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Ribs for non-buckling composite structure in cargo containment system

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GTT is a marine engineering company specialized in the design of cryogenic tanks for LNG storage and transport. GTT has a long experience since the end of the 1960s with more than 300 ships built. Its technologies are characterized by an insulating and tight containment system.

To increase the mechanical and thermal efficiency of its cargo containment systems based on NO96 technology (plywood structure), GTT consider materials with higher thermo-mechanical properties such as composites (with polymer matrix reinforced by fibers).

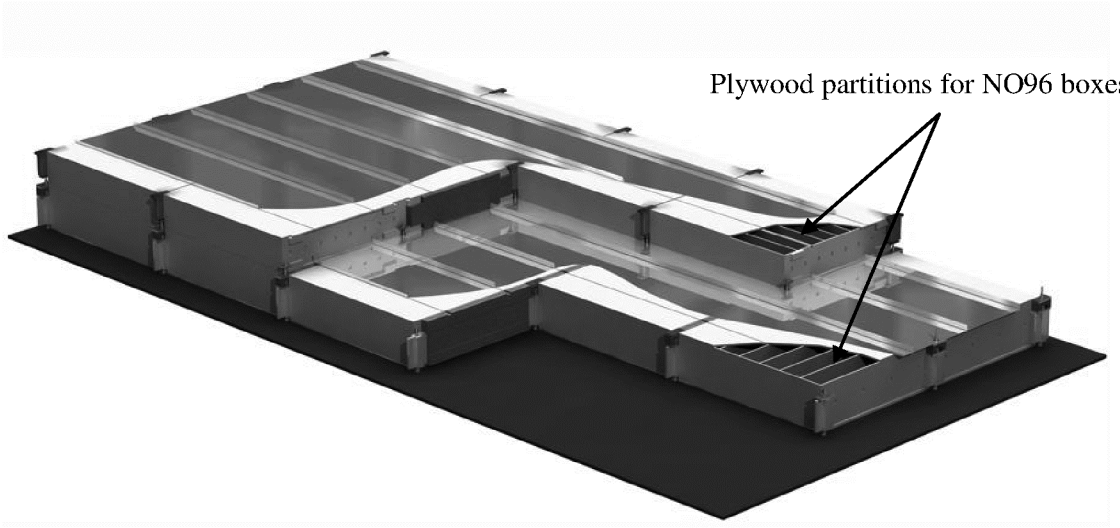


Figure 1 – NO96 Cargo Containment System

Composite materials are a way to increase thermal performance of the structure by minimizing the section of partitions. Indeed, less composite material is needed to ensure the same level of mechanical strength (compared to birch plywood). Since their lower conductivity/compressive strength ratio than plywood, the global heat flow dissipated through structure is decreased. Therefore, a higher performance is achieved for the insulating system.

Composite materials are also a solution to increase mechanical properties and avoid buckling of partitions which is a key factor of mechanical strength for NO96 boxes.

The shape of composite materials is modular and can be optimized. Another advantage is that it can be easily obtained with mass production processes for composite materials, such as molding.

The proposal of corrugated shape for NO96 composite partitions (see Figure 2) allows to increase inertia and limit buckling.

