



DB Technologies & Eurocarbon : World-Class Partnership

- Eurocarbon is known for proprietary world-class braiding and overbraiding equipment and processes that deliver performance and cost advantages
- Eurocarbon's braiding technology selected for many key composite applications in Aerospace and Automotive including the NH-90 Landing Gear Trailing Arm and the Lamborghini Aventador
- DB Technologies' strategic partnership includes exclusive license for Americas as well as a Research and Development agreement to support DB Technologies' applications of the technology.



NH-90 Helicopter



NH-90 Landing Gear Trailing Arm



Lamborghini Aventador



Preform Overbraiding Completed in 30 Minutes

Composites Overview

- Leveraging our leadership in the textiles field, we are now focused on full-service composite structures manufacturing
- Strategic Eurocarbon Partnership: Exclusive license for proven world-class braiding technology
- State-of-the-art overbraiding technology
- Braiding machines from 24-to-144 carrier with complementary composite processes
- Standard braided sleeve line
- Established production capability with plans to expand operations with business growth



Unique Offering

- Deliver significant performance, cost, and waste reduction benefits over other process technologies
- Provide full-service “fiber-to-finished-part” composite structures with unique overbraiding technology
- Create innovative braided architectures that meet challenging customer functional requirements
- Employ world-class equipment and processes that enable simple-to-complex part manufacturing
- Integrate key processes - all contained under one roof



Product Design



Net Shape Preform Manufacture



Final Part

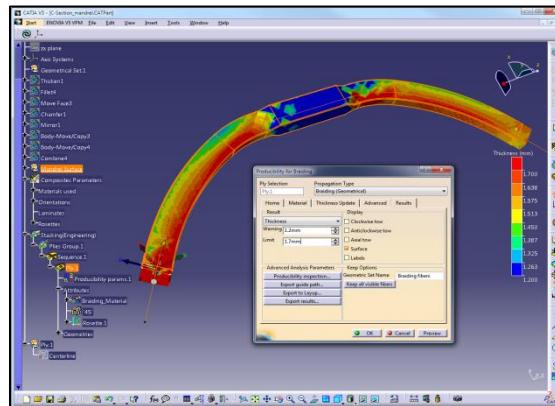
Product Engineering

Turning customer requirements into best value solutions through advanced textiles expertise, design, analysis, and manufacturing process engineering

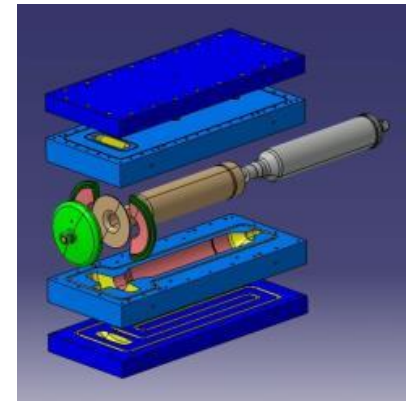
- Solid modeling
- Structure design & analysis
- Materials & process design
- Testing & database development
- Fiber architecture optimization
- Preform design & development
- Optimized manufacturing
- Tooling design & manufacturing



