buildoffsite

Buildoffsite Review 2014–2015

Message from Chief Construction Adviser

Foreword

Construction is one of the UK's most important industries, an enabling sector that is a major contributor to economic growth, across all sectors of the economy. It accounts for a substantial percentage of UK economic activity and provides employment for almost three million people. Growth in construction benefits many other parts of the economy. So it is in everyone's interests that the industry flourishes and is able to compete effectively at home and in the increasingly important markets overseas.

In order to flourish no part of the industry can afford to stand still. Innovation is the key to unlocking improvements in productivity, quality and increased value for clients. If the UK construction industry is to thrive in the global market it must innovate to deliver continuous improvement in product and process. If we fail in this endeavour then in effect we will be exporting UK jobs and economic activity.

Some months ago we launched the industrial strategy for construction, *Construction 2025*. Developed in partnership by government and industry, it sets out a vision where by 2025 construction has been radically transformed.

The strategy has some bold joint ambitions for 2025: a 33 per cent reduction in initial costs and in whole life costs, 50 per cent faster construction, 50 per cent lower emissions, and a 50 per cent improvement in exports.

We will not achieve these ambitions by making small, incremental changes; the task requires the industry to do things very differently. The extent to which clients and suppliers are prepared to radically rethink the design and construction process and to be single-minded in their determination to strip out those practices that add cost but contribute little if any value is fundamentally important if radical transformation is to be achieved. Simply tweaking current working methods and management functions is, I suggest, unlikely to make any significant difference.

Peter Hansford

Leading clients and suppliers are already showing the way, and it is clear to many commentators that the future of the construction industry will increasingly resemble ways of working commonplace in the aerospace and automotive industries. We are talking about an approach to design, manufacturing, assembly and performance in-use that does not recognise poor quality or poor productivity. An approach that assumes zero accidents, and an approach where the use of BIM, Lean construction and the intelligent use of quality offsite solutions becomes the norm. I see this as the inevitable journey that the UK construction industry must take if it is to thrive and meet the vision set out in Construction 2025.

I therefore warmly welcome the work that Buildoffsite is undertaking to promote an improved understanding of quality offsite solutions. Unlocking step-change innovation in product, process and client value is an important contribution to the delivery of our vision for 2025.

Peter Hansford
Government's Chief Construction Adviser

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Buildoffsite works to promote significant improvements in quality, value and productivity across all sectors of the UK construction industry.

Our focus is on working with our Members and our partner organisations to promote an approach to construction that assumes that wherever practical, buildings and structures should be assembled on site from a set of quality manufactured assemblies and components.

We believe that offsite solutions in combination with the intelligent use of Building Information Modelling, the application of DFMA, and the use of lean production techniques to eliminate wasteful processes, collectively have the potential to transform the efficiency and competitiveness of the UK construction industry without compromising on design excellence.

Buildoffsite provides the networking and knowledge transfer mechanism through which innovation linked to continuous improvement in construction process and construction product can be shared across the supply chain and between client organisations.

The membership of Buildoffsite is drawn from across the client and supply chain community and from other stakeholder organisations. We also work closely with the Professional Bodies and with other thought leadership groups. By working together and having regard to respective interests and requirements we believe that it is possible to demonstrate and promote the case for the increased use and development of offsite solutions at a scale and with a visibility and impact that would be impossible for individual businesses or organisations to achieve.

For more information on Buildoffsite and our Membership Scheme contact Anna Whiting on:

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Mission statement

Buildoffsite's mission is to work to bring about a step-change increase in the use of offsite construction solutions in support of a more productive industry delivering better value to clients and customers.

Front cover courtesy Tekla

The stunning Art Science Museum in Marina Bay, Singapore. The challenging design was modelled using Tekla BIM software. The model was used to create detailed drawings for each part of the construction including the fabrication of 5,000 individual steelwork components.

The use of Tekla BIM software substantially reduced the time and cost of modelling the structure. The main contractor has estimated that in the absence of Tekla software the production of working drawings would have taken five times longer.

Constructing the Museum was enabled by the extensive use of offsite components.

The finished building provides 21 galleries spread out over 4600 m^2 of exhibition space.

Offsite construction techniques are applicable to all sectors of the construction industry. The challenge for those new to the use of offsite solutions is to recognise that offsite components and assemblies should not be seen simply as 'like for like' replacements of existing construction methods. The opportunity that the use of offsite brings is to rethink the entire design and construction process so that from the outset the project is seen as an exercise in modern manufacturing and assembly. This approach will:

- ensure greater accuracy and certainty of performance of the construction in use
- reduce waste in manufacturing and assembly
- simplify interface issues
- reduce labour requirements on site
- ensure greater predictability of costs
- speed up the time required for construction on site
- improve site productivity and improve health and safety.

These are all compelling reasons why the use of offsite construction solutions will increasingly become the construction method of choice, not just in the UK but globally.

Chairman's review and introduction

Richard Ogden, Chairman

It is a great pleasure to present the 2014 Buildoffsite Yearbook. Producing the Yearbook provides an opportunity to draw together a summary of how we are developing as an organisation, to provide an overview of our recent and planned activities, to say something about matters that are impacting on the development of the construction market, and most importantly to introduce our growing Membership and to showcase some of their exemplar projects.

In this short overview I will concentrate on some of the emerging strategic activities being progressed by Buildoffsite. A separate review of mainstream Buildoffsite activities follows later in the Yearbook.

Buildoffsite is now entering its 10th year and for much of that decade the UK economy has been severely impacted by a global recession the like of which none of us have had to face before. As always it is the construction industry that was the first to take the hit and just about the last to begin to feel the improving confidence that now seems to be gaining strength. The recession has been disastrous for many construction businesses and unfortunately there is likely to be more bad news ahead as improving confidence encourages the traditional supply side to push for significant price increases. A depressing but probably inevitable short-sighted consequence of the way much of the traditional industry still wants to behave. Echos I fear of the UK car manufacturing sector in the 1970s

Over the last 10 years we have seen continuous growth in the use of offsite solutions in all market sectors and a growing recognition that the use of offsite opens up opportunities to radically rethink design and construction processes in support of achieving improved productivity, site efficiency, performance in use and so on. These tangible benefits are also helping us to win the argument that the increased use of offsite solutions in no way need compromise the ability of architects to design elegant and inspiring structures. Indeed if anything the shift in favour of offsite becoming the construction method of choice should increase the time that architects can devote to achieving design excellence where it really matters.

