Identifying the barriers and opportunities to the adoption of advanced materials in construction

JEC World 2019 Conference
Architecture, Building, Construction & Infrastructure

Julien Sellier
Paris – 13th March 2019
Independent Composites Solution Provider

We help our clients to:

- Make better decisions
- Reduce costs
- Improve efficiency
- Select and develop appropriate technologies for their composite business

Over 200 successful projects since 2010 across all markets
Agenda

- What are Advanced Materials
- Composites in Construction – a Sector Analysis
- Barriers to Adoption
- Conclusions and Questions
What are Advanced Materials?
Advanced Materials

Materials

Process

Design
The Engineers Material Palette

Manufacturing Process

Fibres
Resins
Cores
Adhesives
The Engineer’s Toolbox
Manufacturing Technologies

- Wet lamination
- Press
- Infusion
- Pultrusion
- Prepreg
- Automation
Advanced Material Processes Segmentation
Part size vs Production Volume

- Pultrusion
- Hybrid
- Prepreg
- Resin Infusion

Part Size (m) vs Volume
Composites penetration in end markets compared to competing materials

(Source: Lucintel)
Comparison of requirements for composites applications

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Marine</th>
<th>Automotive</th>
<th>Heavy Truck</th>
<th>Aerospace</th>
<th>Wind Energy</th>
<th>Industrial</th>
<th>Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durability</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Impact resistance</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Corrosion resistance</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Design freedom</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Low weight</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Part consolidation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>High heat</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>High strength</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Sound damping</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Insulation Properties</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Courtesy of COBRA International ‘Embracing Composites’
Established Market Sectors
Part size vs Production Volume

- Automotive
- Rail
- Marine
- Wind Energy
Composites in Construction
Construction Industry Size

- Construction industry **regaining growth** momentum
- Construction market currently worth **€6.8 trillion** and has an expected **CAGR of 3.9%** per year until 2030
Sector Analysis

- Architectural
- Construction
- Civil Infrastructure
- Housing
- Repair and Strengthening
- Bridges
Construction Sector Segmentation

Composite construction sector market share

Source: STRUCTeam Ltd
Construction Sector Segmentation – Part size vs Production Volume

- Strengthening & Rebar
- Housing
- Bridges
- Architecture
- Civil

Part Size (m)

Volume

3/21/2019

© Copyright STRUCTeam Ltd
Established Market Sectors

![Diagram showing volume and part size across different sectors: Marine, Rail, Automotive, Wind Energy, Civil sector. Each sector is represented by a differently colored shape.]
## A Complex Value Chain

<table>
<thead>
<tr>
<th>End Client</th>
<th>Consultants</th>
<th>Contractors</th>
<th>Suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Architect</td>
<td>Cost Consultant</td>
<td>Main Contractor</td>
</tr>
<tr>
<td>Public or Private Body</td>
<td>Responsible for developing and delivering overall project design brief</td>
<td>Responsible for Value Engineering, Cost management and Quantification – Quantity Surveyors, Accountants, Financial institutions</td>
<td>Responsible for Build of project and sub contractor management</td>
</tr>
</tbody>
</table>
# Civil Opportunity Categories

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Sub Segment</th>
<th>Technology</th>
<th>Volume</th>
<th>Part Size</th>
<th>Enabler</th>
<th>Structural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebar</td>
<td>infrastructure</td>
<td>Pultrusion</td>
<td>High</td>
<td>Small</td>
<td>Regulation</td>
<td>Yes</td>
</tr>
<tr>
<td>Refurbishment</td>
<td>Strengthening</td>
<td>Pultrusion</td>
<td>Medium</td>
<td>Small</td>
<td>Contractor</td>
<td>Yes</td>
</tr>
<tr>
<td>Footbridges</td>
<td>Bridges</td>
<td>Pultrusion/RTM</td>
<td>Medium</td>
<td>Large</td>
<td>Operator</td>
<td>Yes</td>
</tr>
<tr>
<td>Facades/Roofs</td>
<td>Architecture</td>
<td>Pultrusion/RTM/PP</td>
<td>Low</td>
<td>Large</td>
<td>Architects</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Barriers to Adoption
Material Challenges

- Expensive, organic materials
- Flammable
- Impact performance
- Brittle failure
- Repairs (supply chain based issue)
- Costs per kg
Design Challenges

- Standards and Mechanical Properties
- Slow development of new standards
- Lack of repeatable design and best practises
- Composite design approach does not align with civil engineering
- Costs per kilo
- Orthotropic properties
- Low stiffness and toughness
- Difficult to modify once manufactured
Manufacturing and Supply Chain challenges

- Insufficient training
- Limited research with composite construction sector
- Material and fabrication cost higher than conventional materials
- Conservatism within the industry
- Maintenance and Repairs
Conclusions

- The construction sector is fragmented but growing

- However, it is likely ‘someone has done it somewhere’

- JEC ‘Future of Buildings’

- World of experts will drive technology and improve accessibility
Questions?

Julien Sellier
Julien.Sellier@structeam-ltd.com

STRUCTeam
www.structeam-ltd.com

+44 (0)1983 240534