Experimental and Numerical Study on the Shear Performance of RC Shear Walls Confined with Welded Reinforcement Grids

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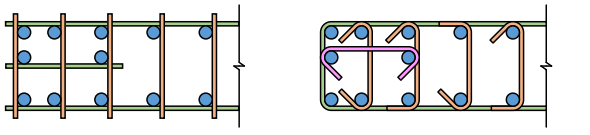
Abstract

The prefabricated Welded Reinforcement Grids (WRG) is an alternative to the conventional hoops and cross-tie reinforcement in RC structures. Its advantages include high precision, customizability, and economization of construction time, labour and material. However, its performance as shear reinforcement of concrete shear walls has not been thoroughly studied. This paper presents an experimental investigation on the static and seismic behaviour of RC shear walls with WRG as shear reinforcement and confinement of the boundary element. For the reinforcement of long shear walls, a detailing of overlapped WRG is proposed and also tested in specimens. The stiffness, shear capacity, failure mode and the development of strain in reinforcement were instrumented and compared. The test results showed that the shear capacity of WRG confined shear walls exceeded the value predicted by the formula of Chinese code GB50010-2010, Eurocode 2 and the US code ACI 318-14. For the shear wall with overlapped WRG, no major difference was observed on its stiffness, shear capacity and failure mode. The contribution of integral WRG and overlapped WRG to the total capacity of specimens was close. The overlapped WRG was able to develop significant strain, even attain its yielding strain. The capacity of reinforcement was fully exploited and tensile force was effectively transferred. A finite element model based on MSC.Marc was established to simulate the behaviour of test specimens. The results of numerical simulation corresponded with test results with a reasonable level of accuracy.

Keywords: Welded reinforcement grids; reinforcement overlap; RC shear wall; shear behaviour; experimental study, numerical simulation.

1 Introduction

The WRG is an alternative to conventional hoops and cross-tie reinforcement in RC structures. In shear walls, the WRGs are placed with longitudinal rebar passing across the grids, and fixed with iron wires to form a reinforcement cage. In this way, the WRG serves as both horizontal distributed rebar and confining reinforcement of boundary elements. The application of WRG in construction of RC shear wall simplifies the cage assembly process and reduces the construction time and labour. Furthermore, as Figures 1 shows, WRG eliminates the hooks in conventional cross-and-tie reinforcement to provide anchorage to the ties. Therefore, more space is left for concrete casting, which is beneficial for the improvement of concrete casting quality.



a) WRG b) Conventional stirrups

Figures 1. Comparison between WRG and conventional stirrups

The WRG has been applied in a series mega-projects. Examples include the Millennium Tower at San Francisco (the tallest concrete structure in

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