After 10 years of effort I believe that we have reached the point at which few in our industry would fail to recognise the growing role of offsite solutions in helping to bring about a modern more efficient industry able to compete effectively against international competition and to deliver a step-change improvement in value for clients and customers.

It has never been our intention to argue that offsite is always the best solution – that would be absurd – but we do want to make the case for an approach to construction based on the widest possible recognition of the opportunity for projects to be assembled on site to be given informed consideration in all cases. The recognition of the potential benefits of offsite also connects with the intelligent use of Building Information Modelling (BIM), Design for Manufacturing and Assembly (DFMA) and the application of lean techniques to constantly challenge the value added by processes and construction solutions.

The Buildoffsite challenges moving forward will be to continue to grow our Membership, to promote the offsite message, to publicise real world examples of

tangible business and project benefits, to expand the number of key representative and other organisations we partner with and to create additional learning opportunities that will support continuous improvement. We must also respect and seek to respond as best we can to the concerns of those who anticipate risks associated with the use of offsite solutions because for them this way of delivering buildings and structures is simply different. This is a long haul task but fortunately we have the support of our Members and also an increasing number of collaborating organisations who recognise that the expanded use of offsite solutions has an important part to play in driving much needed innovation within our industry.

Buildoffsite is a membership organisation and it is through the efforts and openness of the Membership that we are able to share examples of innovative offsite practices in support of continuous improvement. This willingness to share is fundamental to the delivery of our ongoing work programmes. Currently there are about 100 organisations active within the Buildoffsite community, which includes significant organisations drawn from right across client, constructor, designer, manufacturer, insurer and academic interests. It is this wide cross-section of interests which ensures that we keep our focus on both the increased role for offsite solutions and the challenges that the supply side needs to overcome in support of continuous improvement. Offsite solutions need to be demonstrably preferable to traditional solutions if they are to deserve to flourish.

I am really pleased that more of our Members are taking part in our regular management and knowledge sharing activities but of course we want even more engagement on a regular basis. The direct input from the increasing number of Members along with invited guests who attend our regular Direction Group meetings provides us with real time feedback both on how the market is developing and also well considered advice on the ways in which our organisation needs to evolve in order to respond to changing circumstances. It is fantastic that so many Members attend these meetings but we would like even more to take part.

In terms of our strategic ambitions we have over the last year been making progress on a number of matters that will contribute to the future positioning of the organisation. I'm going to focus on just five areas:

Keep pushing the message

We need to keep promoting the role of offsite solutions and the work that Buildoffsite is undertaking. We also need to find increasingly imaginative ways of undertaking our work. The bottom line is that we need to keep delivering events and business to business contacts to promote awareness of the tangible benefits and to provide the environment in which discussion and knowledge sharing can take place. If anything we have increased the number of events we host and hopefully during 2014 we will again be able to deliver an increasing number of events in collaboration with our partners. I am convinced that there is no shortcut. We need to do more and we need collectively to do everything we can to carry the offsite message and the importance of knowledge sharing to all parts of the building and civil engineering industry.

Collaborating with professional institutions

We have set out to build meaningful relationships with the industry's professional institutions. The Institutions are part of the permanent infrastructure of the construction industry and it is their hard work that underpins the skills and competences of our architects, engineers, surveyors, professional builders and so on. The Buildoffsite ambition has been to ensure that the role of offsite construction as a key component of a forward looking construction

industry is recognised by the Institutions and included in professional training and CPD.

I am delighted that over the last year or so with the support of our Members we have established excellent links with RIBA, ICE and RICS and in each case have delivered important collaborative knowledge transfer events demonstrating the value of offsite solutions. We have started to engage with the IStructE and the CIOB which I hope will lead to shared activities. Collaborations with other industry organisations are in planning. These activities represent part of a sustained effort to establish the widest possible recognition and consensus on the role of offsite solutions in a modern, confident and innovative construction industry. We are not looking for special favours – we are simply seeking to secure a mutual understanding of the opportunities that the use of offsite solutions can deliver and equally an understanding of the real world challenges that the offsite supply side needs to address if it is to deserve to be successful. The fact that the Industries prestigious Institutions are willing to collaborate with Buildoffsite provides a clear demonstation that our case is accepted as being mutually relevant. I think this clearly demonstrates just how far our small organisation has travelled in a relatively short time.

House building

I am delighted that at last we have started to make inroads into the new housing market. This effort was initiated by the decision taken by the Department for Business and the Department for Communities and Local Government to invite Professor Nick Whitehouse of Oxford Brookes University and Professor John Miles of Cambridge University to report on the role of offsite construction methods to deliver new housing. Both Nick and John are members of the Buildoffsite Executive Group. Their report, *Offsite Housing Review,* provides a brilliant overview of the housing market and is a must read for any business that is looking to enter this market. A brief review of this report is set out below.

We are now in the process of developing our contacts with the house building sector and with housing clients and funders. We have a way to go but the urgent need for more homes close coupled with the need to ensure quality and energy efficiency whilst taking advantage of new financial models suggests that we are now at the tipping point when the case for a shift to the industrialisation of house building processes becomes compelling. Shortages of traditional skills and substantial price increases in labour and materials are serving to encourage an increasing number of house builders to consider the increased use of offsite solutions as a way to maintain their programmes and to ensure quality and manage risk.

Some really interesting examples of innovative offsite house building solutions are starting to emerge which represent a complete break with tradition. Developments such as the Laing O'Rourke scheme in LB Barking and Dagenham are demonstrating how urgent housing needs can be met whilst delivering exceptional quality and value for money.

International

From the outset the Buildoffsite Membership has included organisations HQ'd outside of the UK but with a significant UK presence. This outreach is seen as important in connecting Buildoffsite with innovative practices taking place overseas and also, of course, in opening up opportunities for our Members to participate in international business and technical collaborations. A development now underway involves exploring the scope to set up separate Chapters of Buildoffsite outside of the UK but operating very much in the style of the UK model. A number of opportunities have been identified which will be progressed over the next year or so. As the construction industry becomes increasingly international

we believe that such networks will become very useful in supporting UK interests in the global market.

In particular we have been in discussion over the setting up of an Australia/New Zealand chapter. This is now scheduled to be launched in the spring.

Buildoffsite Australasia Launch 2014

Australia and New Zealand have a growing offsite construction industry.

