

DEVELOPMENT OF AN INNOVATIVE BRIDGE MONITORING SYSTEM FOR MULTI DISASTERS

H. P. Tserng^{1*}, K. C. Chang¹, Mirosław Skibniewski², C. C. Chen¹, and Y. F. Liu¹

¹ Department of Civil Engineering, National Taiwan University, Taipei, Taiwan

² College of Engineering, Khalifa University of Science Technology and Research;

Department of Civil & Environmental Engineering, University of Maryland

* Corresponding author (hptserng@ntu.edu.tw)

ABSTRACT: Transportation infrastructure plays an important role in national development. With such unique geographic environment, bridges become the majority of transportation infrastructure and building the bridges is regarded as one of the most important public construction projects in Taiwan. However, Taiwan is also known as its natural disasters such as earthquakes and typhoons, which will cause severe damage or even destroy the bridges. For example, Houfeng Bridge was torn down by the flood in 2008. In 2009, another bridge – Shuangyuan Bridge – was also destroyed by debris flow. Several lives were lost in these two accidents. Therefore, it is in doubt that traditional Bridge Monitoring System (BMS) could provide sufficient real-time information to competent authorities. In order to mitigate the damage or even prevent any loss of property or life from the disasters, an innovative BMS based on Wireless System Network (WSN) technology is studied and applied for field applications. For the purpose of providing real-time information to competent authorities, an information management platform will also be developed to work with the monitoring system.

Keywords: Bridge Monitoring System (BMS), Wireless Sensor Network (WSN)

1. Introduction

Taiwan is an island consisting of hundreds of rapid rivers. Based on the unique geographical environment, bridges are highly required and finally become the majority of public transportation (construction) projects. Since Taiwan is located on the boundary of Eurasian plate and Philippine tectonic plates, earthquake frequently happen. No doubly, it is important to prevent aging bridges, which are easily and highly- possibly damaged or even destroyed by earthquakes, form the deadly earthquakes. Table 1 show the number of earthquakes happened in the past 10 years.

Table 1 Number of Earthquakes Happened in the Past 10 Years (Central Weather Bureau)

Year	2001	2002	2003	2004	2005
Number	334	425	347	262	557
Year	2006	2007	2008	2009	2010
Number	405	426	476	752	614

Subtropical climate also has significant influence on bridge structures. The typhoons, which are resulted from tropical depression and happen in late summer, will seriously damage aging bridges. In 2009, Typhoon Morakot (International designation: 0908, JTWC designation: 09W, PAGASA name: Kiko) attacked Taiwan and was later known as the most deadly typhoon in recorded history. Morakot brought the highly-humid southwest air flow, which resulted in consecutive 48-hour heavy rain in southern Taiwan. Table 2 shows the cumulative precipitation of main rivers basin in southern Taiwan. In addition, serious landslide from hillside located in the upstream of the river was triggered by the heavy precipitation. The fast-moving, liquefied landslide (also known as Debris Flow) caused severe structural damage to 196 bridges; fifty of them were destroyed. More unfortunately, numbers of people fell into the river accidentally in the moment when Shuangyuan Bridge collapsed due to the flood.