Design & Structural Analysis

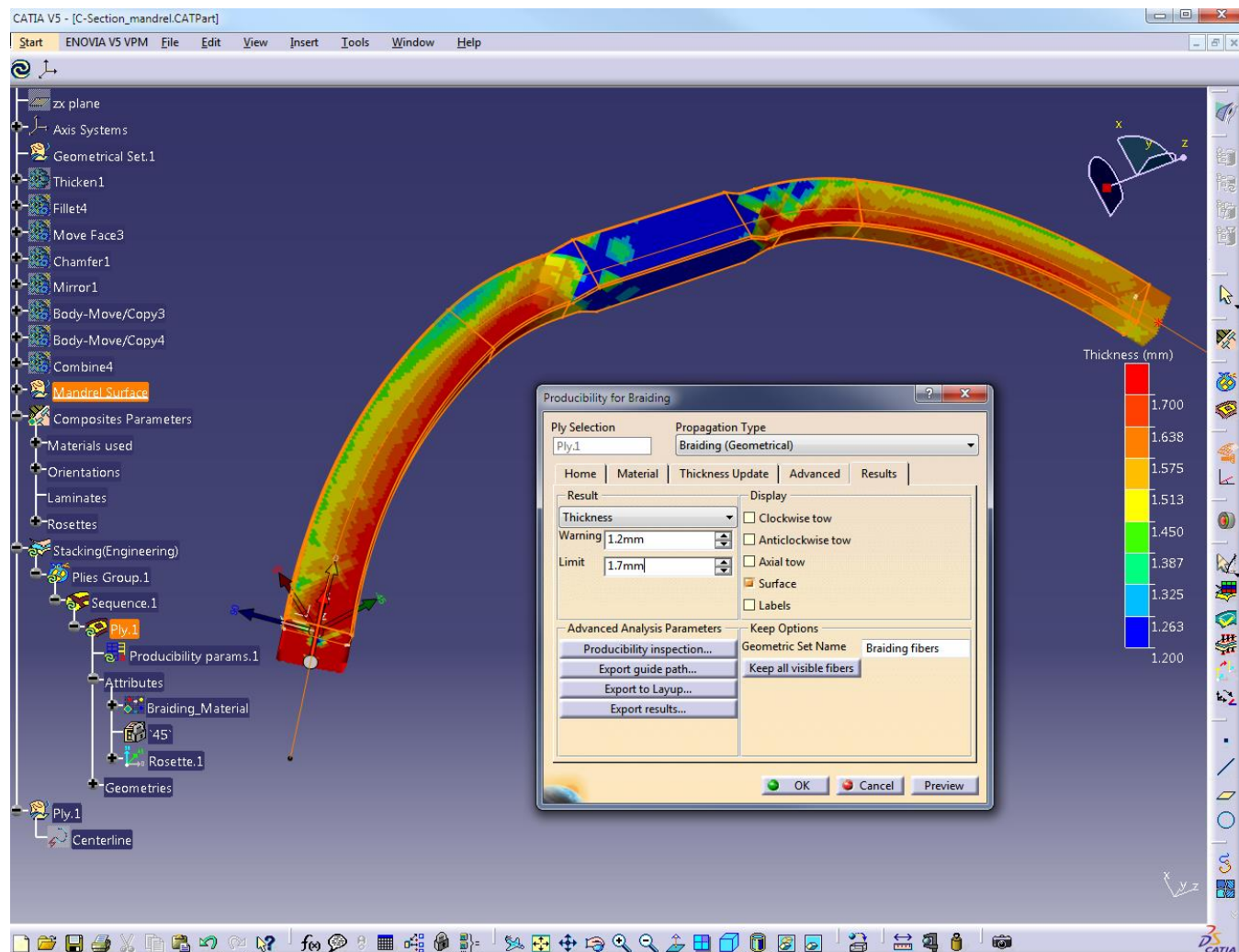


Preform Design



Tool Design

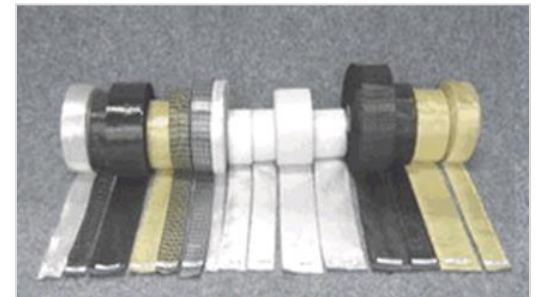
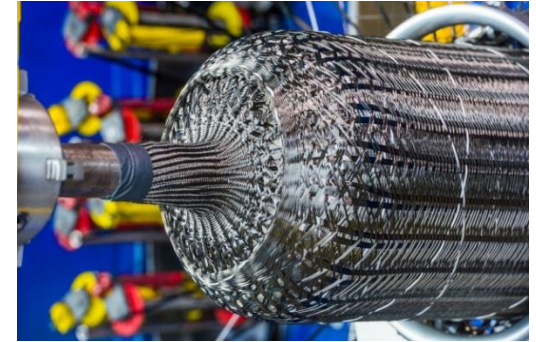
CATIA Modeling of Braids



- Create native CATIA file
- Export to ABAQUS for FEA
- Upload file to braiding machine once verified & optimized

Braiding Capabilities

- **Uniaxial, biaxial, and triaxial** reinforcement architectures
- **Overbraid** complex shapes
 - Standard shapes: rectangular, circular, eccentric, conical
 - Profiles: C / U / Z / T / L
 - Complex part profiles
 - Conformable braids
 - Constant thickness
 - Constant angle
- **Braided sleeves**
 - Standard fibers
 - Current widths up to 12 in.
 - Hybrid options



