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CYCLIC BEHAVIOR OF SANDWICH PANELS WITH PUR CORE AND GFRP, CFRP, AND CONCRETE AS A SKIN

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One of the ways to improve the performance of structures against earthquake is using the sandwich panels to create light-weight structures. Sandwich construction, characterized by two relatively thin and stiff faces separated by a relatively thick and lightweight core, presents high potential as a lightweight structural system. In recent years, different types of sandwich panels have been investigated (Garrido, 2016). A sandwich panel can be studied by means of analytical models which are usually referred to in the literature as models for multilayered beams (Ranzi, 2009; Sousa & da Silva, 2010) or two-layer composite beams (Gara et al., 2006; Schnabl et al., 2007) with deformable interlayer connection. As this paper is concerned with experimental investigation, a literature review of analytical models is beyond the scope of this paper and only some of the most recent works are cited as example from which a comprehensive list of references describing these models may be founded. Nevertheless, the behavior of single sandwich panels is obviously much easier to predict than the behavior of panels constituting eal building floors. In this study, a structural sandwich panel including one layer as a core and two layers in top and bottom of panel was investigated. In Figure 1, a general view of the proposed sandwich panel has been shown. In all of the specimens the material of central layer is Polyurethane (PUR) but the material of two other layers varies in three types, GFRF, Concrete, and CFRP. All of the mechanical properties of the material were gathered in Table 1. Furthermore, the geometries dimensions of sandwich panel in all of the models are constant but the thickness of central layer of panel vary in three values 100 mm, 200 mm, and 300 mm as are shown in Table 2. All of the nine specimens were first modeled as a solid, 3D, and deformable element with considering tie interaction. Next, they were analyzed in powerful Finite Element (FE) software once under monotonic lateral displacement and others under a cyclic displacement-time pattern according to Figure 2.

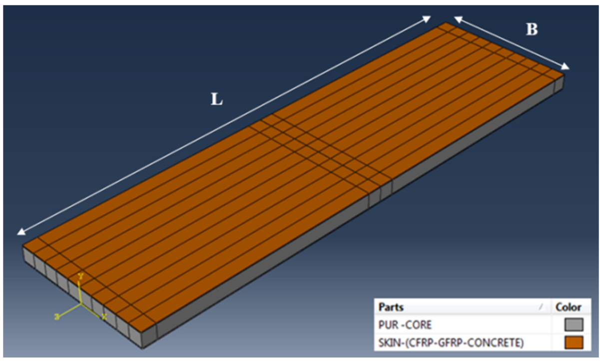

Figure 1. General view of the proposed Sandwich panel.

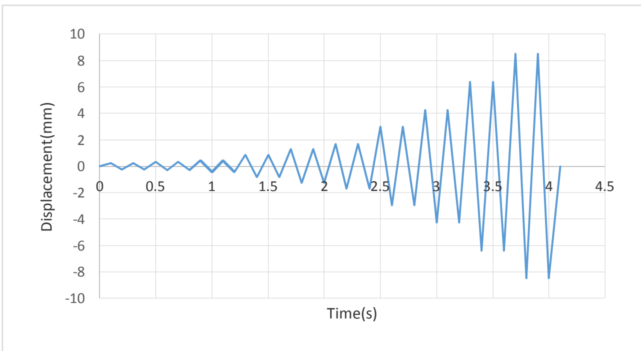

Figure 2. Loading protocol.

Table 1. Properties of material.

Material	Elasticity Modulus (N/mm^2)	Density (kg/mm^3)	Poisson Ratio
GFRP	27100	1.75E-006	0.31
CFRP	69000	1.5E-006	0.28
CONCRETE	25000	2.2E-006	0.2
FOAM	1800	1.2E-007	0.184

Table 2. Geometry dimensions of specimens.

EXPLANATION	L (mm)	B (mm)	T_{core} (mm)	T_{sb} (mm)	T_{st} (mm)	T_{total} (mm)	Models
GFRP and FOAM	3560	1000	100	7	7	114	P.G.F100
GFRP and FOAM	3560	1000	200	7	7	214	P.G.F200
GFRP and FOAM	3560	1000	300	7	7	314	P.G.F300
CFRP and FOAM	3560	1000	100	7	7	114	P.C.F100
CFRP and FOAM	3560	1000	200	7	7	214	P.C.F200
CFRP and FOAM	3560	1000	300	7	7	314	P.C.F300
CONCRETE and FOAM	3560	1000	100	7	7	114	P.CON.F100
CONCRETE and FOAM	3560	1000	200	7	7	214	P.CON.F200
CONCRETE and FOAM	3560	1000	300	7	7	314	P.CON.F300

All of the results including maximum stress and load-displacement behavior of the sandwich panel for every nine models were obtained. Results have been shown stiffness, strength, and ductility has increased in sandwich panel with two layers of CFRP, GFRP, and concrete, respectively. The stress distribution and load-displacement hysteresis curve for sandwich panel with central layer 100 mm and two layers of CFRP (P.C. F100) as a sample have been shown in Figure 3.

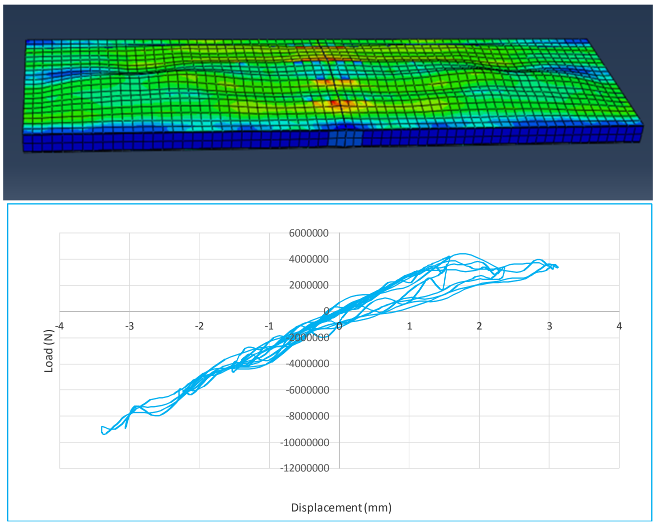

Figure 3. The Stress Distribution and Load-Displacement hysteresis behavior of P.C. F100 model.

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