## More effective advancement of the seismic reinforcement of highway bridges (Research period: FY2016 – 2018)

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## 1. Introduction

In the 2016 Kumamoto Earthquake, the seismic reinforcement that had been conducted in the past reduced the damage to highway bridges. On the other hand, however, there were cases where it required time for functional recovery. In order to advance the seismic reinforcement of highway bridges more effectively, it is necessary to study the method of advancing future seismic reinforcement of unreinforced bridges after analyzing the effect of seismic reinforcement on highway bridges that experienced the damaging earthquake. In this document, the investigative research, which is currently advanced by the National Institute for Land and Infrastructure Management (NILIM), is introduced, in addition to the effects of some seismic reinforcements of highway bridges that were conducted in the past.

## 2. Effects of Past Seismic Reinforcements

Figure 1 shows the rate of highway bridges of government-administered national roads damaged by the 2011 Great East Japan Earthquake. Although the 1995 Kobe Earthquake caused tremendous damage, such as the collapse and deformation of many piers to which the technical criteria established in 1971 or before were applied, the figure (Great East Japan Earthquake) does not show such a tendency. This is because the renewal and reinforcement of highway bridges with low quake resistance as a result of experiencing the 1978 Miyagi Prefecture Earthquake, as well as because the reinforcement was promoted against earthquake ground motion equivalent to those of the Kobe Earthquake based on "The three-year program for the seismic reinforcement of piers on emergency transportation roads (FY2005 -2007)" for preventing tremendous damage, such as the collapse of bridges.

When the Great East Japan Earthquake occurred, Operation Comb for immediately securing rescue routes





to the coastal areas of the Pacific Ocean damaged by tsunamis was carried out. This realized early elimination of road obstacles to secure 15 access routes to major coastal cities after securing the vertical line consisting of the Tohoku Expressway running through the center of inland area and National Route 4. This early elimination of road obstacles was enabled because the damage to highway bridges to which the technical criteria established in 1971 or before were applied was reduced as a result of the advancement of the seismic reinforcement described above. In addition, it is also said to be because the Operation Comb narrowed down the routes where the elimination of road obstacles was intensively advanced, as well as because the cooperation of local constructors based on the disaster agreement was obtained in the elimination of road obstacles.<sup>1</sup>

## 3. For more effective seismic reinforcement

The NILIM is proceeding with the analyses of the damage degree improvement effect achieved depending on the content of seismic reinforcement of highway bridges and the socioeconomic effect achieved through the early securement of road network function. We are planning to perform such analyses on earthquakes, such as the Kumamoto Earthquake, to consider how to carry out seismic reinforcement of unreinforced bridges.

For details, visit:

1) "The road to reconstruction from the Great East Japan Earthquake" and "Earthquake disaster museum" on the website of Tohoku Regional Development Bureau http://www.thr.mlit.go.jp/



Figure 2<sup>1)</sup> Operation Comb