In Australia the investment in the mining industry has been the main driver. In New Zealand the main driver has been the Christchurch rebuild plus the Government's push for a substantial increase in affordable housing. These developments are encouraging the industry as a whole to look at offsite methods to improve the efficiency and cost effectiveness of the construction sector.

Both countries have many construction companies employing offsite products and processes but to date there has been no dedicated group promoting the increased take up of offsite construction and facilitating collaboration between offsite manufacturers.

In 2014 the opportunity has presented itself to establish Buildoffsite Australasia with some key members leading the way. These include Howick Limited a long standing member of Buildoffsite who have their head office in New Zealand, Superstructures a key player in the Australian modular industry and also Pacific Modular.

The inaugural Buildoffsite Australia meeting will take place in Auckland, New Zealand in May to bring together key players from the offsite construction industry from Australia and New Zealand and discuss action to promote growth in the industry and opportunities for collaboration. Buildoffsite members from the UK will take part in this meeting.

We have also followed up contacts made during visits to India and with support from Salford University we are confident that an Indian chapter of Buildoffsite will also be launched.

Having the opportunity to take the business and project case for offsite construction solutions into the vast Indian construction market will, we believe, deliver considerable commercial opprtunities to the UK offsite supply side.

Progress on developing international streams to the Buildoffsite programme will be reported on the website and in the newsletter.

Connecting with Government

Since day one we have enjoyed excellent links with the Department for Business and we continue to benefit from the Department's support and also from the challenge it is able to bring to our work programme. We believe that contributing to the Department's ambitions for private sector led growth is something that the offsite industry is well placed to support.

We are working to build an industry that is more competitive, more effective, and better able to deliver client value as well as supporting international trade. These ambitions for construction were clearly set out in the Industrial Strategy for Construction which was published by BIS last summer. Frankly the traditional industry can not engage with the growth agenda in anything like the way that is possible through the use of offsite solutions close coupled to BIM, DFMA and Lean. We shall look to contribute to the detailed work of the Construction Leadership Council as their work programme develops.

We shall, of course, continue to drive forward with our own work to demonstrate exemplars of tangible improvements in cost, time, sustainability and quality through the use of offsite construction methods and the adoption of new thinking regarding design and construction.

During the last year we have also developed our contacts with the Department for Communities and Local Government and with the Homes and Communities Agency. These contacts are important in helping us reach out to the house building and housing sector as a potential priority market place for offsite construction. We will look to take advantage of opportunities for collaboration.

Looking forward

That Buildoffsite has been reasonably successful is in large part attributable to the fantastic support, mentoring and energy provided by the Buildoffsite Executive Group (see page 140). This Group comprises of incredibly talented and experienced individuals drawn from across the client and supply side who give freely of their time and expertise to support our work and to keep the organisation on track.

I am delighted that Dennis Seal of Kier Developments has agreed to join the Executive Group. Dennis has 40 years' experience of the house building industry and his appointment underlines just how important it is to us to press the business case for the house building sector to adopt offsite solutions.

So in our 10th year I believe that Buildoffsite is positioned precisely where it needs to be in terms of its strategy and resources to energetically build the case for offsite solutions and to benefit from strategic relationships and the contributions from increasingly effective networks.

Without doubt we have come a long way in 10 years but there is no time to relax – we need to continue to build the Buildoffsite organisation and develop our activities to respond to the opportunities and challenges ahead.

Predicting the future is a mug's game but what I am absolutely certain of is that Buildoffsite must remain agile and outward looking so that it can respond quickly and effectively to opportunities to build relationships and to respond to the business needs of the Membership.

Buildoffsite and housing

House building is an important part of the UK construction industry but it is a market that presents some significant challenges for offsite suppliers. The nature of that challenge arises not because the home building process is technical complex – it isn't. In fact home building and in particular low rise building, is generally relatively simple in terms of both product and process. The challenge is not customer resistance to the use of offsite methods – just watch any episode of *Grand Designs* and the odds are that you will see the widespread use of offsite construction methods being selected to deliver some spectacular homes. That also deals with uninformed claims that the use of offsite solutions impedes design excellence – it clearly doesn't.

The real nature of the challenge arises because speculative house builders typically build only at a pace that matches sales. This is most definitely not a criticism – for them this is precisely how they can best run their businesses. Even on the largest sites the level of sales tends to be less than one new home a week. For the most part house builders have found it cost effective to build new low-rise homes using traditional site based methods which essentially do not require any significant up-front investment and as a supply chain can quickly be turned on and off to match demand. Speed of construction, assured performance in use and predictable cost of ownership issues are not generally relevant to the commercial interests of house builders.

The slow uplift in the requirements of Part L of the Building Regulations has long been seen as a 'game changer' that will eventually change the cost benefit assessment in favour of the use of offsite solutions. Until then it is likely that in the build for private sale market the use of traditional methods will dominate. However, at a pace that could not have been anticipated even a few months ago, the position of some of our largest housebuilders is starting to undergo a step-change. The drivers for change have included the knee-jerk response from traditional suppliers to a modest recovery in confidence in the housing market by imposing substantial increases in trade contractor rates and in material prices. The technical press is awash with stories of material

shortages. Another driver has been the arrival on the domestic market of almost unlimited capital (UK and overseas) looking for long-term investment in housing for private rent. It is clear that the traditional industry is incapable of delivering the volume of production that is required. If this investment captial is to stay in the UK then the industralisation of house building is essential.

Some sectors of the housing market including in particular the private and social rented sectors operate to different business models which recognise the value of faster rates of build, higher performance standards and reduced costs in use. These are increasingly significant market sectors and Buildoffsite is starting out on a programme to promote the business and other benefits attributable to the use of offsite solutions to meet these needs and to eliminate risk.

Dennis Seal

Introducing Dennis Seal

Dennis Seal has recently joined the Buildoffsite Executive. He brings with him 40 years experience of the UK house building industry. He is currently a developer client, and is exceptionally well sighted on how well the UK housing market is developing. Dennis is very clear about the factors now impacting on the market.

In 2012 the planets in our solar system aligned and some thought it heralded the end of civilisation as we know it! It didn't. The residential housing market in the UK can be compared to this event but in a more positive and constructive way, in that for the first time, the factors and drivers controlling its destiny are in alignment.

Government support and new initiatives such as Help to Buy alongside greater support for affordable, intermediate and market rented housing will create the demand necessary to fuel growth in the sector. Pressures on resources both in terms of skilled labour and materials will impact on the industry's ability to deliver. Quite how much impact this will have we have yet to see! What we do know is it's a real threat and one to be taken seriously.

