

Research Overview and Objectives

Honeycomb sandwich composite structures (HSCS) is a novel material, in which thin composite/metallic skins are bonded to the two faces of the metallic/composite honeycomb cores by epoxy adhesives. The HSCS are extensively used in aerospace, defense, marine and automotive industries due to their high energy absorption capability, effective acoustic insulation and high strength-to-weight ratios. But, operational circumstances like repeated loading, aging or a sudden intensive load on such structures can lead to formation of disbond along the skin-core interphase, which can substantially jeopardize the safety and integrity of the whole structure and sometime may lead to a catastrophic failure of the structure/system. Therefore, it is essential to accurately identify and assess such hidden disbond locations in the HSCSs. It is also crucial to study the environmental impacts on the disbond severity.

The proposed research aims at studying the individual and combined effect of environmental impacts like the variable temperatures and loadings on existing hidden disbonds/flaws in HSCS. The study addresses the knowledge gap which was evident during the literature review. The study will give a thorough understanding of the complex relationships of the environmental impacts on HSCS and also the mechanisms in which they affect the existing disbonds in such structures. The scope of the research work is not application specific and hence covers a wider range of loading and temperature conditions which is not present in literature.

Motivation

The novelty of the research is not only in the identification of the problem but also in the research methodology. The research makes use of the sophisticated ultrasonic guided wave (GW) based structural health monitoring (SHM) and non-destructive evaluation (NDE) techniques for gaining information of the disbonds and their severity effects due to environmental impacts.

The proposed NDE approach would be advantageous to ensure the inspection consistency and to avoid problems with repeatability of composite manufactures and any systematic errors due to use of a particular type of sensor. A multi-level disbond identification strategy for a single HSCS would also be developed and a comprehensive severity/sensitivity assessment of disbonds due to the environmental effects will be carried out. These different sensitivities would allow us to study the combined effect as well as the individual contributions of each of the external factors.

The proposal outlines the basic research to increase the understanding of the phenomenon of the individual and combined effects due to the environmental impacts on advanced sandwich composites like HSCS. This increased understanding, will help development of more precise and advanced SHM strategies. The study will also provide valuable information for determining the remaining service life of existing structures and avoid any casualties due to the failure of HSCS components.