

# Ring Net for Slope Protection at Kouchiumi District in Sightseeing Areas

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## 1. Introduction

The Route 220 leads from Miyazaki city, down to the Nichinan district, to the project site located at the tourist spot in the southern areas of the city from which the Nichinan Seacoast National Park can be seen. (see Figure 1).

The slope protection project at Kouchiumi district is a multi purpose project which is intended to protect the steep slopes from further failure, to preserve natural environment, to rehabilitate devastated slopes and to create relaxed and comfortable atmosphere in the area.

It is however rather contradictory to implement slope protection works while preserving natural environments because concrete frames and retaining walls for slope protection require massive engineering works such as cuttings and excavations which could cause further devastation in the areas.

The problem regarding disaster prevention and environment at the project site is therefore a trade off problem unless new technology is developed and applied. The new technology employing ring net was developed and demonstrated.

## 2. Disasters

As many as several tens of households are located on the slopes in the project area in which slope protection projects had been implemented since 2004.

The project was launched in order to prevent another disaster due to rock fall as taken place in July 1982 (see Photograph 1 and Figure 2).



Figure 1. Location map of the project area



Photo 1. Damage due to the boulder plunged into the house

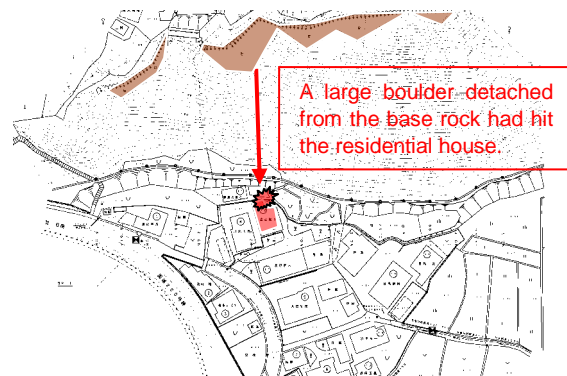


Figure 2. Location of the disaster site

### 3. Geological and topographical settings of the project area

#### (1) Geological conditions

The project area consists of base rocks called Miyazaki complex and alternate layers of sand rock and mudstone and 5 meters thick sand rock are dominant.

The wide rock bedding outcropped around Aoshima island and on Nichinan coast is the typical example.

#### (2) Topography

The project site is located at the estuary of Kouchiumi river in the Nichinan Coast National Park.

The target slope is as steep as 40 degree at the bottom and 80 degree at the top and stands towards the north and the height is 40 meters or more.

Shallow scars identified on the target slope proved, although the slope is densely covered with vegetation, that the slope is still prone to sliding.

### 4. Countermeasures

#### (1) Surface condition of the slope

The slope is featured by the gigantic rock pillars which stand on the top of the slope. The rock pillars have been weathered and therefore heavily eroded. In addition, cracks running on the rock pillars make them quite prone to toppling..

Large boulders which had been detached from the pillars are scattered on the middle and lower part of the slope as shown in Photograph 2 and 3.



Photo 2. Boulders on the slope. The boulder is heavily weathered and eroded.



Photo 3. Boulders detached and scattered on the slope

#### (2) A few criteria for the countermeasure

The countermeasure was selected based on the following criteria:

- a. aesthetic feasibility
- b. no logging (there are cedar as large as 30 cm in diameter. )
- c. no digging work
- d. resiliency to possible rock falls

### (3) the countermeasure selected

Based on the above criteria nets made of steel wire were selected in order to fix rocks which were prone to falling from the top of the slope, while another nets made of steel rings were employed in order to prevent mobile boulders from hitting passersby and vehicles as shown in Photograph4 and Figure 3 and 4.

The steel rings are expected to absorb high energy carried by falling boulders.

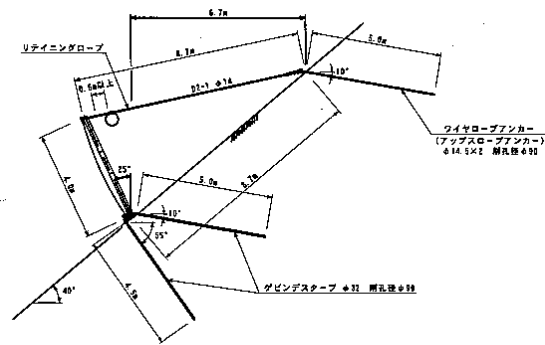


Figure 3. Cross sectional profile of the ringnet method



Figure 4. Longitudinal profile of the slope and the application of the ringnet method

### (4) Specific feature of the ringnet method

A ring-net is made of high tensile strength steel wire of which diameter is from 3.0 to 4.5 mm and the tensile strength is 1,770 N/mm<sup>2</sup>. Steel wire is bended and bundled in order to make a ring so that the size and strength of the ring can be flexibly set up.

The ringnet method was developed and improved by full-scale experiments which had been repeatedly conducted more than 200 times.

It was proved that the ringnet is characterized by extra high energy absorption as well as high reliability and economic efficiency. The method has therefore been applied at the sites which are prone to disasters due to fall of large boulders.

The method has therefore the potential to be used as an alternative to the rockshade structures to cope with a fall of large boulders.

In conclusion, the ringnet method is characterized by the following advantages:

- a. high boulder trap rate
- b. light foundations
- c. easy maintenance
- d. easy construction

#### 4. Conclusion

Construction work in the framework of the Kouchiumi Slope Protection Project is underway. As shown in Photograph 5 and 6, the ringnet method provides us with dual benefits; preservation of natural scenic environment and disaster prevention.

The ringnet method is the most feasible method in the areas located in tourism areas.



Photo 5. Ringnet hoisted



Photo 6. Bird's-eye view of the project area

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