A VISION AND ROADMAP FOR THE USE OF FRP COMPOSITES IN CONSTRUCTION

Sept 2019

COMPOSITES LEADERSHIP FORUM

Sector Landscape

Government Strategy: Construction 2025

Lower costs

33%

Reduction in the initial cost of construction and the whole life cost of built assets.

Lower emissions

50%

Reduction in greenhouse gas emissions in the built environment.

Faster delivery

50%

Reduction in the overall time, from inception to completion, for newbuild and refurbished assets.

Improvement in exports

50%

Reduction in the trade gap between total exports and total imports for construction products and materials.

Echoed by the subsequent TIPS and TIES strategies, enabled by the Construction Sector Deal and the Transforming Construction programme under the ISCF Clean Growth Grand Challenge.

Driving Factors

Offsite factory manufacturing

Development of digitally enabled modularised build systems. Platform Architecture: Interchangeable standardised component model.

Reduced carbon materials

Use of sustainable materials and sustainable outcomes, carbon toolkits, sustainable metrics within specifications, concern with circularity of materials, waste reduction and recycling of waste.

Better performance

Reduced costs through better performance, emergence of SHM and digital twin models to improve efficiency in service.

Life extension repurposing & retrofit

Need to upgrade housing stock to meet the Paris 2050 net zero commitment. Increased re-use rather than rebuild mindset. Life extension of current ageing infrastructure asset base.

Digital enabled systems

Emerging digital tool enables streamlining of design and construction for assured outcomes & reduced leadtimes. Embodied digital sensing and control systems – increasingly intelligent structures.

Changing perception of value from CAPEX to TOTEX

Industry task groups to change traditional procurement model to bring focus on partnerships and value rather than cost.

FRP Composites Landscape (UK)

Infrastructure

Mature		Growing	Future
Footbridges	Trench covers	Rail platforms	Rebar
Strengthening		Non/semi structural parts	
Form work	Rail sleepers		Rail bridges
Troughing		Tunnel components	
		Road bridges	

Applications were identified within sub-sector workshops – it is observed that these could stray outside the topic sub-sector. Strongest applications in terms of value to UK: Rail Sleepers, Rebar, Integrated technologies (SHM, functions, PV), Primary members for buildings, Decorative building, Fencing, Access covers.

GFRP rebar reinforced geopolymer wharf on FRP substructure – Wagners PTY.

Wagners PTY

Buildings

Strengthening	Finishes	Decorative	Building systems	Next Gen rebar
PODs	Roofing products	Rebar		Jetties/piers
Tanks	Cladding		Integrated roof systems	Coastal protection
	Thermal breaks	Flood mitigation		

Net Zero home from automated manufacture of composite panels with an exceptional recycled content – Vitromite Ltd.

Serpentine Sackler Gallery -Design and Display Structures Ltd.

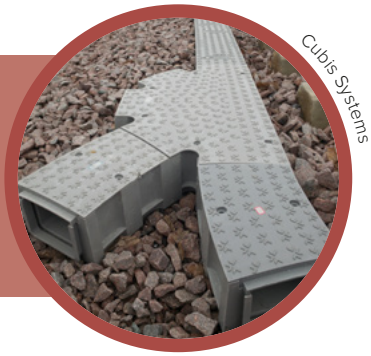
Design & Display Structures Ltd

Industrial and utilities

CIPP	Cladding	Modular building	Grating manufacture
Equip platforms	Kiosks/housings	Fencing	Next Gen rebar
Walkways, stairs & railings	Trench covers	Cable tray	Integrated roof systems
	Thermal breaks	Access covers	
		Cable trough	

From the 2017 Lucintel study commissioned by the NCC, significant global growth was expected in Utilities Poles, Rebar & Bridge Decks.

PROtrough cable trough and chamber system – CUBIS.



Cubis Systems

Barriers to FRP Composite Adoption

Although an improving curve, key barriers are: lowest price procurement, customer knowledge and uncertainty, particularly of durability and fire performance; commercial risk of introducing new materials and new supply chain; increasing drive to sustainable materials and circular economy.

Cost

Cost competitive

FRP composites cannot be significantly greater initial cost than established materials.

Global factors

In many application areas the rest of the world is ahead of UK adoption, so the UK market can be dominated by lower cost imports.

Carbon as a cost

It is likely that embodied carbon will be monetarised or set as a hard contractual target.

Aware

Negative perception

FRP composites are perceived emotively as plastic and undesirable for the ecosystem.

Sustainability valued by stakeholders

Sustainability is becoming increasingly strongly valued across the supply chain from project financiers to SMEs.

