Example where SPARC Fence was installed along the railway



Example where SPARC Fence was installed along the railway



Because the amount of net deformation is small when it catches falling rocks, it can be installed by the road with confidence.



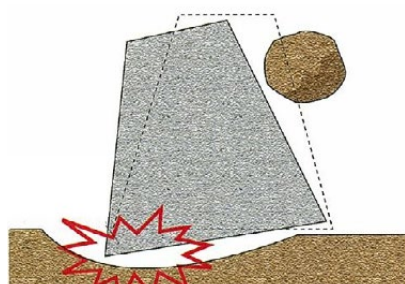
Example of installing SPARC Fence on the snow shed

Geo Rock Wall



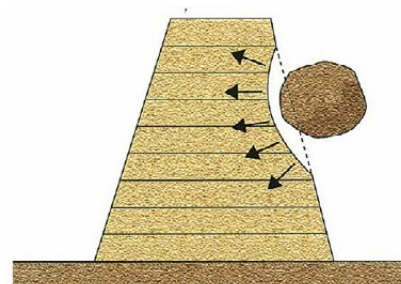
General Description of Method

Geo Rock Wall is a MSE wall reinforced by geotextile and a protection structure against falling rocks and earth. Since Geo Rock Wall is earthen, it can be built under various site conditions. Moreover, it can be blended with the environment by greening the wall surfaces. Since Geo Rock Wall consists of three types of contractual elements, such as the impact-resistant wall (layered with the impact-resistant geogrid and soil), impact transmission bag, and impact catchment bag (filled with soil), it can receive rockfalls ranging from a relatively small mass to a large mass (whose energy is 5500 kJ at the maximum).



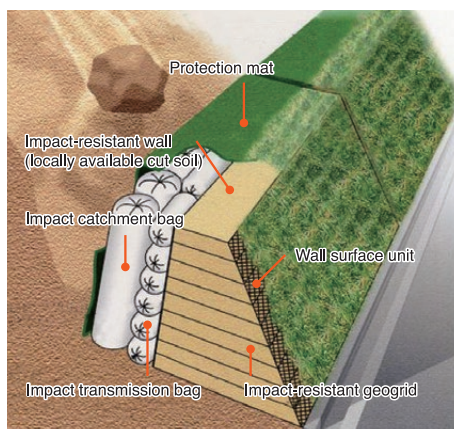
Concrete barrier

For a concrete barrier, it absorbs the energy of a rockfall by its own weight and the deformation of the ground. If the excessive energy is exerted on the ground, the concrete barrier may topple due to the deformation of the ground and the capacity to absorb the energy is decreased.



Geo Rock Wall

While Geo Rock Wall absorb the impact energy by deforming its body. Because of its structure, the impact is not transferred to the ground and therefore foundation improvement work is less required compared with a concrete barrier.



Impact catchment bag

A bag having a high strength and high elongation.

The impact catchment bags receive the impact of a rockfall first and resist the massive amount of energy.



Impact transmission bag

A bag having relatively small elongation property.

The impact transmission bags dissipate and transfer the impact to the impact-resistant wall.



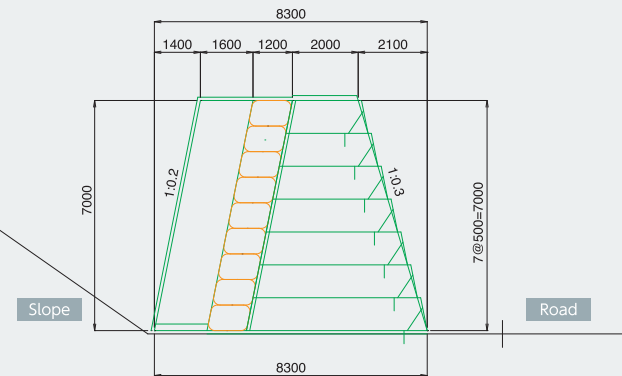
Geogrid

The fibrous material to resist the impact and support the structure of the Geo Rock Wall.

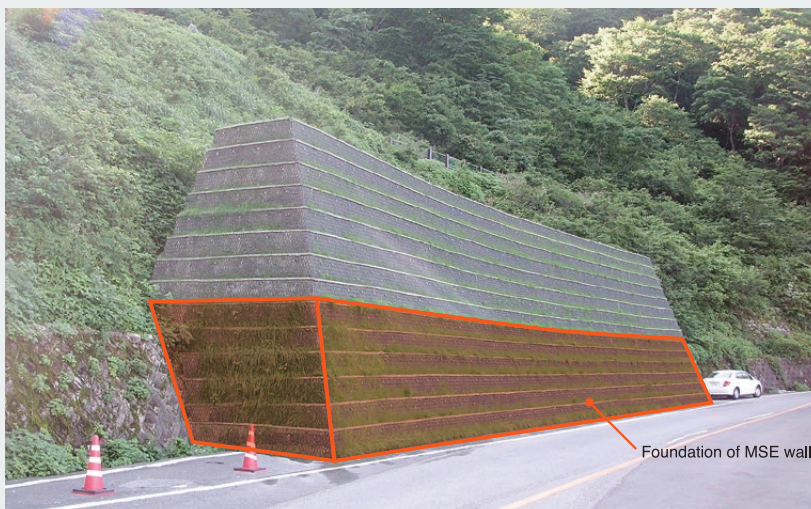
Applicable Location



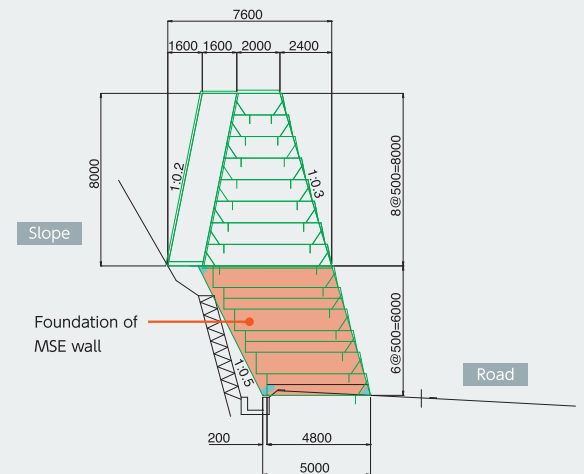
- * A location where potential rockfalls are present over a wide area and taking a measure against the individual rock is not practical.
- * A location where a sufficient space to build the retaining wall is available.



- (1) Typical drawing (without the foundation of MSE wall)
The combination type of the impact-resistant wall, the impact transmission bag, and the impact catchment bag.



If space is limited, the ground is elevated by mounding to form the required level ground, and the dike can be constructed thereon.



- (2) Typical drawing (with the foundation of MSE wall)
The combination type of the impact-resistant wall and the impact catchment bag.

Exceptional Case



Because the dike of Geo Rock Wall is able to conform to the landform, Geo Rock Wall can be built on a valley.

Due to the depressed landform, the location is prone to contain rainwater. To improve drainage, drainpipes are installed.



Geo Rock Wall caught the rockfall. The dike did not suffer any damage from the rockfall.



Construction Procedure



1. Preparation of the impact transmission bags

Make the impact transmission bag by filling the bag with the filling material.



2. Installation of the drainage material and geogrid

Lay the drainage material and geogrid.



3. Installation of the impact transmission bags

Pile up the impact transmission bags prepared in Step 1.



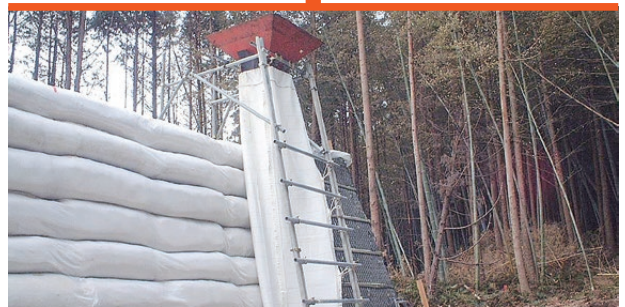
4. Spread and compaction of the embankment material

Spread the embankment material and compact it by rolling.



5. Completion of the impact-resistant wall construction

Repeat Steps 2-4 to construct the impact-resistant wall.



6. Installation of the impact catchment bags

Place the impact catchment bag in places. Then, charge the filling material in the bag.



7. Installation of the protection mat

To protect the impact catchment bags from ultraviolet rays, cover the backside of the dike with the protection mat.



8. Completion

Construction Examples



At the beginning of summer, the wall is covered with fresh green grass.



The impact catchment bags and impact transmission bags are protected from ultraviolet rays by the protection mat.



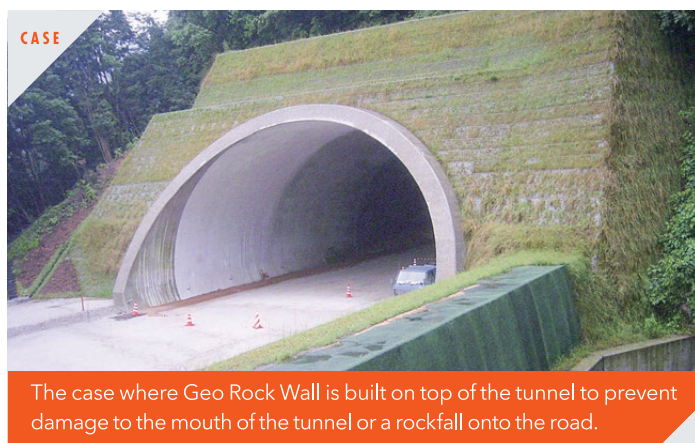
Geo Rock Wall is also efficient as the rockfall protection along the railway.



