Warning System employing Photo Chronograph Technology installed at the Construction Site of the 4th Check Dam in Shiratani Valley

Tochio Field Office
Zintsu River Erosion Control Project

1. Outline and necessity of the Warning System employing photo chronograph Technology (WSPT)

The revised edition of the Ordinance on Industrial Safety and Health enacted on June 1, 1998 says, in it's Article 575-12, that the employer shall take measures to ascertain the occurrence of a debris flow early such as placing a watchman, and in it's Article 575-14, that the employer shall install alarm equipment such as sirens, emergency bells, etc., to inform the workers concerned when a debris flow has occurred and inform the workers concerned where the equipment is located.

In line with the above regulations, the field office had installed a warning system employing photo chronograph technology. The system is intended to monitor the torrent bed from which a debris flow might be initiated and, in addition, to monitor the progress of a construction work.

The images taken by the camera attached to the system are transmitted to the monitoring station the system can be in operational on a round-the-clock basis and controlled by the monitoring station.

2. Outline of the Target Construction Work

The purpose of the construction work is to thicken and raise the existing dam which is located at Shiratani, at the right branch of Hirayu Valley in the Jintsu river basin and is at a height of 1,300 meters above sea level.

The existing 4th dam is 94 meters long, 15 meters high. The construction work had been implemented during the term from 2004 to 2006, for three years.

The dam was intended to protect the national root 471 which leads to Oku-Hida hot spring resort.

In the watershed of the Shiratani valley there are Mt. Yake, an active volcano, Mt. Akandana and Mt. Shiratani of which slopes constantly yield a lot of harmful mobile materials.

The dam site is very prone to debris flow discharges. In fact, there had been two events of large debris flow discharges in 2004.

It is therefore required to monitor rainfall accurately in terms of intensity as well as quantity in order to prevent a disaster due to debris flow discharge.

The dam site is so dangerous for a man to work that a two third of the site became off limits to workforce. Accordingly the area was designated as the unattended construction area in which. (Photo1)

Photo1: Tamping by unmanned vibrator

The Warning System employing photo chronograph Technology was, in accordance with

the above mentioned regulations, installed and operated in order to prevent disasters due to possible debris flow discharges.

3. The principle of the warning system employing photo chronograph

The sensor system employing photo chronograph enable changes in two consecutive images to be automatically identified. The principle of the sensor system is to detect differences between two consecutive images by identifying gaps in contrasting density. The gaps in contrasting density mean the filmed targets are moving.

In another word, as soon as the gaps in contrasting density between two consecutive images exceed the threshold value, the warning system is mobilized.

In this case, the sensor system assesses gaps in contrasting density among five images taken successively once every 0.5 second. The target stretch of the valley in which a debris flow is initiated is located 300 meters upstream from the monitoring camera. Images of the target stretch are taken by the camera set up 100 meters upstream from the dam site. (Photo2)

Photo2: The detection area (The site of □)

The sensor system is operated during the period of time from 7 in the morning till 7 in the evening because nighttime work is prohibited. All the images are digitized and stored. All the data processing systems with display except sensor system is installed in the field office. Warning siren and red lights which work directly with the sensor system give all the people concerned in the work site warnings and help them evacuate smoothly in case a debris flow is initiated. Warning information is automatically transmitted to the field director.

4. Interim assessment of the warning system

The WSEPT has an advantage over the wire sensor system(WSS) which detects debris flow . Wires used for the WSEPT are stretched across the valley and are cut by a running debris flow. The WSS requires rewiring work as soon as a wire is cut by either running debris flow or wild animals. However, in the case of the WSEPT, the camera can be placed at a safer location so that the distance between the work site and the camera can be long enough to avoid risking the lives of those who are in charge of monitoring practices. Furthermore, unlike WSS, the WSEPT requires no wire linking between sensors and monitoring station. Therefore, there is no need to install wiring or rewire in the dangerous valley. It is certain that the WSEPT is characterized by high safety and sustainability with all things considered.

The WSEPT had successfully detected the initiation of debris flow twice after its installation in April 2005.

Improper warnings due to insects flying closer to the lens, direct and/or reflecting sunlight and tree leaves in the field of view must be the subject of future investigation, but not so critical problems.

Considering the high risks of disasters at work sites, the WSEPT is cost effective. The more the cases, the higher the cost effectiveness.

※Translated from Journal of Japan Sabo Association, Sabou to Chisui, Vol.168, pp.39-40, 2005