

Apply Structure Ltd is an integrated design company serving the off-site manufacturing sector.

We provide architectural and structural engineering consultancy services, product and production process design and project management, to clients engaged in capital projects:

- developers targeting earlier return on investment
- manufacturers wanting to enhance their capability
- constructors managing the risk inherent in delivering new buildings.

As experienced leaders in the design, specification and selection of off-site components and building systems, we are focussed on high quality buildings delivered to predictable cost, in less time, and with less resource.

We set out to answer three fundamental questions:

- what is desirable?
- what is feasible?
- what is viable?



Anthony Pearce BSc Dip Arch

Specialises in the definition and execution of business strategy in the off-site manufacturing sector.

30 years experience understanding the innovation process, building physics and the expert delivery of complex projects to achieve best value.

20 years focussed on off-site manufacturing.

Formerly Director of Innovation at The UNITE Group plc.

David Barber BSc CEng MICE MIStructE

Specialises in the design of lightweight building structures in light gauge steel and timber. 35 years experience leading civil and structural engineering consultancy teams, with excellent commercial understanding and deep technical knowledge of light weight building systems. 18 years focussed on off-site manufacturing Expert Witness.

Stuart King BSc

Specialises in leading product development projects in the off-site manufacturing sector. A background in the automotive and off-site manufacturing sectors, combined with an engineering design training and exceptional planning and organisational skills, gives him unique insight into the challenges of planning and executing off-site projects on time in full. Formerly Head of R&D at UNITE Modular Solutions Ltd.











exploration + analysis

> planning + definition

Searching hard for potential solutions which we rigorously assess to determine their feasibility

Helping our client define clear objectives and understand the viability of the best opportunities

implementation + management

Managing all the tasks and resources required to deliver our client's objectives



DfMA begins by understanding the end product and identifying the optimum level of sub-assembly for maximum benefit.

We aim to reduce:

- overall part production cost
- product assembly cost
- material, overhead and labour cost
- product development time
- complexity

Why?

• 70-80% of production costs (materials, processing, assembly) are determined by design

DfMA principles enable us to drive efficient procurement:

- Minimise the number of parts
- Standardise parts and materials for competitive market sourcing
- Create modular sub-assemblies at the optimum level for the project
- Design for efficient connection focus on interfaces
- Simplify and reduce the number of assembly options
- Cross-functional team working to optimise designs for efficient production
- Avoid difficult components
- Avoid special tooling/test equipment
- Minimise operations and process steps
- Comprehensive Bill of Materials down to precise number and type of individual fastenings.





What does a module contain?

- Furniture
- Doors
- Bathrooms
- Windows
- Carpets
- Insulation
- Cladding
- M&E, environmental controls
- Clients aspirations

The module frame – no frame, no module!



Before frame design starts you need to know the....

✓ Fire

- sheathing, boarding, insulation, sprinklers
- Acoustics
- ✓ Cladding
- ✓ Thermal
- ✓ Services
- ✓ Safety

- sheathing, insulation, finishes, gaps
- external, type, weight, movement, balconies
- insulation types, warm frame, cold bridging
- heating, lighting, water tanks & distribution, waste disposal,
- cleaning in service, installation

Structure — needs to support the weight, in the permanent and temporary conditions



Factors influencing Design apart from the 'FACTS' ..

- Timing of the decision to use a modular approach
- Layout
- Number of storeys
- Number of non standard accommodation modules
- Degree of misalignment
- Elevational treatment / degree of fenestration
- Transportation





Building stability is defined by its resistance to:



sliding

sway





overturning

progressive collapse



Modular Buildings rely on















Bedfordshire Schools Kier SMS Scape Framework

- 4 classrooms
- 8 modules in total
- 5 days installation
- 6 weeks total build during summer holidays
- 2015 completion
- Product & production process design
- Structural Engineering





The Wave, Butlins, Bognor Regis – Unite Modular Solutions



- 219 bedrooms
- 35 apartments
- 30 days installation
- 48 weeks total build
- 10 storeys on plinth
- Light gauge steel pre-engineered modules
- 2013 completion



Residential



- 250 bedrooms
- 35 days installation
- 50 weeks total build
- 10 storeys on plinth
- Light gauge steel pre-engineered modules
- 2012 completion



Travelodge Stratford - Unite Modular Solutions



Moving onwards & Upwards

Current tallest 'lightweight' modular structure to date is Creekside Wharf, SE10, at 23 storeys manufactured by Elements Europe. Due for completion late 2018

But going taller?

- Going taller is a concept that has been around for some time and really is a function of building layout and stability of the modules to the core. Vertical loads can be accommodated by variable gauge steel section with building height
- Methodology has been investigated in ICE's paper Modular Design of High Rise Buildings [2009] by Mark Lawson and Jane Richards. The paper was the result of extensive physical testing of modular elements for vertical and horizontal loading..
- It is feasible that structures beyond the height of Creekside Wharf can be created in light gauge steel, using the same principles, where modules essentially act as a vertically self supporting cladding fixed back to stiff cores to provide overall building stability.
- ASL has investigated such designs for residential structures of 30 –40 storeys.





What next?

Thank you for listening