Geo Rock Wall blends with the mountain behind it. The harmony with the landscape is achieved.



The wall surface can be greened artificially if a landscape consideration for the environment is required.



The case where Geo Rock Wall is built on top of the tunnel to prevent damage to the mouth of the tunnel or a rockfall onto the road.

Pocket-type Drapery Slope Guard Net R-type



General Description of Method

Slope Guard Net R-type is a pocket-type drapery that covers the slope with a mesh and induces falling rocks safely to the lower part of the slope.

When it receives falling rocks, energy dissipators slip on the cable, and absorb the rockfall energy by frictional force. Because energy dissipators are deployed at the lower part of the slope, Slope Guard Net R-type makes it possible to implement safely and easily maintenance, such as redrawing the cable after catching falling rocks and replacement of energy dissipators. Because the mesh structure offers high permeability, Slope Guard Net R-type can be deployed without impairing the scenery.

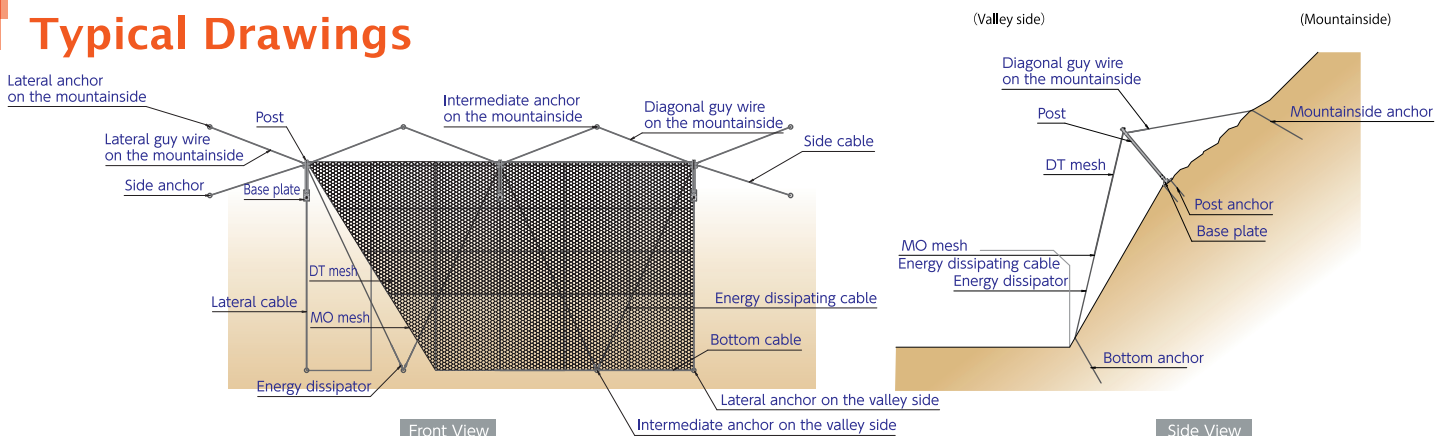


The energy dissipator

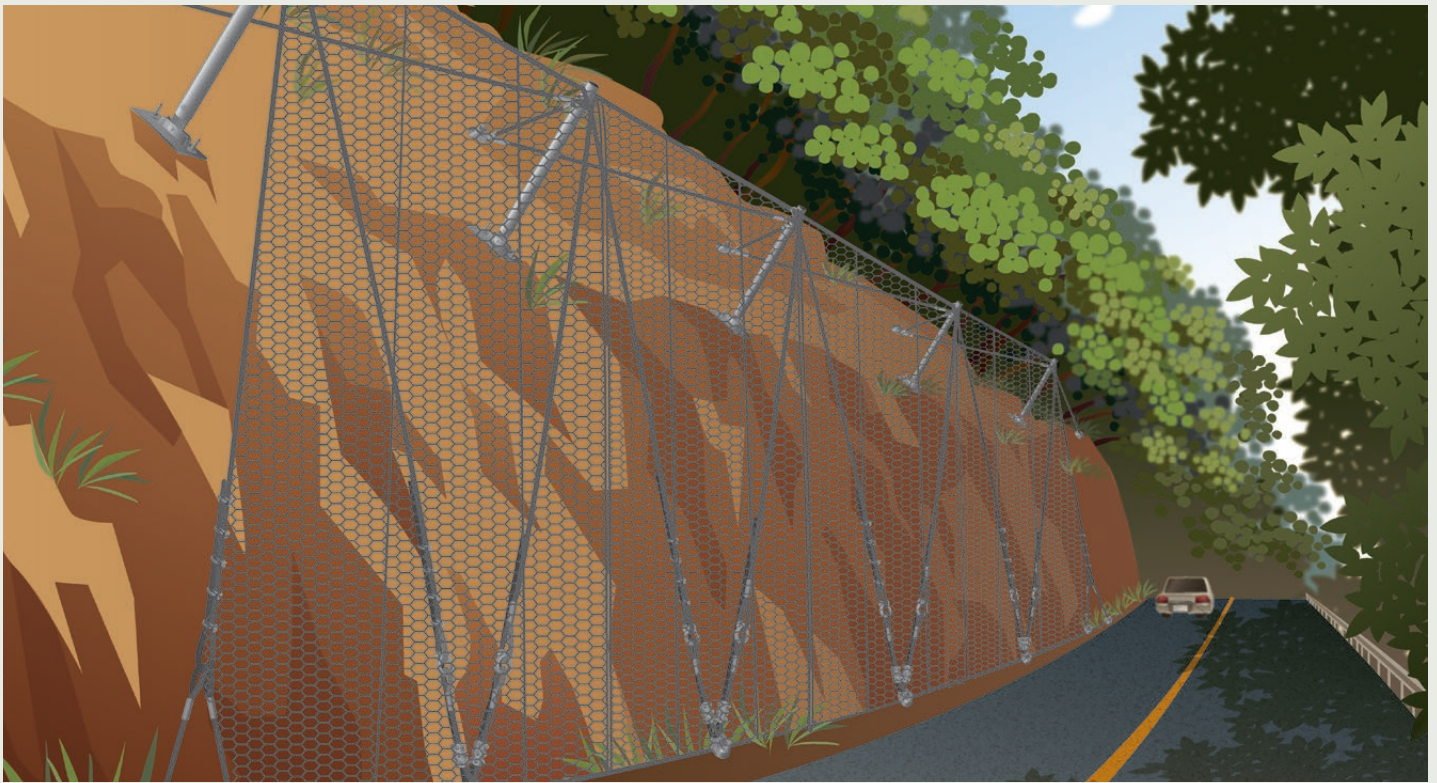


Installing the energy dissipator

Typical Drawings



Applicable Location



- * A location where small scale of rockfall along the slope is a concern.
- * A location where the slope is close to the roadside and there is not space enough to install barriers.
- * Capacity of energy absorption: Up to 200 kJ

Construction Procedure



1. Anchor drilling

Make a hole by using a rock drill and a self-drilling anchor.



2. Grouting

Inject grout into the hole. Check whether the grout overflows from the hole.



3. Installation of the post

Build the post on the base plate.



4. Installation of the cables

Set up the cables between the posts and between the post and anchor/energy dissipator



