UPORABNOST REZULTATOV

Z eksperimenti so bile določene karakteristike XPS, ki so bistvene za potresne analize stavb temeljenih na XPS. Tlačne trdnosti so podobne deklariranim vrednostim v katalogu proizvajalca, doseženi moduli elastičnosti pa so nekoliko nižji. Izmerjene strižne karakteristike, ki jih proizvajalec do sedaj ni navajal, znašajo 0.14 (0.22) MPa (trdnost) oz. 4.5 (7.5) MPa (modul) za XPS 400-L (700-L).

KLJUČNE BESEDE

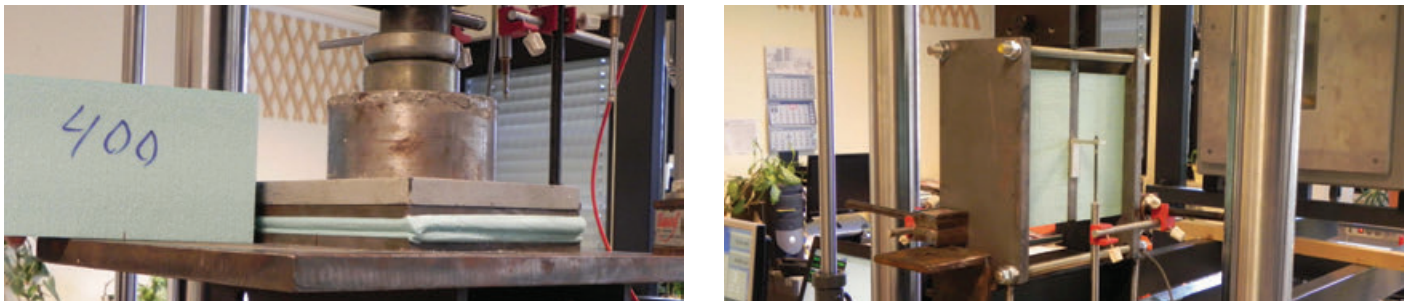
Ekstrudiran polistiren (XPS), temeljenje na toplotni izolaciji, tlačna/strižna trdnost, potresni odziv.

ISSUES AND ITS SIGNIFICANCE

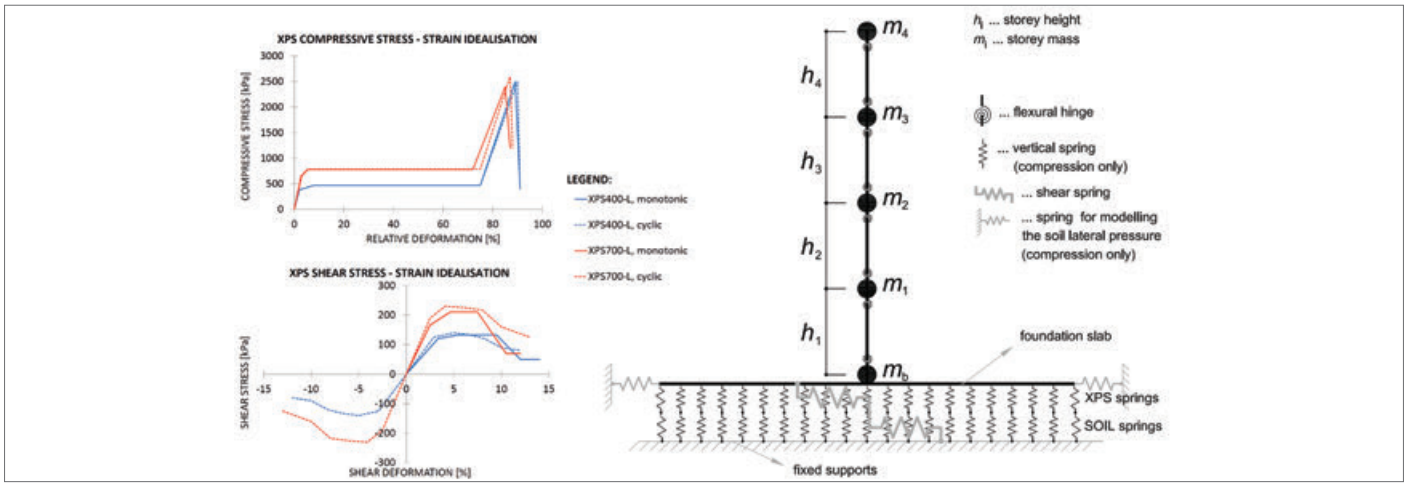
The characteristics of XPS which are essential for the seismic analysis of buildings founded on XPS boards have been experimentally determined. The measured compressive strengths are similar to the declared values from the producers' catalogues, while the obtained values of elastic moduli are slightly lower. Measured shear characteristics which have not been provided by the producers till now are 0.14 (0.22) MPa (strength) and 4.5 (7.5) MPa (modulus) for XPS 400-L (700-L).

