預鑄五螺箍 SRC 梁柱接頭之耐震試驗

研究生：蕭永興　　指導教授：翁正強 博士

國立交通大學 土木工程研究所

摘 要

本研究成功的進行三組實尺寸預鑄「五螺箍(5-Spirals)」鋼骨鋼筋混凝土(Steel Reinforced Concrete, SRC)梁柱接頭之反復載重試驗，主要目的在探討這種新型 SRC 梁柱接頭之耐震性能。三組試體中，一組採用 SRC 柱接鋼梁，另兩組則採用 SRC 柱接 SRC 梁。本研究為了要模擬預鑄工法(Precast Construction)之施工程序，因此在試體之製作、組裝與灌漿等方面均依照預鑄工法之程序施作。

試驗結果顯示，三組梁柱接頭試體的層間變位角(Interstory Drift Angle)均可以達到 4.0%弧度以上，梁之塑性轉角(Plastic Rotation Angle)皆大於 3.0%弧度。此外，三組梁柱接頭之反復載重遲滯迴圈(Hysteretic Loop)均相當飽滿，且當層間變位角到達 4.0%弧度時，梁之抗彎強度仍可維持大於 80%之極限彎矩強度，亦即沒有發生強度驟降的情形，顯示試體具有優越之抗震能力。

另一方面，在梁柱接頭區，本研究三組 SRC 梁柱接頭試體之鋼梁翼板均未採用切削斷面(Reduced Beam Section, RBS)，亦未採用蓋板或肋板補強。試驗結果顯示，由於插入接頭區混凝土中之鋼梁受到混凝土有效的束制，使得接頭區內部的鋼板在反復載重作用下，仍不致於發生扭曲變形。此一現象顯示，SRC 梁柱接頭區之混凝土除了有束制鋼板的作用，並可發揮保護接頭內部銲道之功能。因此鋼梁在未經過切削或補強之情況下，仍然可以發揮良好的耐震性能。此外，由於鋼梁不需經過切削或補強，亦有助於節省製作成本。

關鍵詞：預鑄工法，五螺箍，SRC 梁柱接頭，反復載重試驗，遲滯迴圈，塑性轉角，層間變位角，耐震性能

SEISMIC RESISTANCE OF PRECAST 5-SPIRALS STEEL REINFORCED CONCRETE (SRC) BEAM-TO-COLUMN CONNECTIONS

Student：Y. S. Siao **Advisor：Dr. C. C. Weng**

Institute of Civil Engineering
National Chiao Tung University

Abstract

The objective of this study is to investigate the seismic resistance of a new type of precast steel reinforced concrete (SRC) beam-to-column connection with the rectangular SRC column confined by a multi-spiral cage. The multi-spiral cage is a device of five interconnected spirals, named “5-spirals”, with a large spiral at the center and four small ones at the corners. The innovation of applying the 5-spirals to SRC column is to take its superiority in concrete confinement as well as its efficiency in automatic production for precast construction. Three full-scale beam-to-column connections were tested under horizontal cyclic loading. All specimens were designed to meet the strong-column weak-beam (SCWB) requirement.

The test results showed that all of the specimens developed satisfactory plastic rotation capacity. The hysteretic loops observed from the cyclic loading tests indicated that the spirally confined SRC beam-to-column connections demonstrated excellent performances in both strength and ductility. As required by the AISC Seismic Provisions (2005), the tested connections were capable of sustaining an interstory drift angle of 4.0% radians. For each test, the measured flexural resistance at drift angle of 4.0% radians was larger than 80% of the plastic flexural strength M_p of the connected beam.

It is also noted that the flanges of the steel beam connected to the SRC column were directly groove-welded to the steel section within the SRC column without using the reduced beam section (RBS) technique. The test results indicated that the reinforced concrete in the connection zone provided an “effective constraint” to the steel beam embedded in the SRC column. This constraint had successfully “protected the welded joint” from premature failure, and assisted the beam to develop satisfactory plastic deformation right out of the SRC column face.

Keywords: Seismic resistance; precast construction; 5-spirals; steel reinforced concrete; beam-to-column connection; cyclic loading test; interstory drift angle.