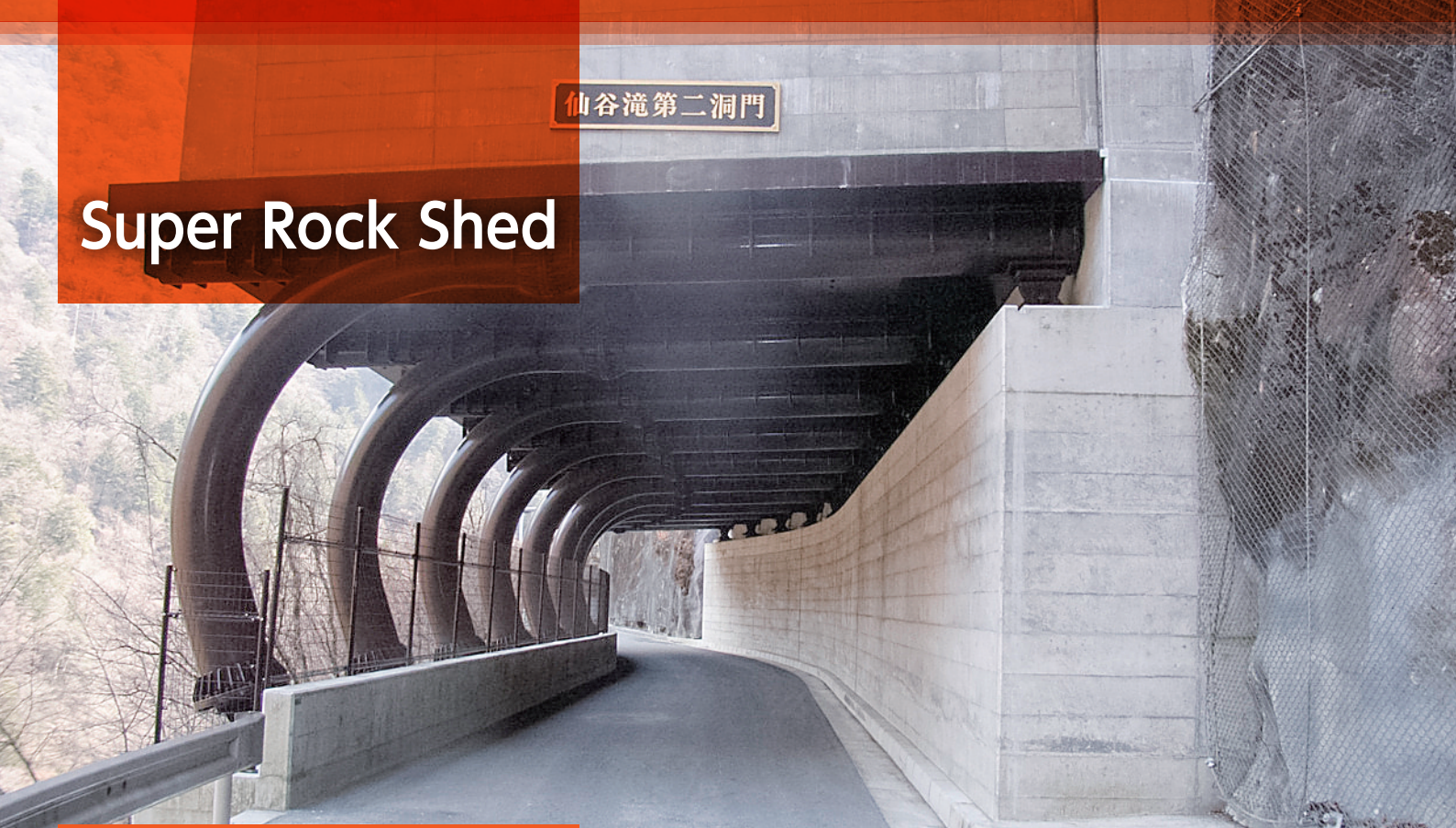
5. Installation of the wire mesh -1

Set up the wire mesh by lifting up with a crane.



6. Completion

Super Rock Shed



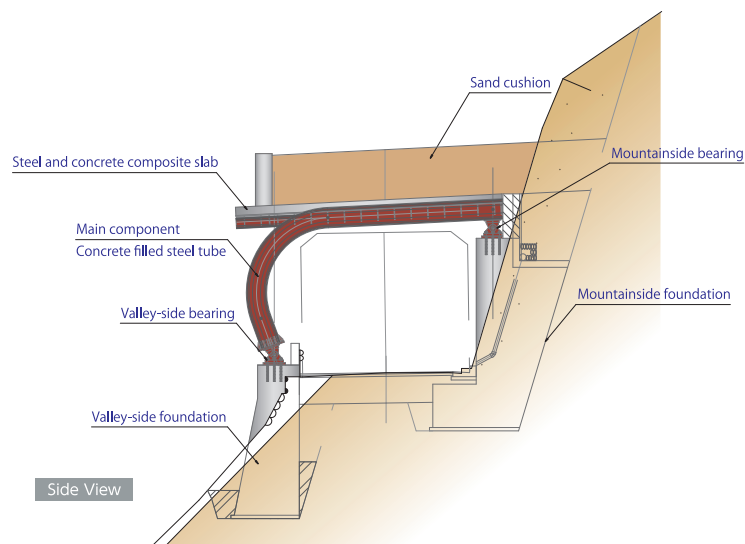
General Description of Method

Super Rock Shed is a construction method that covers the road to prevent falling rocks from hitting the road surface. By means of concrete filled steel tubes with un-bonded PC steel rods for the main beams, and steel and concrete composite for the slab, a large load bearing capacity and high performance of energy absorption have been realized.

Because a main beam is able to deform with constant strength maintained, the structure can hold the survival space without completely collapsing against rockfall that exceeds the design level. This is a construction method capable of responding to major rockfall energy.



Typical Drawing



Applicable Location



- * A location where potential rockfalls present over a wide area and taking a measure against the individual rock is not practical.
- * A location under a steep slope where there is no space to install a structure by the road.
- * A location that cannot be protected by other construction methods due to large scale rockfall.
- * A location where falling rocks might bound across the barrier due to the trajectory height of falling rocks, even if a barrier is installed.
- * Capacity of energy absorption: 8000 kJ

Testing



The world's largest scale actual impact test using full-scale model was carried out. Super Rock Shed did not collapse even against rockfall energy of 8000kJ. Furthermore, because all external surfaces of components are made of steel material, no secondary disaster resulting from concrete spalling occurred.

- * Weight of heavy weight was 21.6 tons, falling height was 38 m.

Draped Mesh

Macro Net



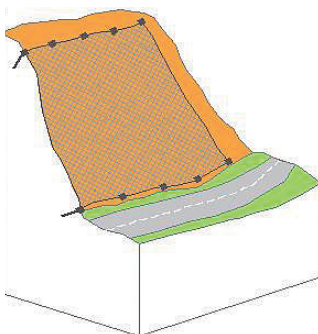
General Description of Method

Macro Net is a draped mesh consisting of a wire mesh, cables, and anchors and applicable to the protection method and prevention method for rockfall. Depending on the combination, Macro Net can be applied to the following three methods: the draped mesh slope

protection, stabilization of rock slope and cable net lashing.

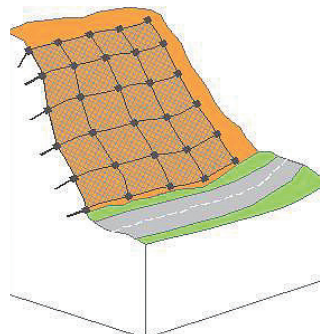
All types of Macro Net use the double twist (DT) wire mesh as the main component. The DT mesh has high tensile strength.

DT mesh



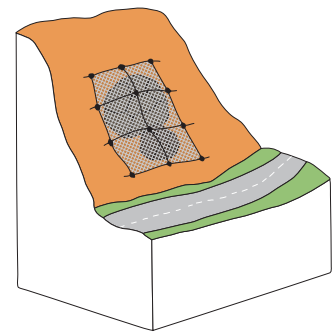
Draped mesh slope protection
(Protection method)

The draped mesh slope protection is a method to cover a slope face to lead a rockfall to the foot of the slope safely. This method can be designed in consideration of loads of debris of a rockfall or a slope failure to prevent a tear of the mesh.



Stabilization of rock slope
(Prevention method)

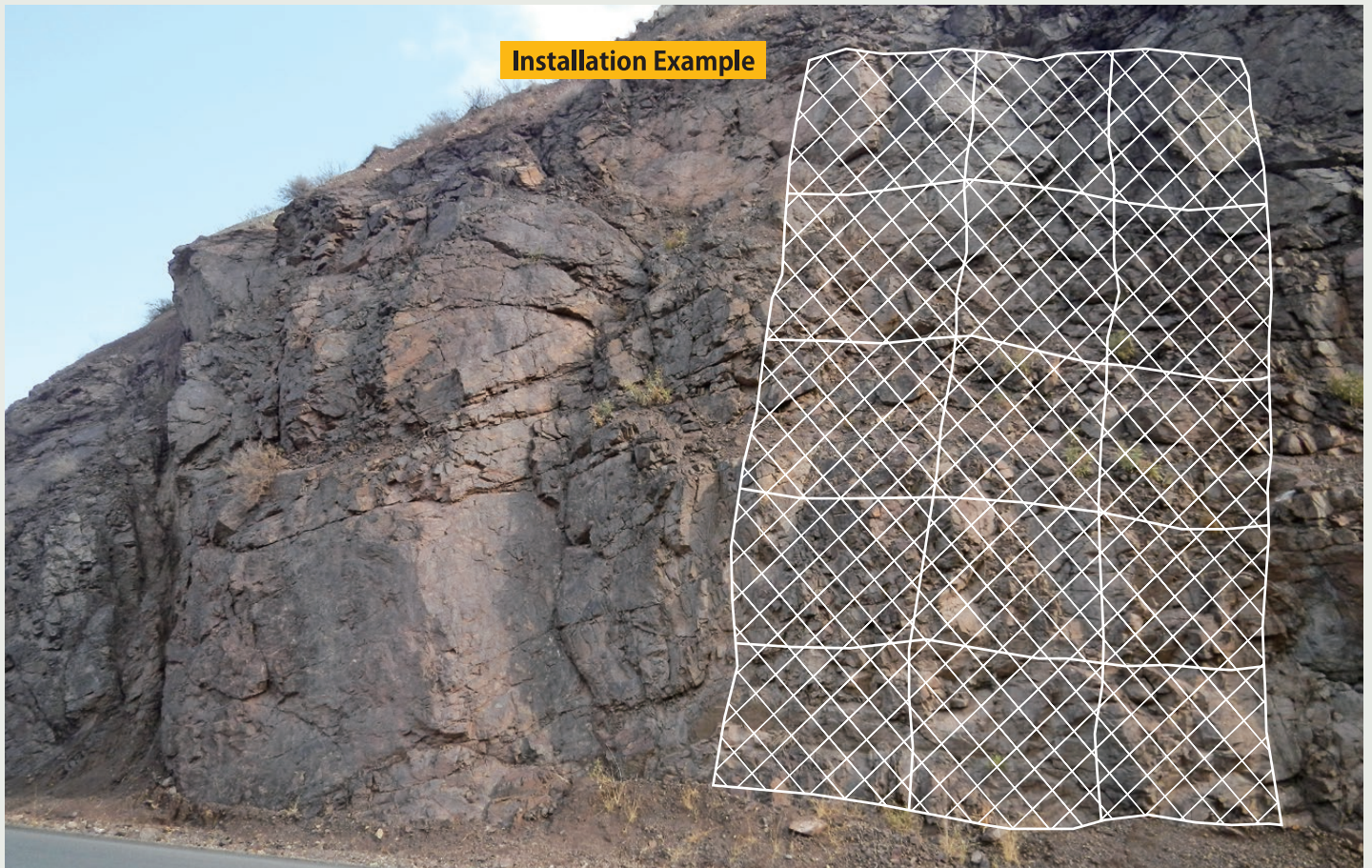
The stabilization of rock slope is a method to stabilize the face of the rock slope using the resistance of the anchors to prevent the infixed rock mass from falling. First, the wire mesh is stretched. Then, the cables are stretched vertically and horizontally over a slope face. Lastly, the anchors are driven in at the cross points of the cables.