2013 has already seen a surge in interest in offsite provision. Continued growth in the private and mixed tenure residential markets will inevitably need to rely on the offsite suppliers and manufacturers to deliver ever increasing quotas.

The key driver for the Buildoffsite residential team is to harness this alignment, translate and make it available to everyone through 'one voice one vision', leading the residential market in the next decade, not following it.

Institutional funding

Back in 2010 a presentation to Buildoffsite members highlighted the potential for a strategic shift in the way new homes might be funded and delivered in the UK.

The presentation also touched on the opportunity for a shift away from market sale in favour of a significant increase in market rent alongside increases in intermediate forms of rented housing and ,of course, in social rented housing. The later with the potential for delivery in key locations with zero public sector funding.

Three years on you may well ask! Are we there yet!

The executive and many of the members of Buildoffsite are agreed that the planets are aligned – to support this fundamental change.

The UK traditional housing supply market works reasonably well for those who want to and can afford to take up this option. Supported by Government incentives

the mortgage market is now clearly supporting growth in volume. The main question for this sector we think is one of could we do even better – much better.

If we can see growth potential in this market (especially in the rented sector) do we want to replicate the old ways of delivering new homes or should we use the opportunity to challenge and do things differently.

The availability of funding to service the delivery of UK housing through the various types of rented model is no longer the big issue. It is true that a degree of refinement and a bit more clarity is required in the commercial delivery of private rented accommodation but on the whole the volume or 'wall of money' (as recently described by Savills) coming into the UK is astonishing and almost certainly totally unprecedented. Money from Asia, the Middle East, Far East and America is we understand looking for a home in the UK residential market. The sums available are quite incredible – certainly billions and potentially more than a trillion pounds.

The UK Investor market in housing and real estate is expected to be worth an estimated £70 billion over the next few years and this figure is likely to grow significantly year on year.

It is not unusual to find investors looking for packages of investment ranging in size from £10m to £800m for a single opportunity. Multiple deals and pipeline opportunities are now part of the everyday speak that is driving the market. You get a sense that there is far more money than product available.

That's got to be good hasn't it?

Of course it has – but in many parts in the UK shortages of new housing stock to service this demand could serve to choke of the flow of investment at the very time when a massive increase in the number of new homes is a policy and a social imperative. Shortages will also threaten build cost inflation and put immense strain on material and labour resources. These factors are already impacting on the availability of new stock to service the existing market and the planned house building activities of the major house builders let alone this potential growth market.

It is increasingly apparent that traditional methods of construction are simply too slow to meet this emerging demand. Funders want stock and they want it now! For probably the first time in a generation or more the need for speed of delivery of quality homes is becoming the paramount consideration.

Is this the opportunity for the widespread adoption of offsite methods to industrialise house building?

Whether delivering from scratch or bolting on to existing supply lines to increase capacity, the application of offsite manufacturing has got to be the key to matching current and predicted demand and escalating delivery volumes to match.

Buildoffsite is embarking on a campaign to push the offsite message into UK house building. Certainly there are practical issues and challenges that need to be overcome by the offsite supply side but there is no fundamental reason why house-building should continue to be the almost exclusive domain of traditional skills and materials. No other industry works this way. The benefits of factory manufacture close coupled to the assembly of components is a plausible model for house building just as much as it is the model for other industries.

If you agree with this vision of what might be – what needs to be – then perhaps you should join with Buildoffsite and help bring about 'one vision one voice' for the future of house building in the UK

The Offsite Housing Review – an overview from Prof. Nick Whitehouse

John and I delivered our report to the Ministries of DCLG and BIS at the end of February last year as planned. The report had been completed to a very tight timescale which could not have been achieved without the enthusiastic contribution of experts from all parts of the sector. We experienced an appetite for change and an acceptance that the existing mode of delivery was untenable in the long term. The shortage of housing in this country continues to increase and new approaches to solve this growing problem are desperately needed. Our report goes into the detail of the problems in the different market segments and demonstrates that offsite techniques have a particular role to play to meet the increasing Part L standards, and where improvements in the output of housing and speed of delivery is needed.

We are currently experiencing an increase in private house starts which is a welcome improvement but as our report demonstrates there is a long way to go to satisfy the need. The private house builders are likely to be constrained by their capacity to build sufficient numbers before the target is reached. Hopefully the current rise in house prices particularly in the South East will not overheat the private house market but as we know the affordable homes sector and social housing provision continue to suffer major shortages. Overcrowding is increasing.

It is more than 10 months since the reports publication and what has been the impact?

It is pleasing to learn that our report has been of value to a number of manufacturers both large and small who have understood the potential opportunity for their products and the need to embrace innovation, high quality and performance at scale. Investment in new manufacturing facilities is taking place. Similarly

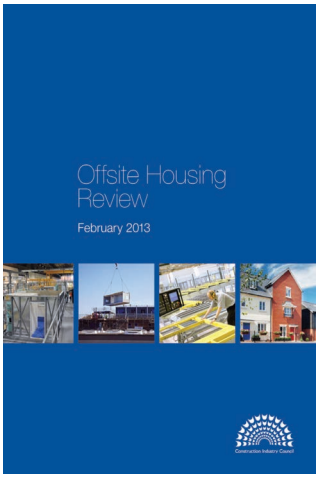
John Miles

Nick Whitehouse

developers and investors are recognising the opportunity to deliver new long term investment models that will give a stable return from high quality, robust, predictable construction. The offsite suppliers should be well placed to deliver to this market.

What is disappointing is that many of the recommendations contained in our report particularly in terms of follow on action have as far as we know yet to be implemented.

Current efforts to harmonise and simplify housing regulations and standards across the country should result in increased efficiency in design and construction.



In contrast it must be in doubt whether existing section 106 agreements and CIL are delivering the anticipated levels of social housing provision. Again it is the affordable and social sectors that give cause for concern. Offsite housing

has the potential to ease some of these problems but it needs a reliable market at scale.

To underpin the scale of the housing challenge the Report identified a medium term shortage of two million homes with a house building industry that over the last 40 years has consistently delivered only 160,000 new homes a year. Industry experts believe that at best the house building industry using predominantly traditional masonry solutions will be able to increase their annual output to 170,000 homes. Patently current arrangements will not be capable of delivering the homes that we need.

