

# Numerical analysis of closed built-up cold-formed steel columns in fire scenario

Master's Dissertation in Civil Engineering, in the area of specialization in Structural Mechanics, by Leonardo Papas Toscano Costa and supervised by Professor Hélder David da Silva Craveiro and Professor Aldina Maria da Cruz Santiago and presented to the Department of Civil Engineering of the Faculty of Sciences and Technology of the University of Coimbra.

## Summary

Cold-formed steel sections' adaptability makes it possible to combine various individual sections to create built-up components with much larger load-bearing capacities, making it a strong contender in the construction sector. This thesis was elaborated to detail the numerical parametric models that assess the behavior of CFS closed built-up columns in fire scenario, as well as the ensuing results. To create 80 virtual specimens, the varying parameters were: cross-section (four different configurations using the C, U and  $\Sigma$  channels), length (1050 mm and 3000 mm), load level (30% and 50% of the ambient temperature load bearing capacity) and fastener's spacing (five for each length). The main goal was to investigate the impact of the spacing when the columns were subjected to fire, so the service level was calibrated to make every column collapse at the same critical temperature. With a ground of comparison — the temperature — the collapse load was compared. It was found that the spacing can reduce the load capacity up to 25.7%, when compared to the configuration with perfect connection. Another objective of the research was to see how accurate the Eurocode's predictions were regarding critical temperature. Dividing the Eurocode's method in two parts: the load bearing capacity at ambient temperature and the iterative critical temperature mechanism, it was found that the latter is not good enough, while the former is bad and the least reliable of the two. Since the second part depends on the first, together they can generate a prediction that is 31.6% off-target, in some instances.