Cable net lashing
(Prevention method)

The cable net lashing is a method to stabilize a huge rock mass by the cable net panel and anchors.

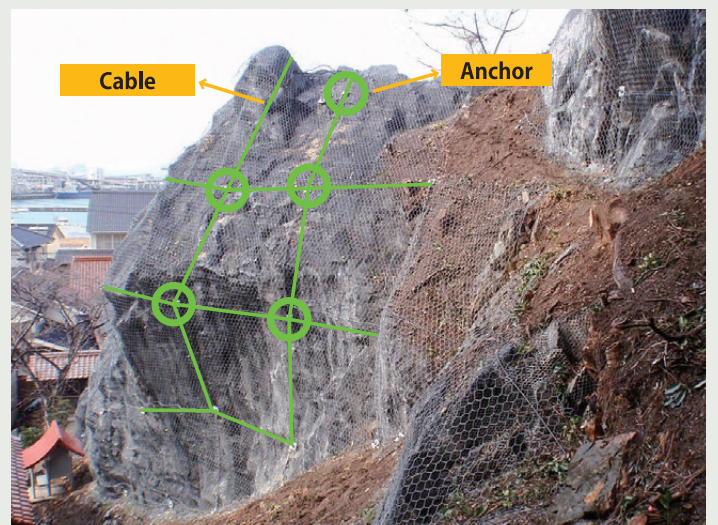
Applicable Location



- * A location where a rockfall source area is limited or rockfall source areas are defined individually.
- * A location where a sufficient space to build a protection structure such as a fence is not available between an object to be protected and a slope.
- * A location beneath a steep high slope and there is a possibility that a rockfall jump over a protection structure such as a fence.



The anchors are driven in only at the top and bottom of the wire mesh to lead small rocks and soil to the foot of the slope. This type of method is effective at locations where a sufficient space for placement of other types of structures is not available on the roadside.



The vertical and horizontal cables are stretched over the wire mesh and the anchors are driven in the cross points. Micro Net can stabilize a rock overhang.



Construction Procedure



1. Installation of the wire mesh -1

Carry up the wire mesh to the top of the slope by a crane or monorail.



2. Installation of the wire mesh -2

Hang the wire mesh from the top of the slope and install it.



3. Anchor drilling

Make holes in the slope face at specified points. Then, insert the anchors into the drill holes.



4. Grouting

Inject cement milk into the drill holes. Check whether the cement milk overflows from the hole.



5. Anchor testing

Test the anchor whether it has the prescribed pulling force.



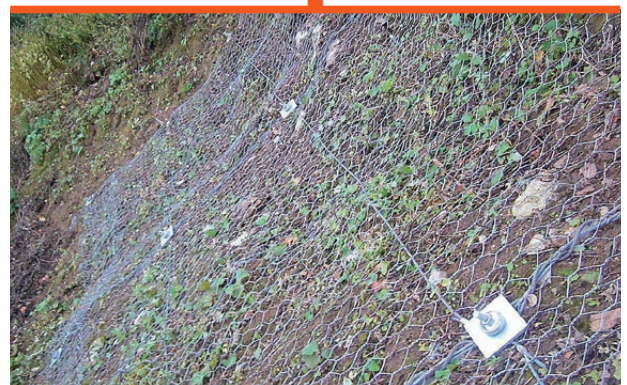
6. Connection of the wire mesh

Tie the connections of the wire mesh with the connection cables.



7. Installation of the anchor head

Install the bearing plate, washers, and nuts to the anchor rod to secure the wire mesh.



8. Completion

Construction Examples

CASE



Draped mesh slope protection

CASE



Stabilization of rock slope

CASE



Stabilization of rock slope

CASE



Cable net lashing

CASE



Cable net lashing

CASE



Draped mesh slope protection

Slope Failure Protection Fence

Slope Guard Fence

Type LE



General Description of Method

Slope Guard Fence Type LE is a construction method, which is set mainly at the lower part of the slope and protects roads and buildings from rockfall and slope failure. The post has a structure that deploys several small diameter steel tubes in an external steel tube for both lightweight of the component and improvement of bending moment. Because Slope Guard Fence Type LE has the pile foundation structure where the post is built directly in the ground, it makes it possible to build in soft ground and narrow sites. This is a construction method excellent in workability, economic efficiency, and maintenance.

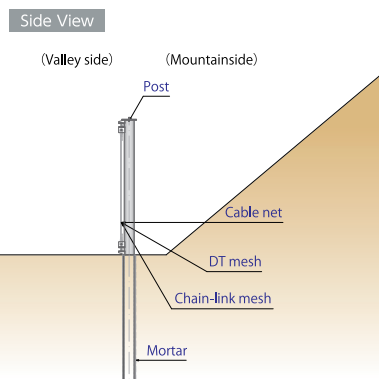
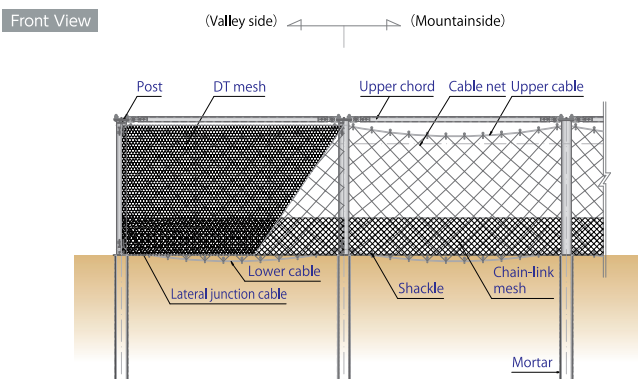


Loading test of static load to check bending moment of LST (Lotus-root Steel Tube)

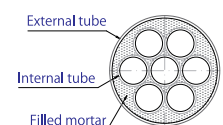


Applicable to the narrow site

Typical Drawings



Sectional View of the Post



Applicable Location



Even where it is difficult to implement concrete barriers as stated below, Slope Guard Fence Type LE is applicable to such a location.

- * A location where there is no space between the object to be protected and the slope, and setting any structure is limited, or it is unable to secure the deposition area for sediment.
- * A location with soft ground.

Example of Recovery Work



The discharge work of sediment was carried out after slope failure due to torrential rain. When removing the cable net, the work is performed by using vehicles for high lift work or by setting up framed scaffolding. Because the cable net is removable by every span with simple work and resetting, Slope Guard Fence Type LE makes it possible to perform maintenance in a short construction period.



Construction Procedure



1. Drilling -1

A large-diameter boring machine is used to drill the location for setting the post. In the case of the site where a crane can be placed, a crane is used.



2. Drilling -2

In the case of the narrow site where no crane can be placed, drilling is performed by setting up a scaffold.



3. Installation of the post

Build the post in the drilled hole. After built in, adjust the location, angle, and direction of the post.



4. Installation of the upper chord

Install the upper chord between the posts.



5. Filling mortar

Fill mortar at peripheral part of the post.



6. Installation of the cables

Set up the cables.



7. Installation of the cable net and wire mesh

Passing through the cable, install the cable net and set the DT mesh and chain-link mesh on the cable net.



8. Completion

Construction Examples



Slope Guard Fence Type LE is applicable to a narrow place behind a private house.



Slope Guard Fence Type LE is also optimal for a place along national highways (colored type in view of the scenery).



The important structure is surely protected from sediment disasters.



Even if installed along the roadside, there is less of a feeling of oppression.



It is possible to install not only at the foot of the slope, but also in the middle of the slope.



It is possible to install also on the shotcrete covered slope.

