SUMMARY

The **longitudinal slip** between the cold formed steel sheet and the concrete is generally the most common failure mechanism of **composite slabs**. The main goal when designing steel sheet profiles for composite slabs is ensuring its effective composite behaviour; conceiving retention systems that achieve higher longitudinal slip strengths.

To carry out the functions entrusted to steel sheet, i.e. permanent formwork and traction reinforcement, many different types of design have been produced, created on the basis of prior experience and which effectiveness has to be evaluated empirically.

Current sheet designs show a repeating embossments pattern all along the span. Its function is to inhibit the longitudinal slip by creating a mechanical interlocking. The resistant mechanism of the embossments consists of a wedge effect that transforms the longitudinal slip movement to force components that produce the transversal bending of the steel sheet and, at the ultimate state, the connection loss.

The profiling shape that defines the ribs of the slab, the embossment locations, its depth, length, etc., are some of the main parameters that significantly contribute to lock the slip. Currently, the design and optimization processes for the geometry, and also the checking of its effectiveness, are carried out in a pure empirical way. Likewise, the composite slabs calculation methods adopted by all national and international standards are also based on experimental parameters, obtained from the test of reduced specimens. These tests attempt to reproduce the real behaviour conditions.

The framework of this work is a research line devoted to improve the longitudinal shear connection between the cold formed steel sheet and the concrete of the current designs as well as to develop innovative concepts that might achieve the permanent connection.

Two main aspects have been developed:

- Experimental: **reduced Pull-out tests and standard m-k bending tests**, with the use of strain gauges measurements.
- Numerical: state a validated procedure for making parametrical **3D non-linear finite elements models** to simulate the failure micro-mechanics due to longitudinal slip.

Within the global aim of improving the knowledge and comprehension of the mechanical interlocking function of the cold-formed steel sheet, this paper presents a numerical and experimental analysis of the longitudinal slip failure mechanics, achieving the following particular contributions:

- Stating a procedure for creating non-linear 3D finite elements models to simulate the slip between the cold-formed steel sheet and the concrete, by which the failure mechanics of several existing designs has been exactly described and analysed.
- Analysis of the shear strength dependency on several geometrical parameters, such as: embossment depth, length, location, profiling angle, sheet thickness, etc., by means of the above said FEM procedure.
- Analysis, by means of FEM, of the longitudinal stress distribution under simple traction, in order to quantify the *stress shadows* due to embossments.
- Effect of the cold-formed steel sheet surface conditions, prior to setting the concrete, in the longitudinal shear strength.
- Analysis of the longitudinal shear efforts distribution transmitted by embossments, along the shear span. Strain gauges have been bonded to the steel sheet, in several sections of the shear span, at different distances from supports.
- General design recommendations. Practical application to the design, optimization and test of the new “T-80” open-rib profile.

The new profile “T-80” is being currently manufactured, commercialized, and used in many outstanding buildings and skyscrapers, showing very good results in comparison to other existing open-rib designs.

KEYWORDS: cold-formed steel sheet profile, non-linear 3D finite elements, shear transfer, pull-out test, embossment, composite slab.