Open-Architecture Technology

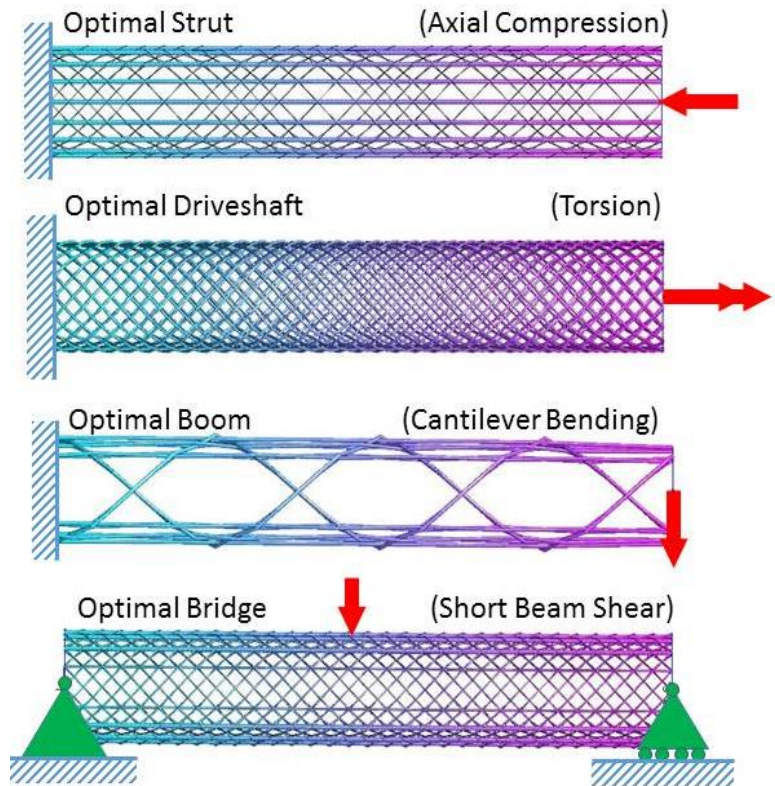
Developed & Patented By Dr. David Branscomb

Benefits of Open Architecture Composite Structures (O-ACS)

- Overbraided complex shapes
- Extreme lightweight truss design
- Tunable properties - strength, stiffness
- No resin infusion required - uses OOA prepreg
- Interconnected truss is damage tolerant
- Patented process



Optimization



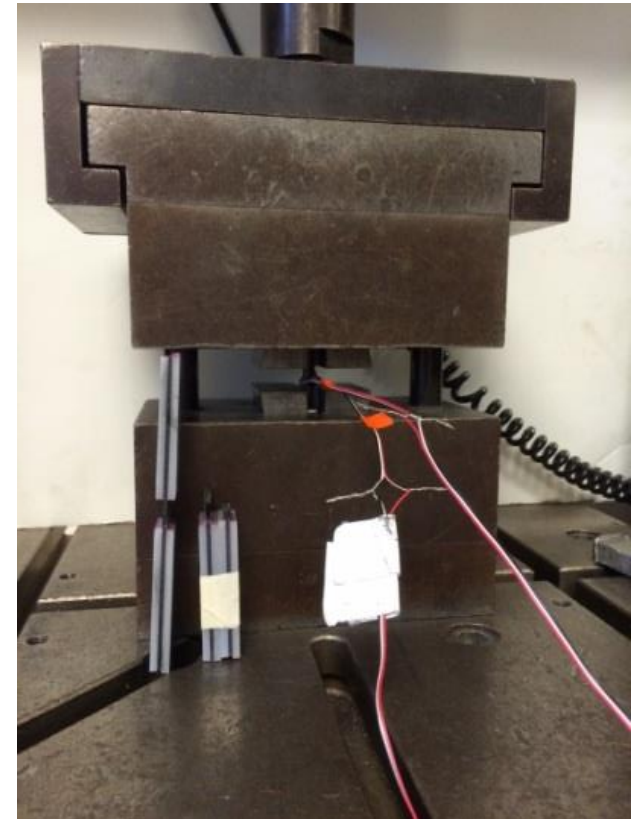
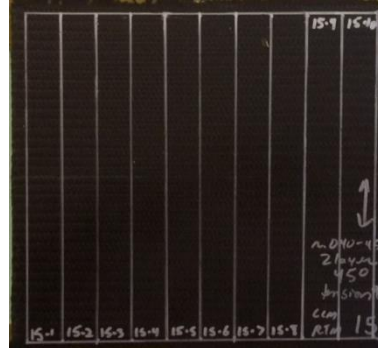
Gurley, Branscomb, Broughton, Beale, "Rapid Design of Minimal-weight Open-structure Composite Beams", CAMX 2014

Material Property Database

Test Description	Property
Acid Digestion	Void %
Fiber Content (ASTM D3171)	Fiber %
0° Tension (ASTM D3039)	E1t, X1t
90° Tension (ASTM D3039)	E2t, X2t
0° Compression (ASTM D3410)	E1c, X1c
90° Compression (ASTM D3410)	E2c, X2c
Shear (ASTM D3518 or D5379)	G12, S12

