

Design and 3D-Printout of The Stack-Corrugate-Sheel Core Sandwiched Decks for The Bridging System

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Abstract : Structural sandwich panels with core of Advanced Composites Laminates / Honeycombs / PU-foams are used in aerospace applications and are also fabricated for use now in some civil engineering applications. An all Advanced Composites Foot Over Bridge (FOB) system, designed and developed for pedestrian traffic is one such application earlier, may be cited as an example here. During development stage of this FoB, a profile of its decks was then spurred as a single corrugate sheet core sandwiched between two Glass Fibre Reinforced Plastics(GFRP) flat laminates. Once successfully fabricated and used, these decks did prove suitable also to form other structure on assembly, such as, erecting temporary shelters. Such corrugated sheet core profile sandwiched panels were then also tried using the construction materials but any conventional method of construction only posed certain difficulties in achieving the required core profile monolithically within the sandwiched slabs and hence it was then abended. Such monolithic construction was, however, subsequently eased out on demonstration by dispensing building materials mix through a suitably designed multi-dispenser system attached to a 3D Printer. This study conducted at lab level was thus reported earlier and it did include the fabrication of a 3D printer in-house first as '3DcMP' as well as on its functional operation, some required sandwich core profiles also been 3D-printed out producing panels hardware. Once a number of these sandwich panels in single corrugated sheet core monolithically printed out, panels were subjected to load test in an experimental set up as also their structural behavior was studied analytically, and subsequently, these results were correlated as reported in the literature. In achieving the required more depths and also to exhibit further the stronger and creating sandwiched decks of better structural and mechanical behavior, further more complex core configuration such as stack corrugate sheets core with a flat mid plane was felt to be the better sandwiched core. Such profile remained as an outcome that turns out merely on stacking of two separately printed out monolithic units of single corrugated sheet core developed earlier as above and bonded them together initially, maintaining a different orientation. For any required sequential understanding of the structural behavior of any such complex profile core sandwiched decks with special emphasis to study of the effect in the variation of corrugation orientation in each distinct tire in this core, it obviously calls for an analytical study first. The rectangular, simply supported decks have therefore been considered for analysis adopting the 'Advanced Composite Technology(ACT)', some numerical results along with some fruitful findings were obtained and these are all presented here in this paper. From this numerical result, it has been observed that a mid flat layer which eventually get created monolithically itself, in addition to eliminating the bonding process in development, has been found to offer more effective bending resistance by such decks subjected to UDL over them. This is understood to have resulted here since the existence of a required shear resistance layer at the mid of the core in this profile, unlike other bending elements. As an addendum to all such efforts made as covered above and was published earlier, this unique stack corrugate sheet core profile sandwiched structural decks, monolithically construction with ease at the site itself, has been printed out from a 3D Printer. On employing 3DcMP and using some innovative building construction materials, holds the future promises of such research & development works since all those several aspects of a 3D printing in construction are now included such as reduction in the required construction time, offering cost effective solutions with freedom in design of any such complex shapes thus can widely now be realized by the modern construction industry.

Keywords : advance composite technology(ACT), corrugated laminates, 3DcMP, foot over bridge (FOB), sandwiched deck units

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