Details of the workshops and conferences that Buildoffsite is delivering to promote the role of offsite solutions in delivering quality new homes are given on the Buildoffsite website: **www.buildoffsite.com**

BIM in Finland – leading the way

There is no doubt that the intelligent take up of Building Information Modelling (BIM) will have significant benefits in terms of the increased use of offsite solutions. The UK is making great progress in the use of BIM as a 'business as usual' tool. This is a transformation that Buildoffsite is actively supporting.

Andrew Bellerby

The question that often arises is why Finland has become a world leader in the application of BIM to construction. Andrew Bellerby of Tekla explains how Finland has become so pre-eminent in the use of BIM.

Finland has a small population of just 5.4 million and is one of the most sparsely populated countries in Europe. However what the country lacks in size it certainly makes up for in terms of the global leadership given to the development and implementation of Building Information Modelling to drive improved efficiency within the construction industry.

Finland started out on its BIM journey more than 30 years ago and implemented a requirement for the use of BIM on projects more than 10 years ago.

Research and development into what has come to be termed BIM was being actively progressed in the 1980's and 1990s and industry started to use BIM in real projects in early 2,000. The early development work involved researchers at VTT (Technical Research Centre of Finland) working on what at the time was called 'Building Product Modelling'. This work helped develop competency within academia and boosted awareness of the benefits of BIM within the industry.

In the early 1990s the Finnish economy was suffering badly. In response Finland started to invest heavily into R&D in many areas, including the construction sector. An analysis of the problems of the construction industry was undertaken which identified poor information management and problems in sharing information throughout the project and building life cycle as some of the main causes of these problems. BIM provided a practical mechanism to manage data in support of project and process efficiency.

In 2002 the Confederation of Finnish Construction Industries adopted BIM as the core element in their new technology strategy and most large construction companies started to use BIM. At the same time, the largest public owner, Senate Properties started several pilot projects testing the benefits of BIM. Senate Properties has required the use of BIM on their projects since 2007 and in 2012 their BIM guidelines were updated to National BIM Requirements.

Today in Finland almost all designers use BIM. The focus is now on increasing cooperation between design disciplines and to derive maximum benefit from using the model in preconstruction and on site. Scheduling,

quantity take-offs, safety planning, logistics and ad-hoc visualizations with the model on site are already BIM business as normal.

Finnish construction professionals are rightly in the vanguard in terms of driving business and project value through the use of BIM and at the same time in honing their own skills. It comes as no surprise that many leading software companies such as Tekla and Solibri are Finnish.

The application of BIM to support project briefing and decision taking

Jaimie Johnston

The benefits of BIM through the design and construction phase are well known. There is also increasing awareness that even greater benefits will be available if the model can be used to optimise an asset throughout is operational life (and even into decommissioning and deconstruction). To this end, facilities management providers and vendors of CAFM (Computer Aided Facilities Management) software are increasingly engaging with the existing BIM communities.

However, BIM is still often viewed as a tool that can only be deployed once design is underway, and this overlooks a huge area of opportunity that Bryden Wood are actively harnessing with clients such as the Ministry of Justice, GlaxoSmithKline and Circle Partnership.

Decisions made at the earliest stages of a project 'chart the course' for that project. Good decision making early on (clear brief, good understanding of requirements) can fundamentally reduce waste in all its forms.

By contrast, late changes have a disproportionate effect on the project – a decision made late in the project can have a huge impact on cost, programme etc.

Waste is often inherently introduced early on in the design process, as a result of the brief and design developing in parallel. This often results in:

- the need for costly redesign
- the risk that essential requirements will get overlooked
- the risk that less important considerations drive the design.

Ultimately this can result in late changes to building design (and in many cases the actual building). This approach also jeopardises opportunities for standardisation, which in turn limits opportunities to take advantage of offsite solutions and other advanced construction methods which are the most effective way to control embodied carbon.

BIM for briefing

While most images used to demonstrate BIM are of highly sophisticated, coordinated 3D models, it is worth reiterating that 'information' is the most important element of BIM. To this end Bryden Wood are using BIM to create libraries with varying levels of geometry (in many cases simple 'blocks' will suffice) that act as 'containers' for a wide range of data that can then be filtered, interrogated and evaluated.

These blocks can be used to capture any existing information or knowledge, and can be refined over time or through the life of a project, both in terms of data richness, and, if appropriate, in terms of geometry.

Objectives

- prepare a clear and consolidated set of design guides and technical standards (using the fewest number of documents possible)

- incorporate lessons learnt from previous projects or frameworks
- place as much 'knowledge' as possible into the libraries to assist and enable corporate learning and effective reuse of good ideas
- identify areas of potential standardisation.

Strategy

- critical engagement with the client to determine what their needs are (**not** the preconceived solutions they want)
- standardise requirements where possible
- explicit recording and visualising of all requirements and elements of the design (visual representations of requirements allow for the easier engagement of the stake holders)
- in the first instance, focus on those elements that have a spatial impact.

Outputs

- design diagrams capturing as many requirements as possible
- a minimum number of additional supporting documents
- strategy describing how the standards will be accessed via or hard coded into BIM
- strategy describing how the diagrams will be used at each stage of a project (estate portfolio management/ options appraisal/briefing/concept design)
- strategy describing how the diagrams will be used to review the emerging designs and proposals against the brief ('optimised solution') to identify areas of non-compliance or potential problem areas.

Benefits include:

- a very 'user friendly' interface with the BIM model, ready for the application of subsequent layers of data eg cost, RDS
- actual requirements can be interrogated and understood (rather than assumed or discussed based on geometric/physical constraints)
- very quick stakeholder engagement, feedback and approval
- diagrams can be filtered to show a number of different critical requirements for specific stakeholders, for example:
  - staff/visitor/flows
  - security and access
- schedules of accommodation (SoA) are generated directly from the diagrams
- diagrams can be set up for a number of model projects, with minor adjustments made for project specific requirements
- SoA for projects can be generated for new projects very quickly
- clients can be very specific about requirements with supply chain to objectively monitor the design rather than retro-fitting a solution into completely designed building (eg services, kitchen design)
- these could be applied to existing assets as a quick and simple way of generating a BIM model which captures much of the operational aspects of a facility (where detailed geometric data is not required).

Jaimie is a recognised expert in the utilisation of BIM to transform project definition and delivery processes. He is currently working in St Petersburg on one of the largest housing projects in Russia.

