

Composite Sandwich Structure Design Requirements



Composite Engineer's Viewpoint

By Rik Heslehurst PhD, MEng, BEng (Aero) FIEAust, FRAeS, CPEng

Part 2 – Design requirement checklist

This article discusses the design requirements for composite skinned sandwich structures. As there are several unknown parameters in composite-skinned sandwich structures, a good set of design requirements is invaluable for the successful development of this type of structure.

The basic customer requirements must address the following aspects for a sandwich structure design and fabrication:

Performance

Functional Performance:

- Tensile or compressive or shear strength of sandwich structure facings
- Axial or shear stiffness of sandwich structure facings
- Facing materials of the sandwich structure
- The density of the sandwich structure
- The core materials for the sandwich structure
- Coefficient of thermal expansion of the core and facing materials in the sandwich structure
- Coefficient of moisture absorption of the core and facing materials in the sandwich structure
- Corrosion potential of the core and facing materials in the sandwich structure.

Spatial Constraints:

- Planar geometry of the sandwich structure
- Attachment method of the sandwich structure
- The sandwich structure edge constraints

Appearance

- The sandwich structure edge requirements (squared, tapered, taper angle, etc)
- Surface finish: i.e. do the facings need to be painted or protected?
- If mechanical fasteners are being used, will flush-head fasteners be required?

Time

- Time to fabricate the sandwich structure, including curing time of facings and core-to-facing bonding
- Durability of the sandwich structure (life-time)
- Storage of sensitive materials: i.e. film adhesives, facing prepregs
- Life-cycle

Cost

- Materials in the sandwich structure
- Expendable materials used to fabricate the sandwich structure
- Co-bonding or secondary bonding of facings to core
- Installation of the sandwich structure to other structures (time and personnel)
- Inspection of fabricated sandwich structure (time and personnel)
- Maintenance and repair
- Life-cycle

Manufacture/assembly

- Quantity to be manufactured
- Co-bonding or secondary bonding of facings to core?
- Curing temperature and conditions
- Trimming and cutting operations
- Joining requirements
- Number of operations to fabricate the sandwich structure
- NDI equipment required for inspection of the sandwich structure

Company capabilities

- Materials storage facilities
- Fabrication facilities and equipment
- Machine shop capabilities
- Clean room availability

Standards

- Legislated requirements
- Company requirements
- Industry fabrication requirements
- Testing

Safety of Personnel

- Cutting and grinding (machining composites)
- Handling of hazardous materials
- Composite and adhesive curing

Environmental Issues

- The damaging environment
 - Fluids
 - Gases
 - Acoustic
 - Impact
 - Electrical
 - Cyclic loading
- Disposal of contaminated waste used during sandwich structure fabrication
- Disposal of sandwich structure materials at the end of the structures/components life-of-type

Maintenance & Repair

- NDI equipment needed to inspect the sandwich structure in-service
- Repair materials and equipment required
- Trained personnel to undertake the maintenance and repair activities.

In the next issue of *Connection* we will consider the terms, definitions and global properties of composite skinned sandwich structures. There are a few terms, definitions and global properties unique to sandwich structures and these will be explained in some detail. All published articles in the series are available online under 'For Industry'.

Rik welcomes questions, comments and your point of view by email to rik@abaris.com