Choosing the Most Suitable Antiseismic Device Technology for High-Rise Buildings, by Considering the Mechanical Response and Environmental Impact

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Abstract
In recent years, several earthquakes have drawn the attention of researchers to the effectiveness of antiseismic devices (AD) and structural designs. These elements certainly influence building safety, but they also impact the environment. Hence, the overall ecological footprint of a building is varied by the size of the structural elements and the inventory of construction materials used. Since both parameters (safety and environmental footprint) are currently key factors in the building sector, this paper aims to compare the ecological impact produced for each of the three most common antiseismic devices: chevron braces, shear walls and energy dissipators. For such a purpose, a 15-storey building was modelled whose structure was sized by setting a similar base shear capacity (i.e. approx. 2500 kN), regardless of the incorporated antiseismic device. Besides this, with the aim of determining the influence of reinforcement ratios, three different ratios (from 3 to 8%) were chosen for each case. Thus, four different structures (including a bare frame as a control case) were assessed in terms of the mechanical response (i.e. modal parameters, pushover curves and time history analysis) and environmental impact (i.e. life cycle impact assessment method). The results showed that the use of energy dissipators provides the most satisfactory mechanical performance and leads to minimise both ecosystem quality and resource scarcity. Although the use of shear walls certainly shows the lowest impact on the human health category, dynamic calculations demonstrate that this solution greatly increases the rigidity, which hinders the effectiveness of such antiseismic devices. The results provide comprehensive guidance for building designers, showing the main advantages of each AD, in terms of safety, damage control and environmental impact.

Author keywords
Chevron brace; Energy dissipator; Inherent damping; Pushover; Shear walls; Time history