BIM – the next steps

Towards a digital built Britain

Mark Bew

As we reach the milestone of the end of the BIM Task Group's second Construction Summit, it seems an appropriate time to look forward towards the 2016 milestone when the Level 2 task group will pass over the programme to legacy and the team will focus on our Level 3 ambitions.

This next stage in developing our BIM ambitions was outlined in the *Industrial Strategy for Construction*, which announced that we are going to be "an industry that is efficient and technologically advanced." So what does that mean and why shouldn't the UK continue its engineering heritage to lead the world in this crucial market? In an ever-changing landscape we have to compete on a new basis. The construction industry is the last bastion of the analogue world and the UK is going to have to work hard if it wants to be in the vanguard on the journey to digital leadership.

The Level 2 BIM programme is a key enabling strategy for the UK. Developing the processes, open data definitions and creating a capable, informed work force has not only led to repeated savings of 20 per cent, but also cemented the UK as the recognised leader in vision, policy, capability and results for digital construction worldwide. This was demonstrated by the Fiatech award this year, the first time such an award has been presented to a public body outside the shores of the USA. But all of this is positioning us for the next game changer... 'digital built britain'. Announced at the 2013 *Construction Summit*, Digital Built Britain is the brand we will deliver BIM contributions to the smart city, smart grid initiatives and to deliver BIM Level 3 capability to the domestic and international markets'.

So as the 2016 target draws closer, we are reminded that the Level 3 programme with its commitments to growth will be with us soon.

For more information go to: www.bimtaskgroup.org

Direction Group meetings

The regular Buildoffsite Direction Group meetings provide opportunities for the Membership to review and comment on the key elements of the work programme and to contribute to the development of that programme. Those who have attended recent meetings will have noted that we have been providing more time for Members to talk about themselves and their business offerings.

We have also begun to introduce potential new members and senior representative figures from organisations

we are seeking to collaborate with so that they can experience how Buildoffsite works and of course to participate in the impressive business to business networking that takes place. We have been hosting more meetings out of London in order to meet the preference of some members and this development is likely to continue. All Members are welcome to attend Direction Group meetings and will be notified well in advance of the meeting dates and locations.

Discovering offsite visits

Developed some while ago ‘discovering offsite’ visits provide opportunities to visit Members’ manufacturing, construction sites and other facilities and to get a real sense of the innovative products and services that are available. Where possible we are now combining these visits with Direction Group Meetings to improve the overall value to the Membership. Taking part in a Buildoffsite organised visit provides a great opportunity to gain a wider appreciation of the innovations on offer and at the same time to network with others taking part in the visit.

Most visits are open to non Members on payment of a fee.

All Members are encouraged to host visits and those wishing to do so should get in contact with Anna Whiting.

Details of upcoming visits are shown on the Buildoffsite website.

It is interesting to note that other organisations are now starting to operate their own version of Discovering Offsite visits. We see this as a compliment. Activities that promote increased awareness of innovative developments and which encourage collaboration can only be a good thing.

Member to member events

We organise bi-annual events for the membership to come together with special guests. These events provide great opportunities to engage with key topics that impact on the future of the construction economy or on business opportunities.

Buildoffsite work programme

The most recent member to member event took place on 7 November and focused on globalisation and the implications and opportunities for the offsite sector.

Members are encouraged to make suggestions for topics for future events.

Buildoffsite Property Assurance Scheme (BOPAS)

buildoffsite
Property Assurance Scheme

The management of risk is always an important consideration particularly when new players are entering the construction market. Buildoffsite together with its partners Lloyds Register and Building Life Plans has launched the BOPAS Certification Scheme to provide product and process assurance for a full 60 year period.

Integrating warranty providers into BOPAS

The Buildoffsite Property Assurance Scheme (BOPAS) was designed to address the issues associated with bringing innovative or non-traditional building systems to the market. Notably, that mortgage lenders are reluctant to lend against forms of construction with which they are unfamilar and that their panel valuers may refuse to value properties (as part of the mortgage application process) that incorporate unfamiliar building systems.

The problem is most noticeable in relation to the first sale of a new home, but can also influence succeeding transactions where there is no warranty in place. Especially since issues affecting durability are more likely to have appeared and modifications to the property are more likely to have taken place.

Because this problem exists, manufacturers have also struggled to secure development funding, unless they can demonstrate that units that incorporate their systems, will be mortgageable.

Whereas methods do already exist to assess product, the industry recognises their limitations. BOPAS is an accreditation scheme for innovative building systems that includes both product and process, and both system and the application of that system in a scheme-specific design. There are three elements to BOPAS:

1 **The Lloyd's Register accreditation process:** the process accreditation evaluates and facilitates the adoption of best practice by manufacturers and constructors in key performance areas such as risk management, competency management, configuration management, procurement management and process control. This takes place at each stage of project development, through concept, design, manufacture

and construction. A structured and systematic approach at each phase of the project life cycle will ensure consistency and repeatability and ensures that the discipline is adopted by organisations and their suppliers/subcontractors seeking accreditation under the scheme.

2 **The durability and maintenance assessment:** the assessment is a rigorous and structured process following the principles of service life planning of constructed assets as defined in the international standard ISO 15686. The durability assessment is based on a standard time frame of 60 years. This would be the minimum expectation for structural components. The purpose of the assessment is to provide assurance on the probable service life of a building based on its component parts and assemblies in typical environmental and in-use conditions. Particular focus is given to issues relating to repairability, maintainability and suitability for the intended environment.

3 **The BOPAS web-based database:** the database will provide the valuer with the requisite information based upon a search by postcode, for the BOPAS approved and warranted property to be valued. It will provide access to information regarding major structural components of an innovative construction and will significantly assist valuers and surveyors in the provision of valuations and advice for their clients.

How will the integration between additional warranty providers work?

The role of the New Home Warranty provider is significant within the scheme. They will undertake the on-site inspections and provide information to the database relating to completed units that have been accredited under the scheme.

Those warranty providers that already underwrite non-traditional forms of construction will have a process that allows them to assess the durability requirements of a particular system, for the purpose of their own underwriting. Under BOPAS, the durability assessment of the non-traditional form of construction, as undertaken by BLP Insurance, is provided for the benefit of the lenders only.

