Abstract

This thesis describes an investigation into reinforced concrete beam-column connection behaviour. This behaviour is governed by mechanisms such as shear, bond and confinement. These are not fully understood in themselves. Seventy external beam-column connection specimens were manufactured and tested. Forty nine of these were subjected to monotonic (gravity) loading and twenty one to simulated seismic loading.

The monotonic tests investigated the influence of the following parameters on specimen performance :

1. Beam steel anchorage
2. Concrete strength
3. Joint ties and their positioning
4. Joint aspect ratio
5. Steel fibre and steel plate reinforced concrete

Non-linear finite element analyses of these tests were conducted using the computer package SBETA. Following a considerable learning period a standard finite element mesh was proposed for reinforced concrete beam-column connection design. This was validated using the experimental results and used to conduct a parametric study.

The experimental work, in addition to this finite element modelling, allowed a comprehensive analysis of monotonic beam-column connection behaviour to be made. Within this thesis, conclusions are made on the prediction of joint strength and the subsequent methods of joint enhancement. Guidelines are developed to be considered in the design of reinforced concrete external beam-column connections.

The twenty one specimens tested to investigate the cyclic strength of monotonically designed connections were subjected to load cycles of increasingly large beam rotations. This allowed cyclic performance to be analysed. An attempt was also made to shift the beam's plastic hinge away from the column face in order to improve this performance.

The cyclic tests gave an insight into how monotonically designed connections would perform if subjected to earthquake motions, very high winds or blast effects. Recommendations are made for the design of such structures.