International Doctorate in Civil and Environmental Engineering

Robustness of CFS structures during extreme events

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Abstract

The use of cold formed steel in civil engineering has increased exponentially in the last decade thanks to the ease of mass production and prefabrication, uniform quality, lightweight designs, economy in transportation and handling, and quick and simple erection or installation. Among all the products made in cold formed steel, there is one extensively used in civil engineering: racks and self-supporting rack structures. Although every kind of rack is widely used in warehouses, and their static behaviour is mostly accepted in academic and professional scene, they are affected by a structural response that is generally complex to predict under earthquakes, characterized by some strong non-linear phenomena, and also under fire, characterized by a lack of studies and specific codes. Sections are generally thin and this feature makes them vulnerable to the action of fire due to the loss of stability; furthermore fire resistance of this kind of members is rather low because of steel thermal conductivity and their high section factor: both lead to a rapid rise in steel temperature and then to the deterioration of mechanical properties. Moreover, this kind of steel sections are also difficult to protect with traditional, passive, fire protection systems because of their unlucky critical section factor and critical collapse temperature.

In recent years, the approach to fire safety in self-supporting warehouses has changed thanks to regulatory developments and the introduction of national fire safety engineering codes. In fact, this type of buildings is generally required to meet performance criteria not in terms of time, but rather of ways of collapse, which must be inwards (implosive collapse) so as not to damage adjacent buildings.

However, there is a lack of scientific research that identifies design methods to achieve this goal in addition to a defined and general f.e. modeling procedure. Moreover, in a country with a high seismic risk such as Italy, understanding how anti-seismic and fire designs interact with each other to define an integrated design methodology is a fundamental objective.