It is the intention that by integrating additional warranty providers into the scheme, it will engender a more collaborative approach to working with non-traditional construction. It has already been established that several different stakeholders across the industry are all working separately and independently on projects that all have the same objective. Rather than duplicate effort or waste time and money, we would hope that by having the warranty providers working in a more collaborative way on certain issues, we can respond better to the needs of the industry and provide a better service to our clients and ultimately, the homeowners. A typical example of this might be to share non-confidential third party information relating to a particular system.

For more information on BOPAS contact Anna Whiting at Buildoffsite: anna.whiting@buildoffsite.com

Sustainability

Intuitively we all know that the use of offsite solutions represents a more sustainable way of constructing buildings and structures compared to traditional methods of construction. However, moving from intuition to information-based decision taking requires access to robust evidence. The challenge is that such evidence is in short supply and even where evidence is available the translation of that evidence into financial information may be difficult to get at.

Category/Attribute	Potential Improvement over Conventional Construction	Societal Benefit	Financial Benefit to Builder/Developer
SOCIAL			
Health & Safety	Up to 80%	Large	N/A
Improved Working Conditions	Significant	Significant	N/A
ENVIRONMENTAL			
Reduced Road Traffic Movements	Up to 60%	Significant	Small
Reduced Energy Used on Site	Up to 80%	Small	Small
Reduced Waste	Up to 90%	Significant	Significant
Reduced Energy-in-Use	Up to 25%	Significant	Small
ECONOMIC			
Faster Construction	Up to 60%	Significant	Large
Improved cash-Flow	Significant	Small	Large
Reduced Snagging & Defects	Up to 80%	Small	Significant

Buildoffsite has carried out a review of available data to systematically and pragmatically examine the sustainability aspects of offsite construction. These have then been assessed with regard to their impact on the triple bottom line of social considerations, environmental considerations and economic considerations. The review also identifies the scale of financial benefits attributable to builders and developers as in most cases these parties are most likely to take the key decisions regarding the decision to adopt offsite solutions.

The conclusions of the report are that the tangible benefits of offsite solutions are numerous. However, in practice, the financial benefits are often seen to be the most compelling. In particular the financial benefits of offsite solutions were found to be particularly significant in terms of reduced levels of waste, enabling faster construction on site, improved cash flow and the reduced need to make good defects and poor workmanship. Each of these may have compelling significance depending on the nature of the project. The potential benefits in terms of enhanced health and safety was also assessed as being particularly significant as both an economic and reputational driver. It is generally accepted that assembling buildings on site from a set of factory manufactured components utilising DFMA principles will ensure a safer construction site. A case study from

Skanska demonstrating how BIM has been used to improve health and safety practice is included in the case study section.

The challenge for Buildoffsite and the Membership is to gather the evidence to demonstrate the range of sustainability arguments that support the increased use of offsite solutions. This is not always a simple matter particularly when we are talking about an offsite component that is being used on a project, which may be primarily constructed using traditional methods. The case becomes more quantifiable and that much easier to make when the building or structure is predominantly constructed using offsite solutions.

Water industry

The privatised water companies in England and Wales are regulated by Ofwat through a regular series of price determinations, which sets out the companies' future spending priorities. The total spend on capital assets between 2015 and 2020 is expected to be of the order of £25 billion. Many of the water companies are openly talking about reducing the time on site for delivery of assets and increasing the volume of offsite manufacture used in the delivery of the assets. Standardisation, productisation, asset standards to standard assets – these are the buzz words in the industry today.

Paul Jackson

Mark Enzer

The government has recently set out its Construction 2025 strategy as shown below.

These government targets play to the need of the water companies to deliver their capital asset programme more cost efficiently, faster and with less disruption to their customers.

In reacting to this development Buildoffsite will set up water sector focussed meetings for members to come together to increase the opportunities for the take up of offsite manufacture in the water industry. These meetings will be jointly hosted by the Water Industry Forum, a neutral independent not for profit business which brings together UK water companies, the Environment Agency, their supply chains and other stakeholders to tackle challenges faced by the sector.

The Buildoffsite Water Hub will be launched in February 2014 and the first meeting is planned for March 2014. This

interest group initiative is being developed by Paul Jackson of NG Bailey and Mark Enzer of Mott MacDonald.

There is considerable interest already from a number of water companies and the supply chain community. The intent is to bring together like-minded people to share their ideas and experiences and to help others to learn and to share knowledge in a collegiate manner. We want to help companies understand what the water industry's move to offsite means for them, their systems and processes. Our aim is to create a network of champions to facilitate change in the water industry in support of the Construction 2025 targets.

Get in touch with Anna at Buildoffsite (**anna.whiting@buildoffsite.com**) if you wish to be part of this group.

Engaging with strategic clients

HS2

At the request of the HS2 project team we have been invited to support them in developing their approach to the procurement of this massive undertaking. This work will require the supply side to innovate to deliver tangible project benefits which will include the optimisation of offsite solutions, design for manufacture and assembly and so on. This has been a fantastic opportunity both to recruit HS2 as a member of Buildoffsite and also to have this once in a generation opportunity to contribute to a project of national and international significance. The collaboration is at an early stage but it is a tribute to the exceptional skills available within the Buildoffsite organisation that we have been invited to contribute in this way.

The HS2 Project

HS2, the new north-south rail link will revitalise Britain's rail network to provide the capacity and connectivity to drive national and regional competitiveness. It will be the first significant upgrade of the UK rail network since its original development in the 19th century – the first major route to be built north of London in the last 100 years – and already the biggest and most comprehensive consultation process ever undertaken in the UK.

The HS2 programme aims to set the standard for the delivery of transport systems and infrastructure by:

- engaging with all stakeholders fairly
- delivering value through the effective management of the design and build programme
- building and operating a safe, sustainable and reliable system to provide exceptional levels of service to passengers.

As the company responsible for developing, delivering and promoting this historic project, HS2 Ltd is committed to delivering this remarkable legacy for the UK.

Cherwell District Council

We have begun to work with Cherwell District Council in connection with their planned development of a former MOD site to establish a substantial sustainable community offering homes, supporting infrastructure and local jobs. The use of offsite construction is seen by Cherwell as a critical component of the project. Similar opportunities are being discussed with Kent County Council.

This development is a unique undertaking for Cherwell and is seen as a significant contribution to meet local housing need closely coupled with practical measures to drive growth in this part of North Oxfordshire. What is proposed is something radically different to traditional housing developments and has the potential not just to drive fundamental changes in house-building processes but also create substantial opportunities for self-build.

Here Helen Town, who is responsible for this development, provides a brief update on the strategic ambitions for the project.

