# To construct flood-resistant road structures

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Toshiaki Mabuchi, Head  Hideaki Nishida, Senior Researcher
Takashi Kimura, Research Engineer,
Foundation, Tunnel and Substructures Division, Road Structures Department

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## 1. Introduction

Multiple typhoons landed on Hokkaido in August and September 2016. The heavy rain of the typhoons widely damaged road structures through scouring in flooding and erosion of riverbanks (photo 1). Almost all of the arterial roads connecting the central and eastern parts of Hokkaido were temporarily disconnected.

To avoid such situations and develop robust road networks, it is desirable to minimize the effects of scouring and riverbank erosion from floods on the functions of road structures, which play important roles in regional economic activities, emergency responses, and transportation of goods.

Under such circumstances, the authors are conducting research to find the structural requirements for already constructed road structures that need to be reinforced, such as the improvement in load resistance capacity to withstand scouring and erosion caused by flooding.

## 2. Contents of the study

Past studies have found that the likelihood of the onset of scouring and the speed of progress is strongly related to the shape of a structure, the depth of its foundation, and span length in terms of structural characteristics, as well as the shape of a river channel (e.g. whether the area where a structure is installed is level or not) and flow speed in terms of river characteristics. These findings are reflected in regulations and standards for the depth of the foundation and span lengths in the Government Ordinance for Structural Standards for River Management Facilities. Still, there are situations that cannot be put under control through local responses in the area of road facilities, such as disastrous events that result in the significant alteration of river flows during a flood. In this fiscal year, the authors are therefore organizing the relationship among structures, ground conditions, and river characteristics that are vulnerable to scouring, erosion, or other conditions based on an analysis of recent damage from the perspective of both road structural characteristics and river characteristics.

Figure 1 is an example of the breakdown of damage to the abutments where the year of construction is known among studied cases of road bridges damaged by floods from 2013 to 2016. For example, the standard span length L for a bridge with piers in a river channel was set to L = 20 + 0.005 Q (Q: planned highest flow rate) (the regulation is relaxed when Q is 2000 $m^3/s$ or less) in the 1976 Government Ordinance for Structural Standards for River Management Facilities (hereinafter "the Ordinance on Structures"). The revision in 1997 changed the span length to 50 meters when L exceeds 50 meters. Before the establishment of the Ordinance on Structures, there was substantial damage associated with structural characteristics, such as damage to abutments and tilting and subsidence, and the ratio of damage caused by the outflow of sediment to the back of abutments regardless of the year of construction was also high.

Photo 1: Road bridge of a national road damaged in a flood

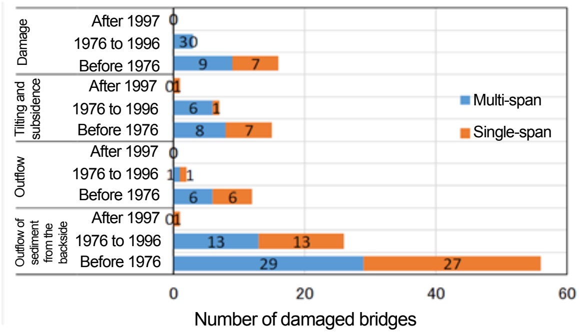


Figure 1: The breakdown of damages to abutments damaged in floods from 2013 to 2016 (by year of construction)

## 3. In the end

The authors are going to continue analyzing the relationship among the history of applicable standards and construction technologies, river characteristics, and factors that affect the load resistance capacity of a foundation and deformability and examining the structural requirements to be applied in cooperation with the River Department.