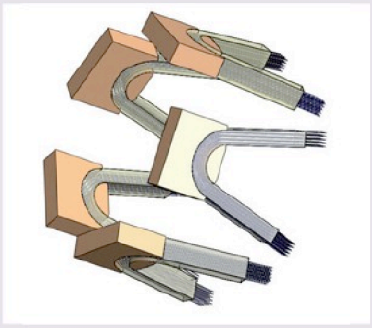

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process

Optimised torque shaft

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Conseil & Technique continues to deploy its technological innovations in the field of composite parts. C&T will soon focus on the issue of composite springs (torsion springs, disc springs). In the meantime, the company has already finalized its latest innovation with the industrial process for producing a torque shaft for motion transmission.

Long composite structures are straightforward enough to manufacture. They can be produced by means of various processes, optimising the positioning of the fibres according to the strength and rigidity requirements.

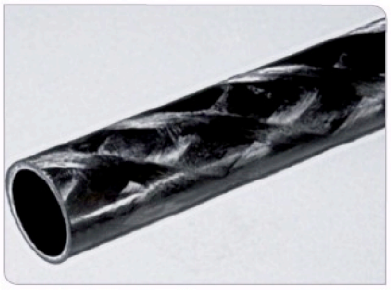

Fig.1: Filament-wound tube

To support the torsional stresses, the fibres are arranged in tubular form in a helix configuration that transforms the tube torsion into traction and compression of the fibres.

Fig.2: Adhesive-bonded end interface

The main difficulty lies in the interfaces that link the composite part and the tube itself. Adhesive bonding is one potential solution, but is fairly unsuitable since the bond must transmit the mechanical shearing forces exerted by the bonded surfaces.

The adhesive joint is the weak point of the assembly

This difficulty leads to over-dimensioning the composite tube, and therefore makes the concept of composite transmission technically and economically inefficient.

SKF Aerospace, a company experienced in producing long composite parts for the aeronautical industry, has addressed this technical problem. To this end, SKF asked its partner in innovation, Conseil & Technique, to use its know-how in the unfolding of composites to design optimised drive shafts.

Unidirectional strain and torsion

The difficulty lies in the transmission of a mechanical force in opposite-acting strain modes, from traction-compression (well-known for composite materials) to torsion. Conseil & Technique has come up with the

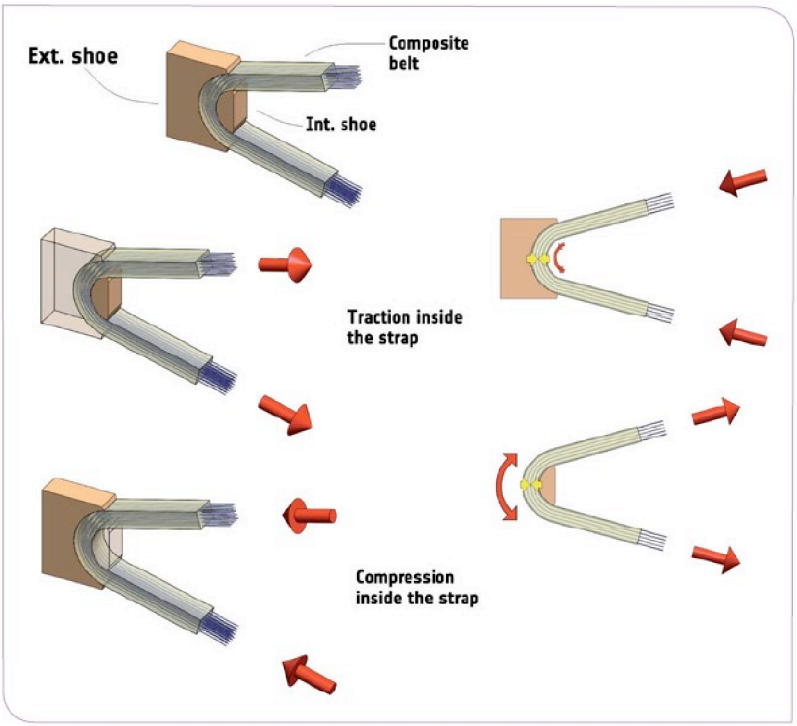

Fig.3: Unidirectional composite in an assembly

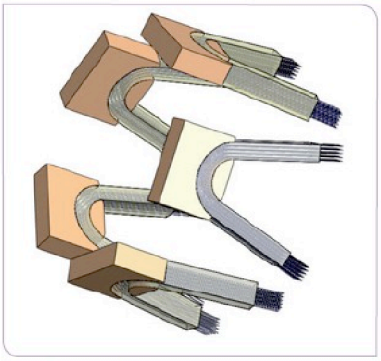

Fig.4: Torque application

Fig.5: Winding the tube together with the interface shapes

More information

Conseil & Technique is a French company that specialises in the development of new products. Established by two academics in 1993, the company seeks to provide a link between the worlds of academic research and industry, in particular in the field of mechanical innovation. A company of human size, Conseil & Technique draws on a network of partners and subcontractors to tackle practically every discipline involved in the birth of a product.

concept of load-bearing by a belt that is sandwiched between two cylindrical parts (external and internal shoes) to obtain a continuous unidirectional stress despite the change of fibre orientation in the composite material. This concept has been validated in parts that are subject to tensile or compression stress, such as aircraft structural rods. This geometry ensures that the fibres will be in a state of tensile or compression stress while systematically subjecting the resin to pure compression, without any shearing. Despite the reversed direction of the stress in the belt, the resin in the curved part is only subject to pure compression. The failure mode of such an assembly is linked to tensile failure in the fibre or to local or global buckling failure. In both load instances, the resin is not the weak element in the material; the fibres are ideally used, making the assembly optimal. In order to enable the part to take up the torsion load, the concept has been developed by Conseil & Technique in a rotationally symmetrical layout around the main axis of the part to be produced. This geometrical arrangement makes it possible to transform the traction and compression in each belt under torsion around the axis of rotation. The torsional moment will therefore only generate "pure" stresses in the fibre and the resin alike.

Fibre organisation

Conseil & Technique has designed a continuous fibre placement machine for producing a composite part with the ideal orientation for supporting torsion in the main body of the tube, while ensuring that the ends are compatible with the previously described concept.

SKF Aerospace has launched the industrialisation of the concept. The initial technical prospects are highly encouraging: the shaft with a nominal diameter of 30 mm is capable of transmitting the same torque as an equivalent steel shaft, at an unparalleled low weight. There are multiple potential applications for this type of shaft: transmission of rotational movements in aircraft, as well as in railways, boatbuilding, the automotive industry, the oil industry, and so on. The concept, based on optimised fibre placement, may be applied to all types of composite material, in all sizes. ■

Fig.6: Torque shaft assembled without adhesive

More information: www.conseil-et-technique.com