

## High toughness RC railway viaduct with columns reinforced by arranging a spiral rebar inside of the longitudinal bars

Kiyotaka Sugita, Shogo Osawa, Kosuke Kuwakino, Daisuke Tsukishima

*Civil Engineer, East Japan Railway Company, Tokyo, Japan*

Contact: [ki-sugita@jreast.co.jp](mailto:ki-sugita@jreast.co.jp)

### Abstract

Since Japan is the land of earthquakes, the seismic design is very important for the design of civil engineering structures and the design of architectural structures in Japan. The seismic design standard has been revised by the damage of earthquakes in the past. After the 2011 off the Pacific coast of Tohoku Earthquake, there is the need for Anti-Catastrophe Performance and redundancy to have the measures for Unanticipated Earthquake in the seismic design of Japan.

Therefore, the authors developed the new method of the reinforcing bar arrangement. The new method can enhance dramatically ductility capacity in the RC column, so it is possible to give sufficient redundancy against Unanticipated Earthquake. The authors think that it is a very effective technique in the seismic design. In this report, we report the performance evaluation method of the RC column by the new method and the construction results.

**Keywords:** seismic design, RC rigid-framed viaduct, ductility, Anti-Catastrophe Performance, redundancy

### 1 Introduction

Since Japan is the land of earthquakes, the seismic design is very important because many sections of civil engineering structures and architectural structures are determined by the seismic design. Until now, the seismic design of Japan has been reviewed and improved from the damage of the earthquake experienced in the past. However, the damage of the 2011 off the Pacific coast of Tohoku Earthquake (hereinafter as The Tohoku Earthquake) was very serious damage so as not to have experienced it so far.

After this earthquake, there is the need for Anti-Catastrophe Performance and redundancy to have the measures for Unanticipated Earthquake in the seismic design of Japan, especially about the railway structure with high public utility.

The Anti-Catastrophe Performance is the first concept shown in the revised design standards for railway structures in 2012. It is intended to avoid catastrophic state even if an earthquake greater

than the assumed earthquake occurred while ensuring safety against the design assumed earthquake. In other words, even if some of the members reach the limit of destruction, it is necessary to prevent the whole structure from being destroyed and collapsed. And it is necessary for the whole structure to have redundancy and robustness.

Therefore, the authors developed the new method of the reinforcing bar arrangement. This method is applied to the columns of all RC rigid-framed viaducts for the railway designed in East Japan Railway Company (hereinafter JR East). This method is that a method of arranging a spiral rebar inside of the longitudinal bars and controlling the position of plasticity hinge in the upper and lower 1D section of the column (D is the height of the cross section of the column). The authors had the experiment to confirm the performance of the new method. The RC column with the conventional method of the reinforcing bar arrangement shows the behavior that is near to collapse in the post-peak region after the