KEY WORDS

Extruded polystyrene (XPS), foundation on thermal insulation, compressive/shear strength, seismic response.



Slika 5: Vzorec XPS pred in na koncu tlačne preiskave (levo) in preskušanec za strižno preiskavo nameščen v preskuševalnem stroju (desno). [Bokan-Bosiljkov, 2013a]
Figure 5: XPS specimen before and at the end of the compressive test (left) and XPS shear test setup (right). [Bokan-Bosiljkov, 2013a]



Slika 6: Idealizirani diagrami napetost – deformacija vzorcev XPS 400-L in 700-L in poenostavljen numerični model (4-etažne) stavbe temeljene na XPS.

Figure 6: Idealised stress – deformation diagrams of the XPS 400-L and 700-L specimens and simplified numerical model of a (4-storey) building founded on XPS.

David Koren

PREISKAVE TRENJA IZBRANIH SKLOPOV IZ XPS

SLIDING RESISTANCE OF XPS FOUNDATION SETS

POVZETEK

V okviru eksperimentalnih raziskav izvedenih v Konstrukcijsko-prometnem laboratoriju na UL FGG so bile opravljene tudi preiskave trenja na sklopih, ki se uporabljajo na stiku konstrukcije s temeljnimi tlemi. Ti testi niso standardizirani in so bili za potrebe preiskav zasnovani posebej [Bokan-Bosiljkov, 2013b]. Testirani sklopi so bili sestavljeni iz ene ali dveh XPS plošč, betonske plošče, z/brez hidroizolacije (HI) ali polietilenske folije (PE) med izbranimi sloji. Sklopi s HI

SUMMARY

In order to estimate the coefficients of friction between the different constituent elements in TI foundation set shear tests were carried out in the testing Laboratory of Civil and Geodetic Engineering Faculty at the University of Ljubljana. These tests have not been standardised yet and they were for the need of our experiment specially developed [Bokan-Bosiljkov, 2013b]. Various TI foundation sets were analysed – composed of one or two XPS boards, concrete slab, with/without a waterproofing insulation (HI)

so bili testirani pri različnih tipih HI: nelepljivi, enostransko/obojestransko lepljivi in pri HI s posipom. XPS plošče so bile v primeru enoslojne TI debeline 200 mm, v primeru dvoslojne pa 2 x 120 mm (XPS 400-L) oz. 2 x 100 mm (XPS 700-L). Preiskave so potekale v okvirju za monotone in ciklične strižne preiskave konstrukcijskih elementov. Ob izbrani predobremenitvi sklopa v vertikalni smeri smo s servo-hidravličnim batom vsiljevali pomike v horizontalni smeri. Za vsak testiran sklop je bil izmerjen odziv pri različnih stopnjah tlačne predobremenitve (od 50 do 300 kPa) ter ovrednoteni koeficienti lepenja oz. trenja v primeru zaznanega zdrsa med sloji sklopa.

Testi so pokazali, da so za zdrs kritični sklopi s kontaktom XPS–HI (nelepljiva ali enostransko lepljiva HI) pri nižjih ravneh predobremenitve (npr. 50 kPa). Izmerjeni koeficienti lepenja so bili okrog 0.3. V primeru sklopa iz dveh XPS plošč brez vmesne HI ali PE je bil izmerjen koeficient lepenja približno 0.6. Pri sklopih s kontaktom XPS–beton je koeficient lepenja znašal okrog 0.5. Pri večjih tlačnih predobremenitvah (npr. 300 kPa) pa se zdrs v večini primerov ni zgodil, temveč je prišlo do strižnega deformiranja XPS plošč. Rezultati kažejo, da kvaliteta XPS plošč (400-L in 700-L) na dosežen koeficient lepenja v splošnem nima bistvenega vpliva.

Ugotovili smo, da obstaja možnost, da hiša temeljena na dvo- ali več-slojni TI med potresom zdrsne v horizontalni smeri (slike 7 in 9). Podrobni rezultati potresnih analiz z upoštevanjem možnosti zdrsa so prikazani v prispevku B. Azinovića.

UPORABNOST REZULTATOV

Glede na opravljene meritve in numerične analize potresnega odziva stavb smo ugotovili, da lahko pri nižjih, lažjih in vitkejših stavbah z visoko nosilnostjo, do zdrsa pride že v primerih s projektnim pospeškom tal (a_g) večjim od cca. 0.15 g (v primeru stika XPS–HI) oziroma 0.25 g (v primeru stika XPS–beton). Za Slovenijo ($a_{g,max}$ = 0.25 g) to pomeni, da do zdrsov lahko pride v kar nekaj primerih.

