DESIGN OF COMPOSITE BEAMS USING LIGHT STEEL SECTIONS

Author: RODERA GARCÍA, AIDA
Tutor: MIRAMBELL ARRIZABALAGA, ENRIQUE
POPO-OLA, SUNDAY O.

ABSTRACT

Composite construction is well established for some decades as a construction method but it has traditionally used hot rolled steel sections rather than light steel (cold formed) sections. The main components of traditional composite construction have been hot rolled steel framework, steel decking, shear connectors and in-situ concrete with mesh reinforcing steel. The benefits of this construction method are several and the most important of them are speed of construction due to the rapid erection of the steel framework, economy in use of materials, robustness to damage and good performance in service. To these benefits some more can be added if light steel sections are used instead of the traditional hot rolled. The advantage that light steel gives are basically two: that cold formed steel is cheaper that hot rolled and that is also lighter in weight.

Light steel framing comprises galvanized cold formed steel sections of C or Z or similar forms of 1.2 to 3.2 mm thickness. Previous works have studied how these sections behave as beams or columns under different loads cases, but the composite action of light steel sections with in-situ concrete is a field not yet fully explored.

Composite light steel beams use back to back double C sections rather than hot rolled steel I beams, but the general form of construction is similar to conventional composite construction. Importantly, welded shear connectors cannot be used for the relatively thin steel used in light steel construction, and therefore it has been necessary to develop alternative forms of shear connectors using powder actuated, or pneumatically driven pins. These shear connectors use profiled strip steel elements which are fixed by pins. To know the resistance and behaviour of these innovative shear connectors some tests have been carried out determine the design resistance of these connectors.

The aim of this project is to provide guidance on the design of composite beams using light steel sections, a carefully study has been carried out getting eventually design examples which illustrate the calculus method and can be adapted in a easy way to a design particular characteristic, and design tables to aid rapid selection of light steel sections, depending on the span, the loading and the steel grade used.

To be able to achieve the objectives a progressive work has been carried out. First a literature review on generic forms of composite construction such as composite slabs and beams as well as the types of shear connectors was carried out. The review also types of the materials involved and their properties. With the information already available from previous studies it was possible to get deeper knowledge of the specific shear connectors and beams sections used in composite light steel construction.

Once the materials resistance values and elements dimensions are known, the design of the composite slabs and composite beams was studied. However using cold formed steel sections (slender), the thin thickness of the steel, means that there are some differences in the calculation of the resistance capacity of the composite beam. These differences have been taken into account and to show how the design process of a composite beam works, two design examples have been developed step by step. One is for the case when the beam is not propped during the construction stage and the other one for when the beam is propped. Following this process design tables have been computed for the cases of propped and unpropped and using different steel grades and imposed load. With tables is quite difficult to get a general idea of which relations exist between the different variables, this is the reason why some graphs are presented which show the relations with clarity. The objective of these design tables and graphs are for use during the design stage, making it easier for engineer selection the light steel section base on loading and the span required.