• Material Systems Evaluated

- T700/862-W
- IM7/RTM-6
- IM7/EP2400



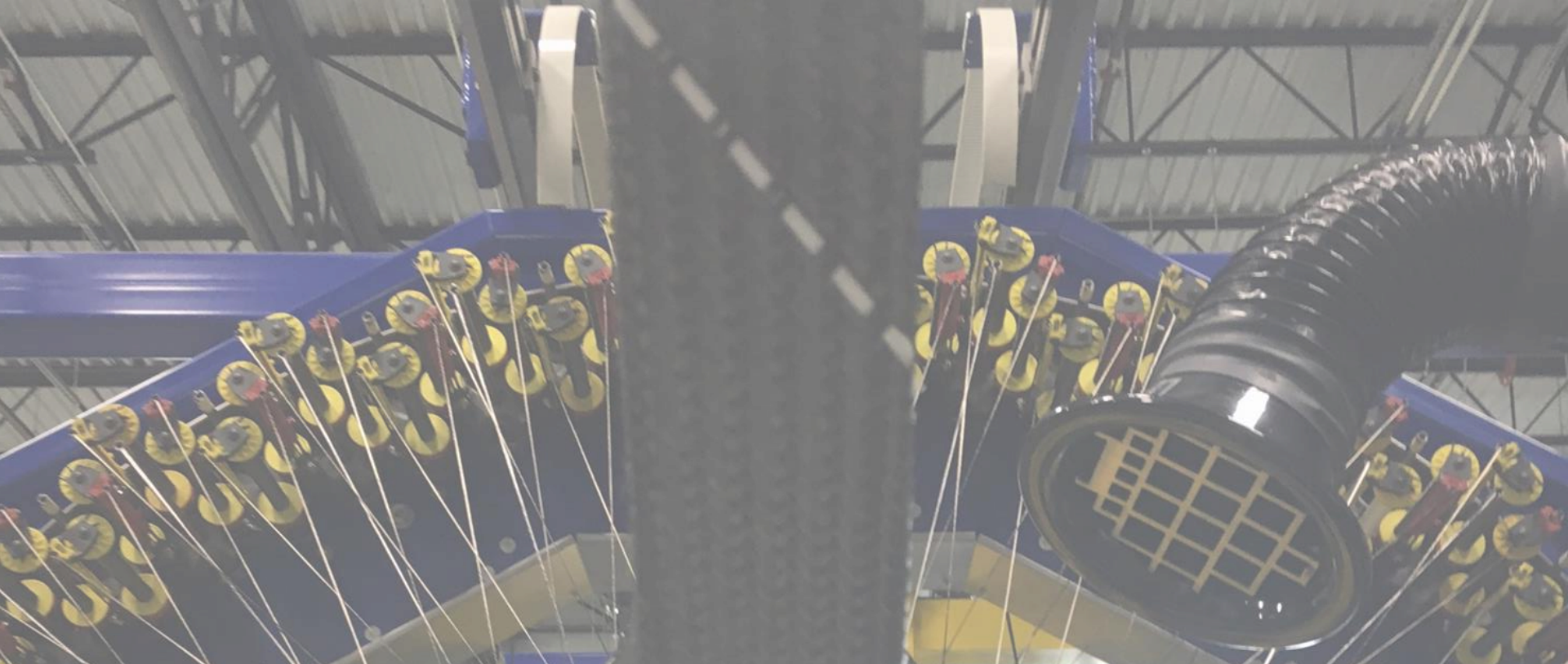
• Example Braid Configurations

- IM7 Braid 0/±60° = triaxial, 6K axial, 6K bias, FAW 603 gsm
- IM7 Braid 0/±45° = biaxial, 6K bias, FAW 485 gsm

Summary and Discussion

- DB Technologies has unique braiding technology and “fiber-to-finished-part” capability that can be leveraged to bring significant performance and cost benefits to customers
- Our braiding technology can be applied to a broad range of structures –including interiors, systems, secondary structures and primary structures

Types of Structure	Application	Benefits
<i>Interiors & Systems</i>	Rails, Support Structures, Brackets, Clips	• High-throughput process (cost) • Preform tailoring for performance and cost
	Tanks, Bottles, Tubes/Ducts	• Continuous fiber paths • High-throughput process (cost) • “Continuous” manufacturing
<i>Secondary Structure</i>	Shafts, Braces	• Fiber tailoring for performance • Incorporation of “features” • “Continuous” manufacturing
	Frames, Ribs, Beams, Stiffeners. Splices	• Fiber tailoring for performance • High-throughput preforms • “Continuous” manufacturing
<i>Primary Structure</i>	Spars, Beams	• Fiber tailoring for performance and damage tolerance • High-throughput process (cost)



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