ABSTRACT

Light gauge elements have been used for built-up beams and the economical design of built-up beams normally requires thin webs. But, if the web is extremely thin, the problem of plate buckling may arise. Using thicker plates, web stiffeners or strengthening the web can possibly reduce this risk. The use of corrugated web is a potential method to achieve adequate out-of-plane stiffness and shear buckling resistance without using stiffeners.

In the present work, experimental and analytical investigations have been carried out to study the structural behaviour of cold-formed steel beam with plain web, trapezoidally corrugated web, concrete encased plain web and concrete encased trapezoidally corrugated web. The entire study is divided into three distinct phases.

In the first phase, twelve experiments were conducted to find the effect of web corrugation angle on the behaviour of cold-formed steel beams. Beams having two different web depth-thickness(d_w/t_w) ratio and with three types of web corrugation angles 0^0, 30^0 and 45^0 were tested. Two beams were tested in each series. Beams with plain web and 45^0 corrugated web showed shear buckling of the web, but the failure due to shear in the web could be eliminated with 30^0corrugated web. The cold-formed steel beams with trapezoidally corrugated webs having 30^0corrugation have been found to have

higher moment carrying capacity compared to the beams with plain web and 45^0 corrugated web. It is observed that the beams with trapezoidally corrugated web have lower displacement ductility than the beams with plain web.

In the second phase, in order to find the effect of concrete encasement in the web, twelve experiments were conducted on cold-formed steel beams. The test specimens consist of cold-formed steel beams with concrete encased plain web and concrete encased trapezoidally corrugated web having 30^0 and 45^0 corrugations. Beams having two different web depth-thickness (d_w/t_w) ratio and with three types of web corrugation angles 0^0, 30^0 and 45^0 were tested. Two beams were tested in each series. It is found that the beams with concrete encased trapezoidally corrugated web not only increases the moment carrying capacity but also the ductility and the resistance to transverse deflections. The ductility of the beams with concrete encased trapezoidally corrugated web is more than the beams with concrete encased plain web. The super elastic property of the beams with concrete encased corrugated web enhances the usage of it in the earthquake resistant structures.

In the third phase, finite element analysis of beam specimens with plain web, trapezoidally corrugated web, concrete encased plain web and concrete encased trapezoidally corrugated web was carried out using the finite

element software package ANSYS and the experimental results were validated with the results obtained from the finite element analysis.

The failure mode, moment carrying capacity, lateral buckling resistance and displacement ductility of the beams with plain web, trapezoidally corrugated web, concrete encased plain web and concrete encased trapezoidally corrugated web are presented. The experimental results were also compared with the analytical results.