MSE Wall for Slope Failure Protection

QK Wall



General Description of Method

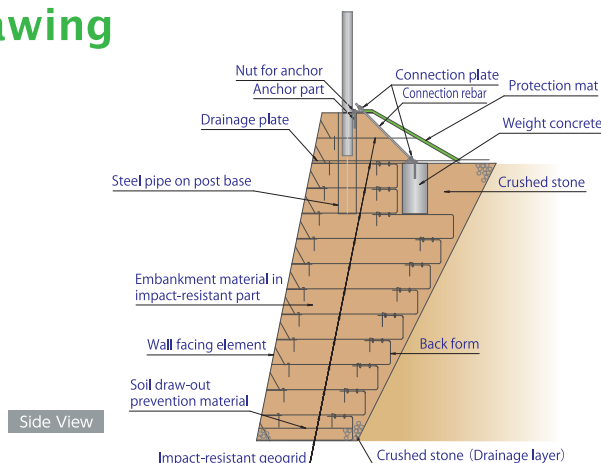
QK Wall is a MSE wall of soil reinforced by geotextile, and it protects roads and buildings from slope failure. It receives sand and soil on the top end to disperse and absorb the impact. Because of the soil structure, QK Wall can be built in various locational conditions and will match the surrounding scenery by vegetation of the wall surface. Because its body is leaning toward the slope, it is possible to meet the site where the space to install the wall is confined. As compared with concrete barriers, excavation and ground improvement are hardly necessary, and this is a construction method excellent in workability and economic efficiency.



The structure combined rockfall fence to the upper part of MSE wall.

Sand and soil is received at the deposition area of the backside. For preventing the deterioration by ultraviolet rays, the protection mat is laid.

Typical Drawing



Applicable Location



Even where it is difficult to implement concrete barriers as stated below, QK Wall is applicable to such a location.

- * A location where there is no space between the object to be protected and the slope, and setting any structure is limited, or it is unable to secure the deposition area for sediment.
- * A location with soft ground.



Because of the shape leaning toward the slope, QK Wall is applicable as a place where the space to install the wall is confined. It is effective for steep terrain.



QK Wall is optimal as a measure to prevent slope failure on a steep slope behind a private house on a narrow site.



Construction Procedure



1. Installation of the geogrid and wall facing elements

Lay geogrid and connect with wall facing elements set in the valley side of the dike.



2. Installation of the back form

Set back form on the mountainside of the dike.



3. Spread and compaction of the embankment material

Spread embankment material and compact by rolling .



4. Spread and compaction of the embankment material

Repeat above Steps 1-3 and construct the dike.



5. Installation of the counterweight

Pour concrete as counterweight at the back of the dike, and further repeat above Steps 1-3.



6. Installation of the steel pipe on the post base

Set the steel pipe being the base of the post at the location of the fence, and further repeat above Steps 1-3.



7. Installation of the rockfall fence

Build the post in the steel pipe and install the cable and the cable net to construct the fence.



8. Completion

Construction Examples



QK Wall blends into the surrounding scenery with vegetation.



QK Wall can be installed in a confined space on the roadside.



An example where QK Wall was installed adjacent to the concrete barrier by the railway.



An example where the fence was colored so as to be familiar with the scenery.



In case any consideration to the surrounding environment is required, it is possible to make the wall surface green artificially.



It is possible to install QK Wall in a confined space behind a private house.

ARC Fence Type S

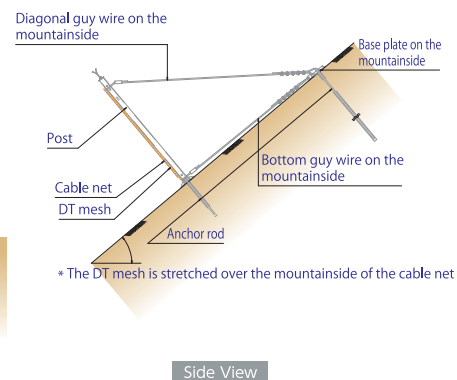
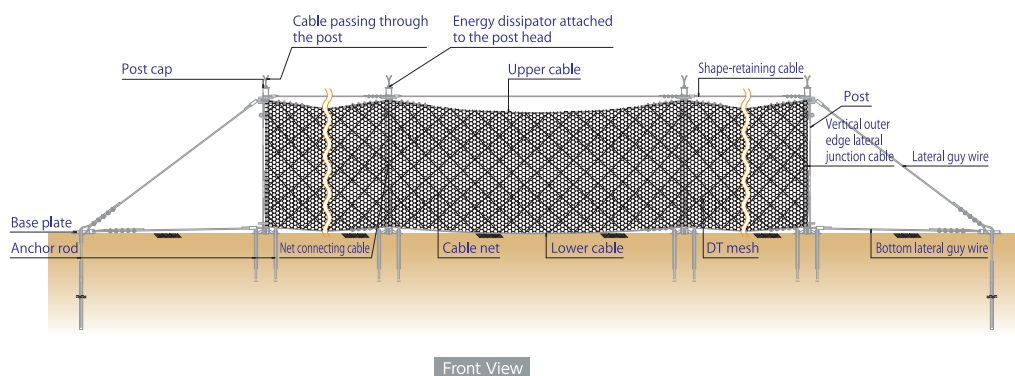


General Description of Method

ARC Fence Type S is a snow net commonly installed on a slope. ARC Fence Type S consists of the cable net, DT mesh, and posts to prevent avalanche by supporting the snowpack on the slope. Since the foundation of ARC Fence Type S is structured by the anchors, excavation can be limited. This construction method is an environment-friendly. Because ARC Fence Type S is developed by improving the rockfall barrier, ARC Fence Type S can be installed in a location where there are risks of rockfalls as a protection fence for both rockfall and avalanche.



Typical Drawings



Applicable Location



[Purpose: Avalanche control in the starting zone]

Type of avalanche: Full-depth avalanche and surface-layer avalanche

Snow depth: Up to 3.0 m

Slope angle: Up to approximately 60°

Terrain: Applicable to rough terrains, gullies, and even terrains

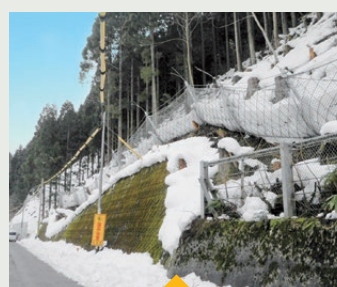
Slope length of starting zone: Applicable also to 200 m or more length

Geology: Applicable to soils, soft rocks, hard rocks, and landslide-prone areas

* ARC Fence Type S can be installed at a location where there is a risk of rockfall in snowy area.



By adjusting the span length and its layout, ARC Fence Type S can be installed between trees and therefore cutting of the trees can be minimized.



Because ARC Fence Type S has the net structure, they conform to the landform and can be laid out successively in series. Thus, the deposited snow will not pass through clearances between them.



For snow bridge, the deposited snow may pass through the clearance between them.

Construction Procedure



1. Anchor drilling

Drill the ground by a rock drill to make holes for the anchors.



2. Grouting

Inject grout into the hole. Check whether the grout overflows from the hole.



3. Anchor testing

Test the anchor whether it has the prescribed pulling force.



4. Installation of the post

Install the plate on the foundation. Then, insert the post into the plate.



5. Installation of the cables

Set up the cables between the posts and between the post and the anchor.



6. Installation of the cable net

Set up the cable net between the posts by drawing the cables.



7. Installation of the wire mesh

Set up the wire mesh over the cable net on the mountainside. Then, fix the wire mesh to the cable net.



8. Completion

Construction Examples



ARC Fence Type S can be installed at the back of a house with no danger.



Construction example on a roadside



ARC Fence Type S holding deposited snow.



Because ARC Fence Type S can be installed successively, they block avalanche securely.



By installing ARC Fence Type S in a multi-layered arrangement, an avalanche throughout a slope can be prevented.



The net structure blends with the environment.

Snow Net

Tra-net Fence



General Description of Method

Tra-net Fence is a snow net to be set mainly on a slope. It supports the snowpack on the slope with the triangular net knitted into with cable to prevent avalanche. Because the foundation is made of an anchor structure, little excavation of the ground is required in the construction, and there is a little impact on the natural environment. As for rockfalls exceeding 100kJ of energy, Tra-net Fence can deal with them by setting additional energy dissipators. Because it is possible to respond up to the maximum rockfall energy of 500 kJ, Tra-net Fence is also effective for rockfall mitigation in snowy area as avalanche defense at the place at risk for rockfalls.

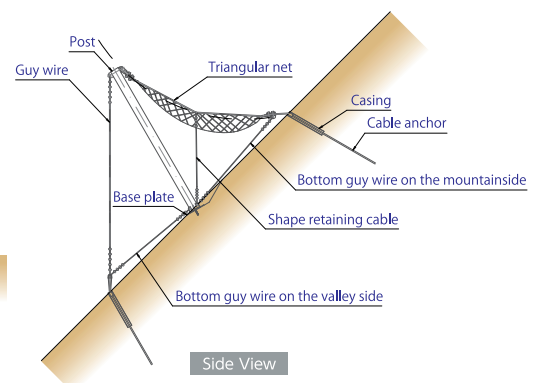
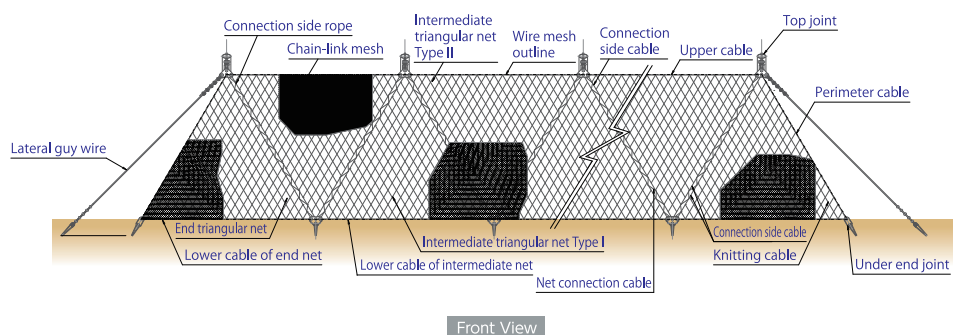


Tra-net Fence can be installed around trees.