KLJUČNE BESEDE

Ekstrudiran polistiren (XPS), toplotna izolacija, trenje, konstrukcije, temeljenje, potresni odziv.

or a polyethylene (PE) sheet. For HI different types were applied: without/with adhesive on one/both sides and a HI with sand. The investigated thickness of the XPS boards was 200 mm (one-layered TI), while in the case of two-layered sets 2 boards of thickness equal to 120 mm (400-L) and 100 mm (700-L) were applied. At selected level of pre-compression (from 50 to 300 kPa) in the vertical direction of the tested set horizontal displacements were induced by means of a servo-hydraulic actuator. For each tested TI foundation set the response and the coefficients of friction were assessed.

The tests have shown that for sliding the contact XPS–HI sheet (without adhesive on one/both sides) exposed to lower levels of pre-compression (e.g. 50 kPa) is the critical one. The corresponding coefficient of friction was around 0.3. In the case of TI foundation set consisted of two XPS boards without HI or PE sheet between them it was equal to 0.6. Testing the contact XPS–concrete resulted in coefficients of friction around 0.5. However, in most cases of higher levels of pre-compression (e.g. 300 kPa) a shear deformation of the XPS boards was a typical response and a sliding did not occur. The quality of the XPS boards (400-L and 700-L) has not proven to significantly affect the frictional capacity of the analysed TI foundation set.

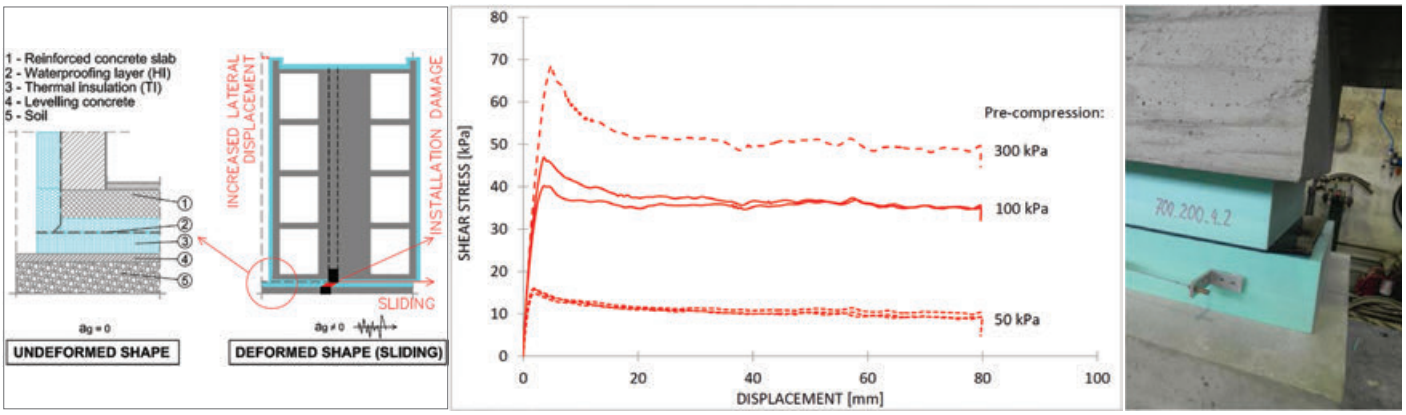
It was found out that there exists a possibility that the passive house slides in horizontal direction during a strong earthquake (Figures 7 and 9). More detailed results of seismic analyses are presented in the contribution of B. Azinović.

ISSUES AND ITS SIGNIFICANCE

Based on the performed tests and simulations of seismic response of buildings it was found out that sliding is a likely failure mechanism in the case of low-rise, light-weight and slender buildings with high strength subjected to earthquakes with ground accelerations (a_g) around 0.15 g (contact XPS–HI) or 0.25 g (contact XPS–concrete). Thus, in Slovenia ($a_{g,max}$ = 0.25 g) sliding is very likely.

KEY WORDS

Extruded polystyrene (XPS), thermal insulation, friction, structures, foundations, seismic response.



Slika 7: Shema TI konstrukcijskega sklopa iz dveh XPS plošč in vmesnim slojem HI ter možen potresni odziv stavbe (zdrs).
Slika 8: Sklop iz dveh XPS plošč kvalitete 700-L z vmesno enostransko samolepljivo HI: diagram odziva napetost – deformacija pri različnih tlačnih predobremenitvah.
Slika 9: Zdrs pri predobremenitvi 100 kPa. [Bokan-Bosiljkov, 2013b]

Figure 7: Scheme of a TI foundation set with a HI sheet between two XPS boards, and the building's possible seismic response (sliding).
Figure 8: 700-L TI foundation set with a HI sheet with adhesive on one side between two XPS boards: stress – displacement diagrams at different levels of pre-compression.
Figure 9: Sliding at a pre-compression level of 100 kPa. [Bokan-Bosiljkov, 2013b]