Abstract

**TITLE**  Study of bending-shear interaction in beams with inclined transverse reinforcement

**AUTHOR**  Pau Canal i Oliver

**TUTORS**  Antonio R. Marí Bernat and Jesús M. Bairán García

Transverse reinforcements to resist shear and torsion in reinforced concrete structures usually consists in stirrups perpendicular to the axis of the beam. However, inclined bars may be used, like bent up bars or trusses, which crosses the cracking plane forcing both parts to stay together. This approach might be even more effective than stirrups. Although inclined bars are seldom used at present, the use of space trusses is very frequent in precast concrete beams, such as half-slabs and half-beams for one-way floor systems.

The study of the shear resistance behaviour of this type of floor systems has gained interest because precast units are not needed any more since continuous work surfaces are incorporated for safety reasons, resulting a very economic in situ one-way floor system, reinforced with a space truss. Currently some experimental campaigns are being carried out in the Laboratory of Technology of Structures of the UPC in order to study the behaviour of this type of floor system.

On the other hand, at the UPC a research project is being carried out that includes the development of a numerical model for non linear analysis of arbitrary shaped concrete sections under combined of skew bending, shear, torsion and axial loading. This model allows the analysis of sections with longitudinal reinforcements and other bars perpendicular to the axis of the beam, but was not prepared to carry out calculations with inclined bars.

In this dissertation the previously mentioned numerical model has been studied and the necessary modifications to allow the calculation with inclined reinforcements have been implemented. On the other hand, it was also necessary to modify the program in order to make it capable to calculate beams with families of reinforcements with different inclinations with respect to the beam axis but with identical orthogonal projection on the cross section, as the case of the inclined bars in a space truss.

In order to verify the numerical model with the modifications carried out, one of the experimental campaigns of the laboratory with beams with inclined transversal truss (with two different heights of the truss) has been modelled numerically. The results of the numerical model and the experimental values have been compared with the curves that relate the applied shear and the strain in the truss bars. In spite of the great dispersion of the experimental measurements – strain measured in bars are very affected by discrete cracking crossing or not a bar –, the curves calculated numerically (considering smeared cracking) were adjusted satisfactorily to the average behavior of the experimental data.

Making use of the advantages of the numerical modelization with finite elements, the evolution of stress and strains and their distributions in the cross section have been analyzed. The analysis has also been carried out for identical nominal models to the previous ones but with a simplified cross section, without gussets, so also the influence of these in the sectional response were studied.