# BEHAVIOUR OF CELLULAR BEAMS AT ELEVATED TEMPERATURES

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## ABSTRACT

Cellular beams are beams that present openings in the web. The insertion of this openings can cause a good architectural characteristic, but the main reason is to improve the mechanical performance, overcoming larger spans compared to the original solid beams, reducing its weight in addition to the passage of technical installations trough the openings.

However, cellular beams are subject to specific failure modes, different from solid beams, such as the Vierendeel mechanism, the web-post buckling or the 2T plastic collapse, among others.

This work aims to analyse the behaviour of cellular beams at ambient and elevated temperatures, representing the effect of a fire situation. A set of experimental tests were performed in IPE220 steel beams, class S275, with openings in their webs, considering different diameters and web post widths.

The cantilever beams were fixed at one end and subjected to an incremental concentrated load at the free end until the collapse, as represented in Figure 1. During experimental tests the vertical displacement at the free end was measured using a potentiometric wire gauge, and the strains around the holes and at the web post were measured by extensometers. For tests at elevated temperatures an electro-ceramic resistances were used to increase the temperatures at a heating rate of 800 [ºc/h] until a steady state regime of a constant temperature equal to 600[ºc] was attained and the mechanical load start to be applied until the collapse.

The experimental results were compared with numerical results obtained from the finite element method using the software Ansys, considering nonlinear geometric and material simulations. The model includes local geometric imperfections based on the first buckling mode. An incremental and iterative procedure was used, with the Newton-Raphson method

Experimental and numerical load vs displacement curves are compared and the collapse loads obtained for each beam. The experimental tests allowed to calibrate the numerical model and expand it for other geometric configurations.


*Figura 1 – Experimental setup at ambient and elevanted temperatures.*

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