ABSTRACT DISERTATION

Providing accommodation in a large scale at relatively affordable price has always been a challenging task not only for government but also for housing industry. There are two key factors in order to solve these two challenges. The first factor is to reduce the self-weight of the structure to maintain affordable prices. In building construction, the self-weight of a structure represents a large proportion of the total load on a structure. The adoption of appropriate material results in the reduction of element cross section, size of foundation and supporting elements thereby reduces the overall cost of the housing construction. The second factor is to utilize the panelised housing system to encourage the mass production of houses. With this construction system, a house can be built faster than stick-built homes. In most cases, panelised homes can be assembled in a matter of days which means that lesser labour is needed, and more homes can be built. Other advantages of panelised homes are such as the system can eliminate costing delays, less weather damage during construction and also precision engineered to highest quality.

This research has been carried out to meet these challenges, which is aimed at developing a new type of hybrid composite sandwich wall panel that might be manufactured as modular panelised system. The typical sandwich panel used in building application commonly consists of metal skins and soft core. Although oriented strand board (OSB) is commonly employed for the skin of sandwich structure in structural insulated panels (SIPs), the observed shortcomings of this typical skin such as mould build-up and disintegration in the presence of flood water have reduced their usage. In this study, metal-based skins of thin flat aluminium sheets were adopted. Metal skins are preeminent choice for their many advantages, but the price is always a concern. Consequently, reducing the thickness of the skin as much as possible is the only way to keep a competitive and reasonable overall cost. However, using thinner skins may result in the early failure of sandwich structure, such as face wrinkling or indentation. The sustainable hybrid concept offered in this research has been considered as a practical solution where an intermediate layer made from natural fibres composites (NFC) laminate was introduced.

In this regard, the research work has focused on four main stages to observe the suitability of natural fibre composites to be incorporated into the hybrid sandwich panels:

1. A validation of the concept of hybrid sandwich structure using a statistical based experiment approach.
2. An investigation of the mechanical properties of natural fibre composites that particularly prepared using vacuum bagging method.
3. An examination of structural behaviour of the hybrid sandwich panels under flexural and in-plane shear testing that includes a comparative analysis of the relative performance of hybrid and conventional sandwich panels and developing theoretical models to predict the behaviour of the developed hybrid sandwich panels.
4. A significance analysis of the experiment results using statistical software (Minitab 15) for both flexural and in-plane shear testing.

The investigation results throughout these four research work stages have provided clear evidence that, for structural application, natural fiber composite could be best employed as the intermediate layer of a hybrid sandwich panels.