As compared with structures with concrete foundation, it requires less excavation and offers excellent workability and minimal environmental loads.



Typical Drawings



Applicable Location



[Purpose: Avalanche control in the starting zone]

Type of avalanche: Full-depth avalanche, surface-layer avalanche

Snow depth: Up to 6.0 m

Slope angle: Up to approximately 60°

Terrain: Applicable to rough terrains, gullies and even terrains

Slope length of starting zone: Applicable also to 200 m or more length

Geology: Applicable to soils, soft rocks, hard rocks, and landslide-prone areas

* Applicable to a location where there is a risk of rockfall in snowy area.



Because Tra-net Fence is possible to meet rockfall energy up to 500 kJ, it is applicable to a location where there is a risk of rockfall in snowy area. The performance has been confirmed in the actual impact test by free-fall of a heavy weight.



Because it is possible to set Tra-net Fence in response to undulating slopes, the clearance between the bottom of the net and the ground is difficult to arise, and it makes it possible to prevent slipping of falling rocks.



Construction Procedure



1. Anchor drilling

Drill by using a boring machine.



2. Grouting

Inject grout into the hole. Check whether the grout overflows from the hole.



3. Anchor testing

Test the anchor whether it has the prescribed pulling force.



4. Installation of the triangular net

Install the cable and top joint on the head part of the post, and fix triangular net on the top joint.



5. Installation of the post

Set base plate and build in the post.



6. Installation of the triangular net

Install the triangular net on the under joint mounted on the mountainside anchor, and connect each triangular net with the cable.



7. Installation of the wire mesh

Install the chain-link mesh on the mountainside of the triangular net and connect them.



8. Completion

Construction Examples

CASE



Because of the net structure, the terrain-oriented arrangement is possible.

CASE



It is possible to set with tree trimming and excavation minimized.

CASE



Colored type to blend in with the scenery.

CASE



Because it is possible to arrange without any clearance in a series, slipping of snow never occurs.

CASE



It is possible to arrange on a slope face with frame work.

CASE



Example set as a rockfall fence.

Snow Glide Tripod

Tripile

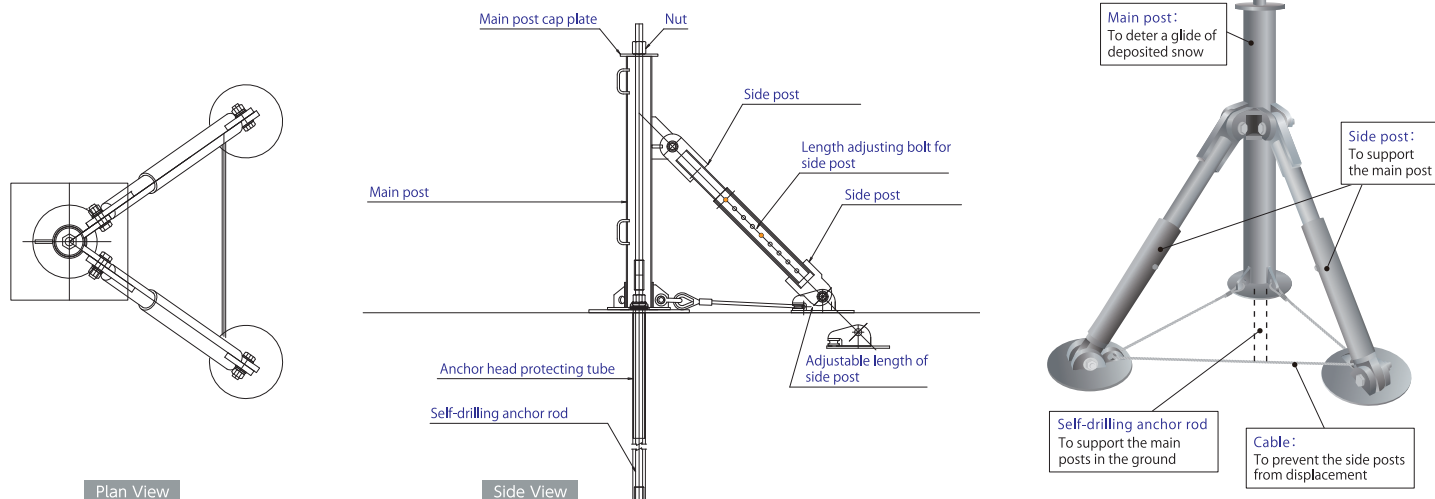


General Description of Method

Tripile is a snow glide tripod installed on a slope to prevent a full-depth avalanche by deterring a glide of deposited snow by its main posts. Since the components of Tripile are the light weight (even the heaviest component of it weighs approximately 20 kg), it can be installed manually. Because of its simple structure, Tripile can be assembled easily on site and installed without using heavy machinery. Thus, a short-period installation can be achieved.



Typical Drawings



Applicable Location



[Purpose: Avalanche control in the starting zone]

Type of avalanche: Full-depth avalanche

Snow depth: Up to 4.5 m

Slope angle: Up to approximately 55°

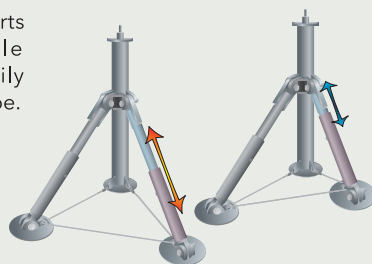
Terrain: Applicable to rough terrains, gullies, and even terrains

Slope length of starting zone: Up to approximately 100 m

Geology: Applicable to soils, soft rocks, and hard rocks



Since the side post that supports the main post has a flexible structure, Tripile can be readily installed on a natural rough slope.



A case where the anchors of the Tripile are connected to the anchors of the frame work. The length of the side post can be adjusted to the actual slope profile on site.

Construction Procedure



1. Anchor drilling

Make holes to install the main post bases using a rock drill and the self-drilling anchor.



2. Grouting

Inject grout into the hole. Check whether the grout overflows from the hole.



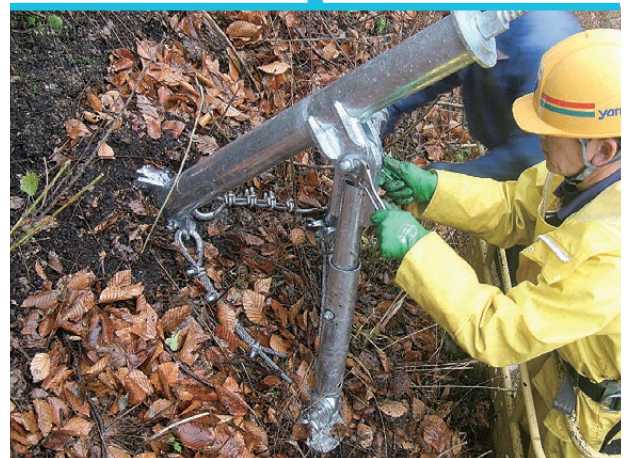
3. Anchor testing

Test the anchor whether it has the prescribed pulling force.



4. Installation of the main post and side post

Insert the main post in the hole by adjusting its angle to the drilling angle. Then, mount the side post.



5. Assembling

Adjust the angle and length of the side post to the landform. Then, connect the bases of the main post and side post with the cable.



6. Completion

Construction Examples



Tripile effectively prevents an avalanche by deterring a glide of deposited snow.



Since Tripile can be installed on a confined space such as a clearance between structures, they can be readily used to prevent a partial avalanche. Compared with snow bridges or barriers with concrete foundation, Tripile minimizes an alteration of the land for the construction. Moreover, there is little feeling of oppression in a place where Tripile is installed.



Because of its simple structure, Tripile can be installed readily on a long wide slope within a relatively short period.



Because the side post is length-adjustable, it can be installed on a slope face on which the frame works are constructed.



By using it with other avalanche defense structures such as fence or barrier, Tripile can reduce loads exerted on those structures.



A case where Tripile is installed between the frame works.