Lack of awareness and confidence

The knowledge base of potential users is sparse and very variable so FRP composites may not be considered, or rejected at an early stage as unsuitable, based on flawed knowledge.

For many key engineers FRPs are not considered as they don't understand where they could be beneficial; there is limited consideration for new applications in particular.

There is an apparent lack of consistent appropriate training for designers, specifiers and users.

Immature supply chain

The supply chain is dominated by smaller SMEs compared to traditional, well-established materials, increasing the perceived commercial risk.

Confusing taxonomy

The term composites means many things in construction - from doors to concrete decks. The confusion this creates and use of mixed and specialist language and unfamiliar acronyms puts up barriers.

Regulatory

Building regulations

The Building Regulations have evolved around traditional materials and approaches, they are difficult to apply both to FRP composites and Smart Construction in general.

Codes

Construction is highly regulated and is founded upon comprehensive codes, there is no Eurocode for FRP composites (currently in drafting by CEN/TC250). This is seen by a conservative industry as a technical risk and also drives a costly and time consuming design process.

Durable

120 year durability

Some Civil Engineering applications require a life of 120-years, far exceeding the history of these modern materials; many historic structures far exceed this albeit with costly maintenance.

As modern materials FRP composites have a limited track record; evidence and data is widely dispersed and hard to access and relate to.

How to repair

Within the sector repair is thought to be relatively specialist and for adopters an uncertainty, perceiving that there is no obvious repair supply chain.

Fire

Limited FST performance

Post the Grenfell tragedy there is increasing insistence on non-combustible materials in buildings (BSEN13501-1 Class A1 or A2) – a requirement that most polymer based composites cannot attain (Limited to Class B).

Drive to non-combustibles

There is a misconception that "plastics" composites have poor and limiting fire performance.

Confusing regulatory framework

Fire specifications are difficult to follow and inconsistent across different applications – they also do not fully align to the rest of the world so the UK is not benefitting from advanced polymers.

Cost and variability of testing

Fire testing is costly and can be inconsistent between methodologies and even test centres.

Unlocking

Key Recommendations:

- Need for Government to support new and beneficial technologies in construction through policy
- Collate and make available consistent evidence of performance and benefits
- Undertake a GAP analysis of standards to identify barriers and inconsistencies and ensure future standard development is not an unintended barrier
- Develop composites supply chain for more efficient processing and train-up the "technology skilled" rather than "craft skilled" workforce required for the future
- Improve understanding of multi-materials joining, performance & recycling
- Identify and develop end-of-life recycling and enable design for recycling
- Fast-track product approval system to enable first of a kind demonstrators as bridgehead deployment of new technologies
- Undertake co-ordinated knowledge building with potential adopters

	**Productivity & cost effectiveness**	Improved materials	Digital processes & automation	Integration of functions	Joining technologies	How to repair damage	
		Formable rebar	Improved durability	Phase change materials	Energy efficient materials		
	**Regulatory**	LCA methodology	Open access standardised material data	Prequalified standard materials	Performance guidance	Gap analysis of codes and standards	Appropriate FST test methods
		How to inspect	Appropriate test standards	Fast track approval/ qualification			
	**Skills**	Rationalise taxonomy	Manufacturing skills shortage	Courses for design professionals	Skills gaps SMART construction		
	**Sustainability**	Design for circular economy	Design for end of life	Reuse waste	Cost effective recycling		
	**Supply chain**	Break down silos	Align customer champions		Aggregate supply chain		

A key non-technical activity is to build much closer contact with the construction sector to build awareness and confidence through education. Also to engage with I3P and the Construction Innovation Hub to ensure that they are aware of FRP composites as a potential solution to the challenges they are identifying as the Construction Sector transforms.

COMPOSITES LEADERSHIP FORUM

Established as a result the 2009 UK Composites Strategy to strengthen leadership in the sector.

The CLF is working to influence the Government and other bodies to bring together support for composites and ensure growth and industrial success for the UK.

Strategy refresh delivered 2016.
www.compositesleadershipforum.com

Stakeholders:

BEIS, Innovate UK, EPSRC, KTN Ltd, DIT (formerly UKTI)

Delivery partners:

National Composites Centre, Composites UK, CIMComp

Industry groups:

Aerospace Growth Partnership, Automotive Council, Motorsport Industries Association, Construction, Defence, Renewables UK, Marine Industries Alliance, Railway Industry Association, Materials Suppliers

CLF-Construction representation

- Atkins
- BEIS
- BRE
- BSI
- BuildOffsite
- CITB
- Composites UK
- Construction Innovation Hub
- Costain
- Environment Agency
- Expedition
- Foot Anstey LLP
- Highways England
- HS1
- I3P
- ICE
- I Struct E
- KTN
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- Network Rail
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