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Enhancing racking stiffness in tall timber buildings using double-skin façades: A numerical investigation

Kozem Šilih, E.[a,*], **Premrov, M.**[a]

[a]University of Maribor, Faculty of Civil Engineering, Transportation Engineering and Architecture, Maribor, Slovenia

ABSTRACT

The main goal of the paper is to present possible benefits in application of previously developed innovative in-plane load-bearing timber double-skin façade elements (DSF) as additional bracing elements in tall timber buildings. Therefore, a six-storey prefabricated timber structure of a height of 15 m and with a regular floor-plan is analysed by a seismic excitation of a_g = 0.225·g with a strong asymmetrical position of transparent façade elements. Two structural solutions are analysed: a hybrid system combining CLT and Light Timber-Framed walls and a non-hybrid structure made entirely of CLT. In both cases, DSF elements are first considered non-resisting and later as racking-resisting bracing elements. Numerical results show that using racking-resisting DSF elements in a hybrid system (CLT+LTF) achieves a similar increase in overall racking stiffness as a non-hybrid CLT structure with non-resisting DSF. Previous studies highlight hybrid timber systems as the preferred approach due to structural, energy-efficient, and ecological advantages. This finding is significant, offering practical benefits and new design opportunities for modern tall timber buildings with asymmetrical transparent façades, improving both energy efficiency and interior illumination in contemporary prefabricated structures.

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**Corresponding author:*
miroslav.premrov@um.si
(Premrov, M.)

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Izvirni znanstveni članek

Povečanje strižne togosti visokih lesenih stavb z uporabo dvoslojnih fasad: numerična analiza

Kozem Šilih, E.[a,*], **Premrov, M.**[a]

[a]University of Maribor, Faculty of Civil Engineering, Transportation Engineering and Architecture, Maribor, Slovenia

POVZETEK

Glavni cilj članka je predstaviti prednosti uporabe inovativnih lesenih fasadnih elementov z dvoslojno zasteklitvijo (DSF), ki v ravnini prevzemajo obremenitve, kot dodatnih ojačitvenih komponent v visokih lesenih stavbah. Članek analizira montažno leseno zgradbo s šestimi nadstropji, višine 15 m, s pravilno tlorisno zasnovo in izrazito asimetrično razporeditvijo prosojnih fasadnih površin, ob projektni potresni obtežbi z značilnim pospeškom a_g = 0,225·g. Preučeni sta bili dve konstrukcijski rešitvi: hibridni sistem, ki združuje križno lepljene lesene plošče (CLT) in lahki leseni okvirni sistem (LTF), ter nehibridna zasnova, izdelana izključno iz elementov CLT. V obeh primerih so bili elementi DSF najprej obravnavani kot nenosilni, nato pa kot strižno odporni ojačitveni elementi. Numerični rezultati kažejo, da vključitev strižno odpornih elementov DSF v hibridni sistem (CLT+LTF) omogoča primerljivo povečanje celotne strižne togosti kot pri nehibridni konstrukciji CLT z nenosilnimi elementi DSF. Predhodne raziskave izpostavljajo hibridne lesene sisteme kot najprimernejšo rešitev zaradi njihovih konstrukcijskih, energijsko učinkovitih in ekoloških prednosti. Ugotovitve prispevajo k razvoju novih zasnov in praktičnih rešitev za načrtovanje visokih lesenih stavb z asimetričnimi prosojnimi fasadami ter k izboljšanju energijske učinkovitosti in naravne osvetlitve notranjih prostorov montažnih objektov.

PODATKI O ČLANKU

Ključne besede:
Les;
Steklo;
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Strižna odpornost;
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Potresno projektiranje

**Kontaktna oseba:*
miroslav.premrov@um.si
(Premrov, M.)

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