Procedia Engineering

Volume 143, 2016, Pages 708–716

Advances in Transportation Geotechnics 3 . The 3rd International Conference on Transportation Geotechnics (ICTG 2016)

Using Remote Sensing Techniques to Identify the Landslide Hazard Prone Sections along the South Link Railway in Taiwan

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Abstract

In this study, we demonstrate the capability of combining remote sensing and GIS technique to identify and map out the possible landslide and debris flow hazards along the South Link Railway in Taiwan. Using high resolution aerial photography, terrain models, landslide inventories, the disaster prone areas of 3 types of mass movements were identified. In total, 48 slopes hold high landslide susceptibility; 35 torrents have high debris flow susceptibility; the rockfall from 11 sites would reach the railway line. The result shows consistencies with hazard records and could provide vital information for railway line improvement, hazard prevention and mitigation purposes.

Keywords: Remote Sensing, South Link Railway, Taiwan, Landslide, Rockfall, Debris Flow

1 Introduction

Taiwan is located in the region with earthquakes and typhoons occurring frequently. From the statistics of the Central Weather Bureau, over the past 50 years there were 4.9 typhoons hitting Taiwan annually (Lo, W. C., Tsao, T. C., and Hsu, C. H., 2012) (Chen, Y. R., Yeh, C. H., and Yu, B., 2011). Moreover, the hill slopes and high precipitation also provide good conditions for landslide hazards (Tsao, T. C., Hsu, C. H., Lee, C. F., Huang, C. M., Wei, L. W., and Lee E. T., 2014). According to UN statistics, Taiwan is among the highest absolute GDP (Gross Domestic Product) (140 billion USD), as well as the highest relative GDP (33%) exposure due to precipitation or earthquake triggered landslides (UNISDR., 2009).

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 Selection and peer-review under responsibility of the Scientific Programme Committee of ICTG 2016

doi:10.1016/j.proeng.2016.06.107

Additionally, with land development, tourism and other human activity moving into the mountains, more and more elements at risk were exposed to debris flow hazard (Hsu, C. H., Tsao, T. C., Chang, Y. L., and Chen, C. Y., 2012). Several critical infrastructure such as highway, railway were exposed to landslide hazard (Lee, C. F., Huang, W. K., Wei, L. W., Tsao, T. C., Chang, Y. L., and Chi, S. Y., 2015). Thus, it is worth noting that landslide hazard had been one of the major natural hazards in Taiwan because of tremendous economic loss and casualties.

2 Study Area

The length of the South Link Railway is roughly 98 km from Fangliao Township in the west to Taitung City in the east (Figure 1). During the route selection stage during 1980s, a relatively high risk route was selected because of budget limitation, thus the railway line was exposed to landslide and debris flow hazards (South Link Railway Construction Office, 1992). The railway line passes through the southern foots of the Central Range in Taiwan and goes along with various landforms and geological zones (Chinese Institute of Civil and Hydraulic Engineering, 2008).

The South Link Railway could be divided into several sections based on construction type: embankment and bridge (8.8 km), tunnel (38.9 km), and slope-land sections. According to the disaster records form Taiwan Railways Administration (TRA, 2015), several shallow landslides, rockfall and debris flow events impacted the railway in the past decade (Table 1). On Aug. 31, 2013, Tze-Chiang Limited Express was derailed (Figure 2) because of hitting the debris flow (China Times Inc., 2013). Thus, it highlighted the importance of safety of the South Link Railway.

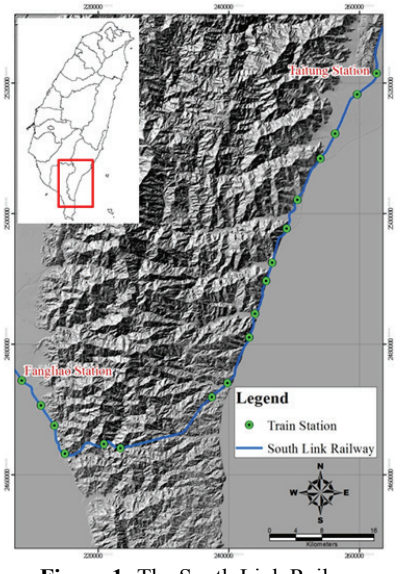

Figure 1: The South Link Railway

Date	Event
2004/9/15	Typhoon HAIMA
2005/7/19	Typhoon HAITANG
2012/6/14	0614 Rainfall
2012/6/15	0614 Rainfall
2013/8/13	0831 Rainfall

Table 1: Hazard events of the South Link Railway in the past decade

Figure 2: Disaster image on Aug. 31, 2013 **(China Times Inc., 2013)**