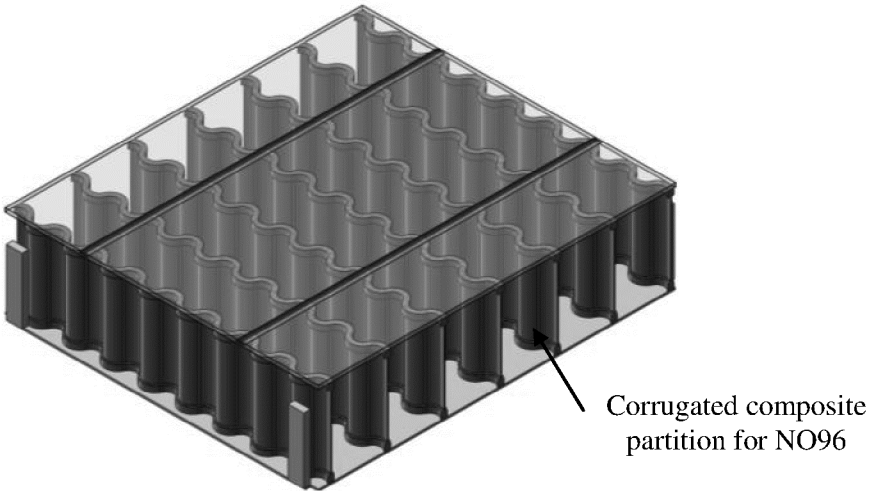


Figure 2 – NO96 box with corrugated composite partitions

Including stiffening ribs on the design (like in Figure 3), is a complementary way to increase the composite partitions strength and avoid buckling.

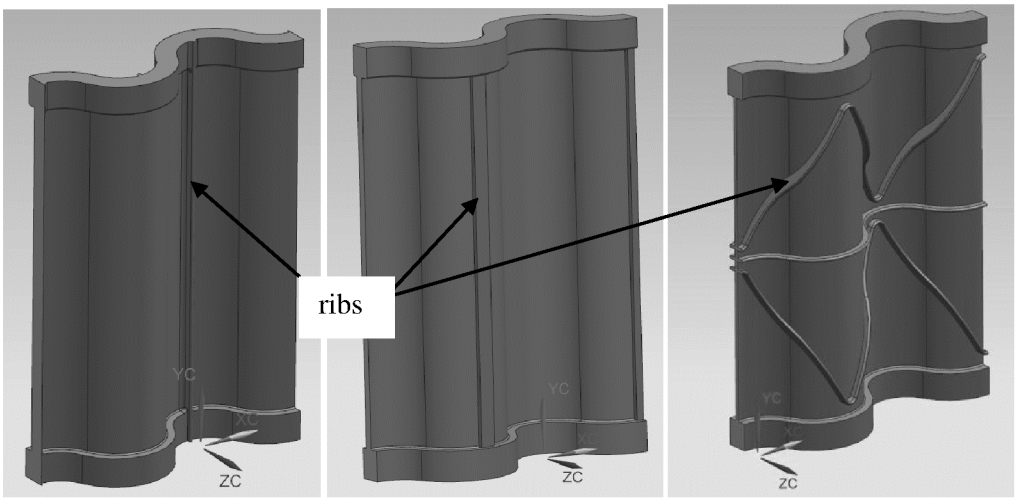
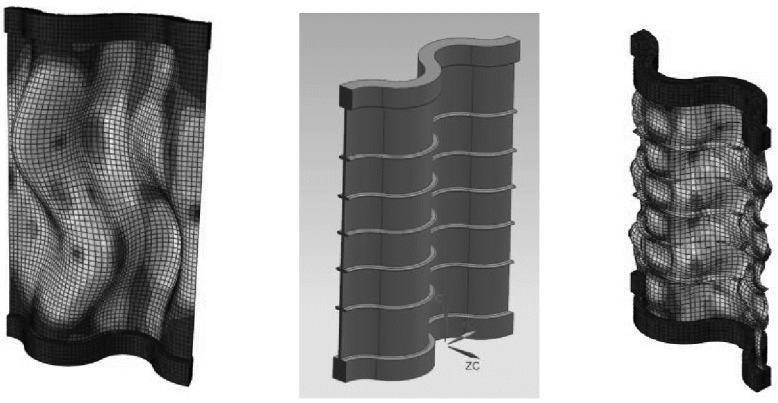


Figure 3 – Ribs for corrugated composite partitions

Horizontal ribs on the corrugated partitions is a relevant way to avoid 2nd order buckling ("S shape") as illustrated on Figure 4. The ribs improve significantly the strength gain of the partition for a low impact on section (and then on thermal performance), around 40% is considered.



2nd order buckling (S shape) | Horizontal ribs | Limitation of 2nd order buckling thanks to horizontal ribs

Figure 4 – Limitation of second order buckling with horizontal ribs

This principle is also applicable to other types of structures such as pillar structure.