Geo Snow Wall



General Description of Method

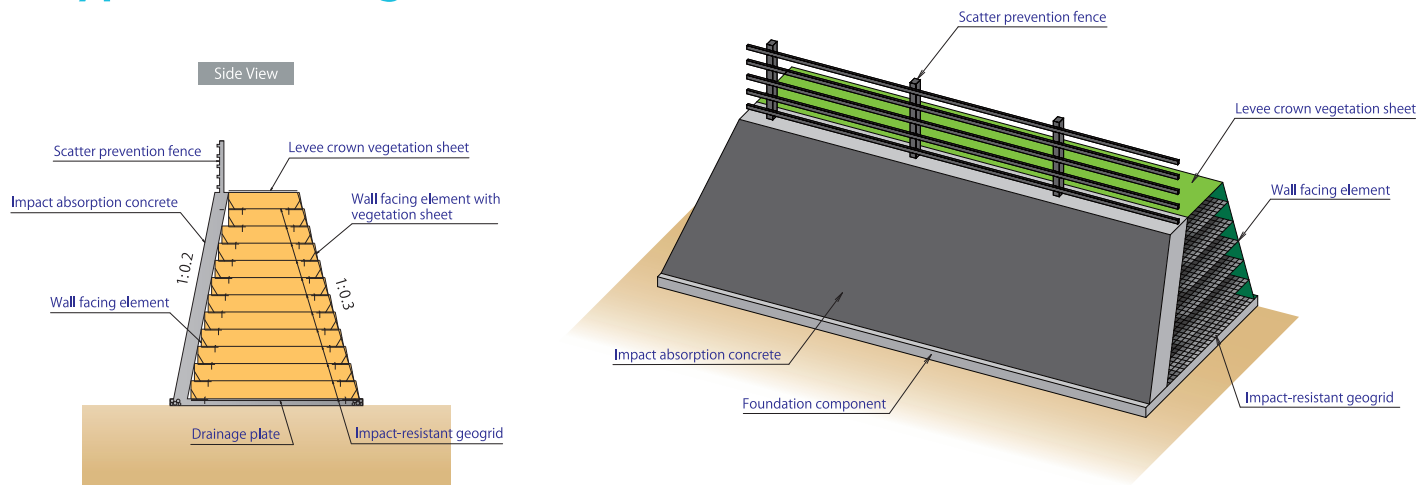
Geo Snow Wall is a MSE wall reinforced with geotextile. Geo Snow Wall protects roads or buildings from an avalanche disaster, changes a course of the avalanche, and guides the avalanche to another place where the road and buildings will not suffer damage from the avalanche.

Geo Snow Wall does not require a pile foundation because its structure has flexibility due to the earthen embankment. Should the ground sink,

Geo Snow Wall will sink along with the ground. Additionally, Geo Snow Wall can blend with the environment by greening its surfaces.



Typical Drawings



Applicable Location



[Purpose: Avalanche control in the avalanche path or deposition zone]
 Type of avalanche: Full-depth avalanche and surface-layer avalanche
 Snow depth: Up to 6.0 m
 Slope angle: Up to approximately 30°
 Terrain: Applicable to rough terrains, gullies, and even terrains
 Length of avalanche path: Applicable also to 200 m or more length
 Geology: Applicable to soils, soft rocks, and hard rocks



A case where a sufficient space to construct Geo Snow Wall is not available. The ground is elevated by mounding to form the required flat space. The dike is constructed on the mounding.

Exceptional Case



The construction site where sufficient space is available. The wall facing elements are not installed on the road side. The earth cut from the higher ground is used for the mounding to reduce the construction cost.

Construction Procedure



1. Installation of the drainage material and geogrid

Install the drainage material and geogrid.



2. Installation of the wall facing elements

Install the wall facing elements at the base of the impact resistant wall.



3. Spread and compaction of the embankment material

Spread the embankment material and compact it by rolling. Repeat Steps 2-3 until the level of the impact resistant wall reaches the same height of the levee crown.



4. Installation of the scaffolding

Build the scaffolding on the mountainside to construct the impact absorption concrete.



5. Installation of the impact absorption concrete

Arrange the rebars in the impact absorption section. Then, pour concrete into the section.



6. Completion

Construction Examples



The appearance of Geo Snow Wall in winter season after the construction.



The wall is covered with fresh green grass at the beginning of summer.



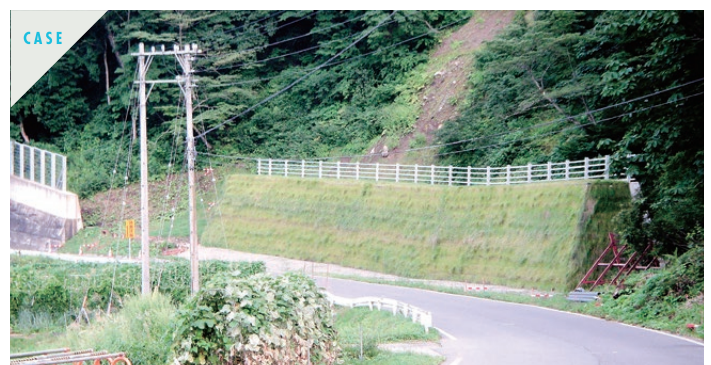
Geo Snow Wall is effective to a location site where a sufficient space is available on the roadside.



Since the impact absorption concrete is built on the mountainside, the pressure of the deposited snow can be distributed evenly over the impact resistant wall.



Geo Snow Wall can be designed depending on the snowfall on the site. Thus, the object to be protected can be securely protected.



Geo Snow Wall can blend with the environment by greening.

Avalanche Protection Fence Slope Guard Fence Type LS



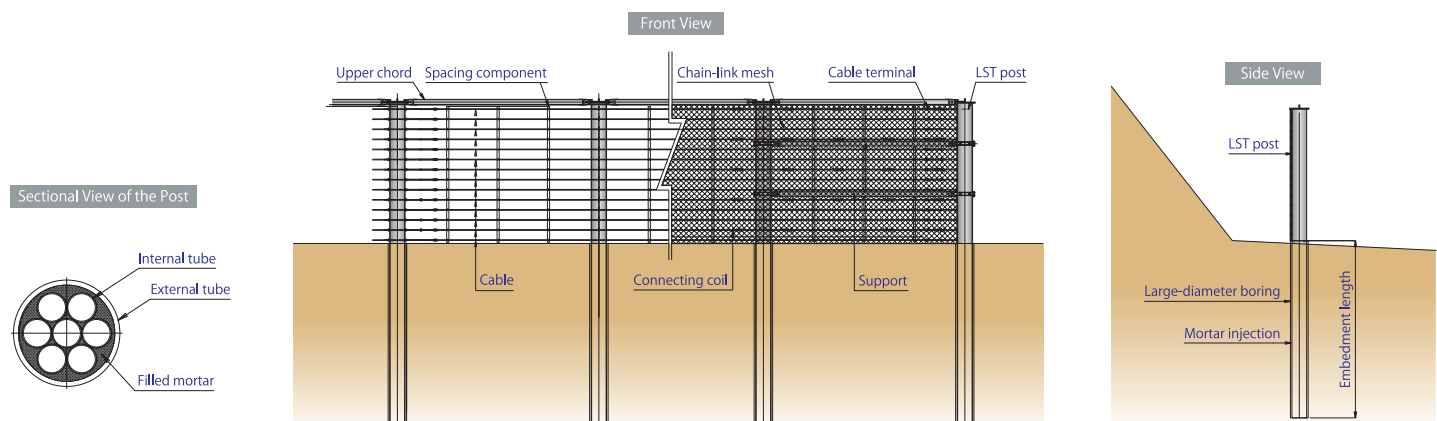
General Description of Method

Slope Guard Fence Type LS is mainly installed on the base of a slope to protect a road or buildings from the avalanche or deter a glide of deposited snow to prevent the avalanche. The post has a structure in which a bundle of the small-bore steel tubes is deployed in the external steel tube thereby weight reduction and an improvement of the bending moment can be achieved. Slope Guard Fence Type LS is installed by embedding the post directly into the ground. Thus, the concrete foundation or

the foundation improvement work is not required in the case where the ground is not firm. Therefore, the construction period and cost can be reduced.



Typical Drawings



Applicable Location



[Purpose: Avalanche control in the avalanche path or deposition zone]
Type of avalanche: Full-depth avalanche and surface-layer avalanche
Snow depth: Up to 6.0 m
Slope angle: Up to approximately 30°
Terrain: Applicable to rough terrains, gullies, and even terrains
Slope length: Up to approximately 100 m
Geology: Applicable to soils, soft rocks, and hard rocks



Since the post serve as the foundation structure, the construction of a concrete foundation is not required. Slope Guard Fence Type LS can be installed also on the intermediate zone of the slope.



Slope Guard Fence Type LS can be used to prevent deposited snow from sliding onto the road.

Construction Procedure



1. Drilling

Make a hole at the post installing location using a large-diameter boring machine.



2. Installation of the post

Insert the post in the hole. Adjust the installation height and angle of the post. Then, fix the post with the temporary material.



3. Installation of the upper chord and support

Connect the post heads to prevent the posts from leaning.



4. Filling mortar

Pour mortal into the hole. After the mortal is cured, remove the temporary material.



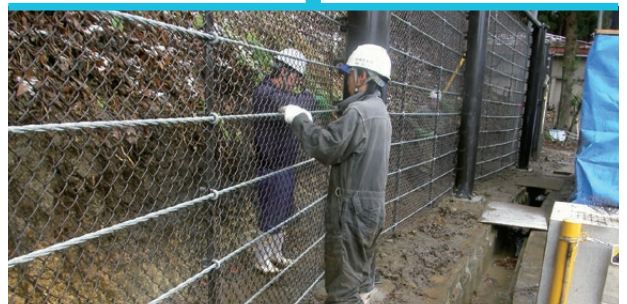
5. Installation of the cables

Set up the cables between the posts.



