

Shear Resistant Mechanism of Reinforced Concrete Beams for Seismic Design of Railway Structures

Ken WATANABE

Assistant Senior Researcher
Railway Technical Research
Institute. Tokyo, Japan
wataken@rtri.or.jp

Moe YONEHANA

Graduate Student
Tokyo Institute of
Technology, Tokyo, Japan
yonehana.m.aa@m.titech.ac.jp

Junichiro NIWA

Professor
Tokyo Institute of
Technology, Tokyo, Japan
jniwa@cv.titech.ac.jp

Yukihiro TANIMURA

Laboratory head
Railway Technical Research
Institute. Tokyo, Japan
tanimura@rtri.or.jp

Toshiya TADOKORO

Assistant Senior Researcher
Railway Technical Research
Institute. Tokyo, Japan
tadokoro@rtri.or.jp

Summary

Reinforced concrete (RC) deep beams are used as a structural member having a shear span to effective depth ratio of not exceeding 1.0 as well as for the application to frame structures, caisson foundations, and corbels. There is, however, a peculiar problem in the analysis of RC deep beams; the variety of supporting condition for RC deep beams induces various failure modes. The goal of this research is to identify the shear-resistant mechanism as well as the shear-load capacity of RC deep beams. To tackle with this objective, the research has focused on internal strain distributions of the RC deep beams under external loading. Based on experimental results, this paper concluded the failure mode and the load capacity of RC deep beams associated with supports condition and the specimen design.

Keywords: RC deep beams; supports condition; shear-load capacity.

1. Introduction

Reinforced concrete (RC) deep beams are widely used as a structural member having a shear span to effective depth ratio of not exceeding 1.0 as well as for application to frame structures, caisson foundations, corbels. Civil engineers in Japan have considered the shear-load capacity of RC deep beams loaded under the simple-supported condition, and the shear compression failure with principle compressive stress flows from the load point to supports after the occurrence of diagonal cracks [1]. There is, however, a peculiar problem in the analysis of RC deep beams; the variety of supporting method for RC deep beams subjected to the seismic force induces various moment diagrams. For example, the moment diagram in RC deep beams used for caisson foundations shows the symmetry with respect to the middle of the span under vertical loading. On the other hands, the moment diagram in RC deep beams used for frame structures shows the anti-symmetry moment diagrams under horizontal loading. Because the resistant mechanism is corresponding to the moment diagram, the shear-load capacity of RC deep beams is strongly depending on types of civil engineering structures. A few studies have explained and predicted the failure mode of RC deep beams, which was influenced by the support condition [2]. The difference in failure modes between predicted and experimental results has caused a large safety factor in the design of shear-load capacity and deformation capacity of RC structures.

The goal of this research is to identify the shear-resistant mechanism of RC deep beams in frame structures subjected to the seismic loading. This paper discussed the effect of supports condition on the shear-resistant mechanism as well as the shear-load capacity of RC deep beams. Based on