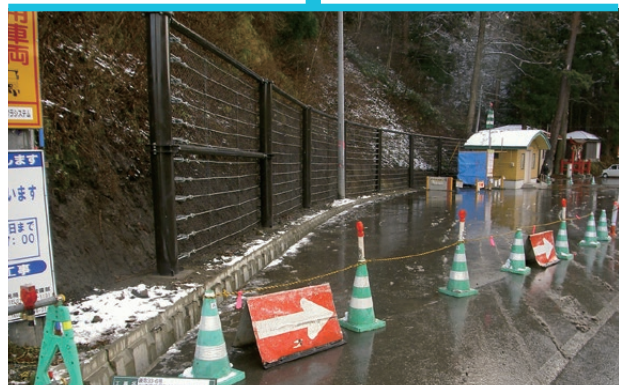
6. Installation of the wire mesh

Set up the chain-link mesh between the posts.



7. Installation of the connecting coils

Bind the cables and chain-link mesh with the connecting coils.



8. Completion

Construction Examples

CASE



The net structure reduces the feeling of oppression.

CASE



Slope Guard Fence Type LS can fill the clearances between the existing fences by adjusting its span length to prevent an avalanche.

CASE



The posts can be painted to adapt them to the environment.

CASE



A case where Slope Guard Fence Type LS is installed on a concrete barrier.

CASE



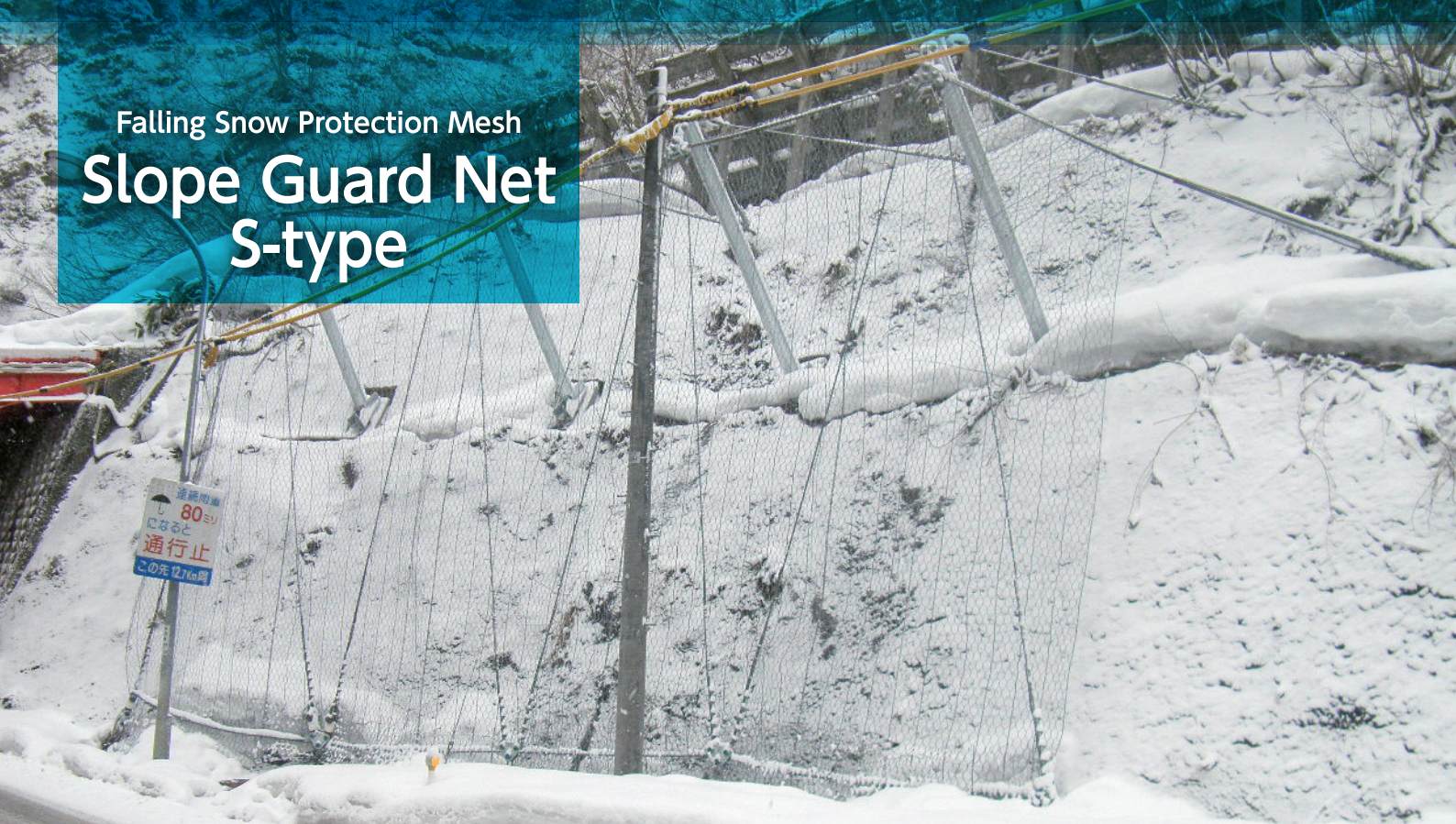
Slope Guard Fence Type LS conforms to the landform and installation conditions of a site.

CASE



Slope Guard Fence Type LS can be installed in a narrow space on a roadside.

Falling Snow Protection Mesh Slope Guard Net S-type



General Description of Method

Slope Guard Net S-type is a construction measure to protect roads and buildings from falling snow from a steep slope in snowy areas. On the slope over the gradient of 60° snow accretion becomes less and snow falls down from the slope after the snow. Furthermore, snow cornices produced by creep deformation of snow on steep slopes are at risk of falling and hitting vehicles and residents. Slope Guard Net S-type makes snow falling from such slopes pile up between the wire mesh and the slope to protect the object.

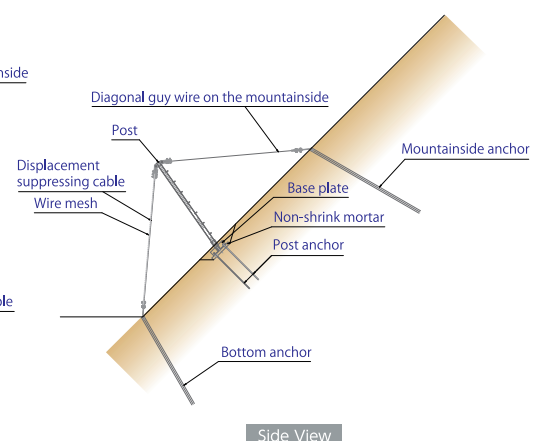
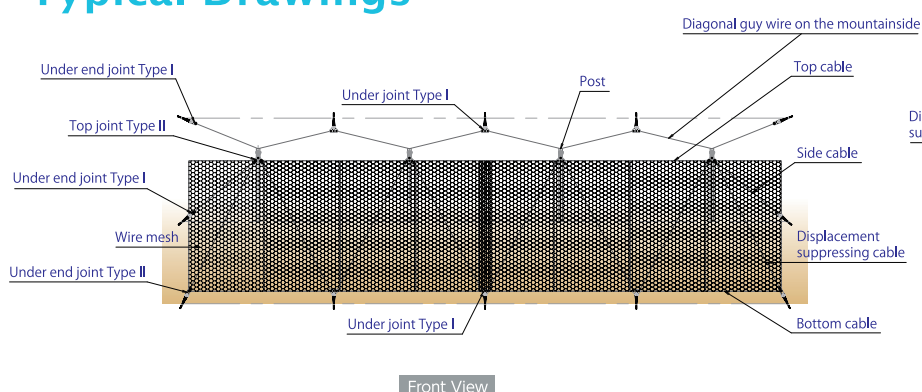


Because of the mesh structure, Slope Guard Net S-type has higher permeability and less feeling of oppression even by the road.



Hang a wire mesh from the head of the post to the lower part of the slope and form the deposition part.

Typical Drawings



Front View

Side View

Applicable Location

Before installation



After installation



No snowfall season



Snowfall season



- A steep slope with a gradient of 60° or more and is in danger of falling snow
- A location where snow on the steep slope becomes a snow cornice with a danger of falling snow
- A location where there is no space to build a structure between the road and slope

Construction Procedure



1. Anchor drilling

Drill by using a boring machine.



2. Grouting

Inject grout into the hole. Check whether the grout overflows from the hole.



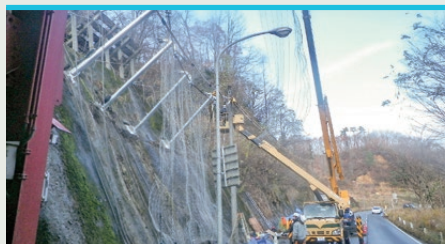
3. Installation of the post

Install the base plate on mortar and build in the post.



4. Installation of the cables

Set up the cable between the posts and between the post and anchor.



5. Installation of the wire mesh

Install the wire mesh and connect with the cable.



6. Completion



Tokyo Branch

International Division

Sumitomo Fudosan Shiba Building No.2 6F,

1-5-9 Shiba, Minato-ku, Tokyo, Japan

TEL: +81-3-6435-2680 FAX: +81-3-6435-2682

Seoul Office

T2-705 Jungbalsanro24

Ilсандong-gu Goyang Kyoung-gi Korea

TEL: +82-31-902-1303 FAX: +82-31-902-1305

Head Office and East Port Plant

5322-26 Oaza Hasugata, Seiro-machi, Kitakanbara-gun, Niigata, Japan

TEL: +81-25-278-1551 FAX: +81-25-278-1559

URL : <http://www.proteng.co.jp/en/>

E-mail : info@proteng.co.jp