Cherwell District Council is in North Oxfordshire and includes the towns of Banbury, Bicester, Kidlington and surrounding villages. Cherwell joined Buildoffsite through its Build!® programme which seeks to test out new approaches to housing and regeneration. Cherwell has already found huge advantages to being a member of Buildoffsite in terms of the learning and networking opportunities that membership gives.

An exciting venture for Cherwell's Build!® programme over the next few years is the acquisition and development of Graven Hill, Bicester, a former MOD site. Cherwell's vision is that this will be the UK's largest custom build site through the delivery of 1900 homes and a hub for off-site manufacturing through 1m square foot of commercial space. Cherwell sees offsite manufacturing as a key element in its strategy for economic growth, sustainability and innovation.

Doing business internationally

In an age when global competition has become the norm it makes sense for companies of all sizes to look hard at opportunities to win business overseas.

Those involved in the offsite supply side are well placed to take advantage of the emerging commercial opportunities that open up as a consequence of international interest in the use of offsite construction solutions to drive value and competitiveness.

Doing business internationally was a theme of the Buildoffsite member to member event on the 7 November. No one is going to claim that developing overseas markets is either easy or without risk. However it is a truism that the alternative of doing nothing is not particularly attractive. Help is available and here we feature guidance from Michael Caroll of UKTI and also some practical advice from Paul Cooper of Ormandy.

Doing business over there – Michael Caroll, UKTI

UK Trade & Investment (UKTI) works with UK-based businesses to ensure their success in international markets, and encourage the best overseas companies to look to the UK as their global partner of choice.

We provide expert trade advice and practical support to UK-based companies wishing to grow their business overseas.

Michael Caroll

UKTI has professional advisers both within the UK and across more than 100 international markets. Whatever stage of development your business is at, we can give you the support that you need to prosper. Through a range of unique services, including participation at selected trade fairs, outward missions and providing bespoke market intelligence, we can help you crack foreign markets and get to grips quickly with overseas business practice.

Companies in the offsite sector will be interested to hear about the High Value Opportunities programme

– UKTI's flagship trade initiative that was launched in 2011. The programme identifies and validates large scale procurement projects worldwide with budget values of over £500m and where UK companies can compete for at least £250m and more.

The programme offers UK companies of all sizes access to UKTI's global network to help them win more contracts resulting from these major projects. Using our UK and overseas network and market specific expertise and our ability to pull together relevant knowledge and intelligence across governments and business, UKTI can provide support to develop and implement strategies to win contracts in and around large scale overseas projects. The type of support available to UK companies includes:

- early intelligence on opportunities
- support with identifying in-market partners
- help with navigating overseas procurement processes;
- facilitating access to decision makers
- senior level lobbying
- tailored support for companies of all sizes.

There are huge opportunities for UK based companies of all sizes resulting from these projects.

For further information on UKTI and its support for UK companies please visit: **www.ukti.gov.uk**

Doing business over there – Paul Cooper, MD Ormandy Group

Ormandy was established in 2001 and through a mix of organic growth and acquisitions we now have a turnover of approximately £23m. We employ some 200 people and we export to a number of markets including in particular into mainland Europe and the Middle East.

Paul Cooper

Our core business involves the supply of a wide range of water heating products developed for a number of market sectors. We supply solutions to quite a number of international businesses including GSK, Rolls Royce and BP. We have also supplied product into some of the most iconic modern buildings including the Shard. We are very good at what we do and from day one we have embedded the principles of meaningful partnering and the use of offsite solutions into all aspects of our business. We really do walk the talk.

I believe that we can do our very best work when we can work directly with the client. We need to be able to understand the client's needs and to ensure that what we are offering really meets their business requirements over time. Working through an intermediary may make this task considerably more of a challenge.

Currently we are exporting about 15 per cent of our production and this figure is growing year on year.

Even for a company of our size we are acutely aware that growing our business depends on getting out there and developing commercial opportunities in international markets. We have no option but to think and act globally.

There are a number of priority requirements for doing business overseas but perhaps the most important is to have excellent local partners who really understand the local markets and the ways of doing business plus of course a detailed knowledge of the solutions that we are able to offer. I have been really impressed with the information and support services provided by UKTI –

tapping into their local knowledge of local markets has proved to be highly cost effective for us.

Looking forward there is no doubt that we will continue to work hard to increase our international business. We will continue to focus on the Middle East where we can benefit from a strong base of expat UK consultants and where the use of British Standards and conformity assessment is widely recognised. We are also looking to grow our business in South America including in particular Chile – once again the UKTI team have been very helpful in providing market information and contacts.

Progressing export markets is of course not a one way street. In looking to do business we are also looking out for opportunities to support our supply chain including sourcing quality components wherever we can find best value and where this can enable us to increase the range of our products. This is the flip side of globalisation but the really important thing for our company is that by being open to collaboration we can ensure that our manufacturing businesses can win work in a much wider set of markets because we are able to construct great value offerings.

I was really interested to see the improvement targets set out in the Construction 2025 Strategy. Last year we improved our exports by 40 per cent – albeit from a low base. We will work hard to achieve substantial double digit growth year on year because we believe that anything less means that our business is missing out on the great opportunities that are out there.

Members' featured projects

The projects featured in this yearbook represent a slice of projects delivered by the Buildoffsite Membership. The selection covers projects for a wide range of markets and for a wide range of customers.

The offsite solutions have been selected as the construction methods of choice because, uniquely, they can best deliver client's requirements whether this be time compression, right first time quality, assured health and safety, predictable and cost effective performance in use, adaptability, meeting site specific conditions and so on. The range of offsite benefits is incredibly extensive.

These featured projects along with those featured on the Buildoffsite website provide an excellent source of information on the range of offsite solutions that are available and the business and project benefits that have resulted from their use.

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Case study 1: 1100 m^2 London store created for Sainsbury's, Accio Group

Benefits

Time/cost: assembly in just 13 days – four week saving in ground works

Quality: pre-configured assembly including internal specification and finishes

Sustainability: reduced site works, reduced impact on local community, and reusable structures

Working in partnership with the Store Development team at Sainsbury's Supermarkets Ltd, Accio have embraced visionary store design solutions and innovative Buildoffsite processes to create a fully assembled store in just 13 days.

The offsite design and build program involved the preconfigured assembly of 30 steel frame 3D volumetric modules, taken through to an agreed interior specification with all cabling, air conditioning cassettes and interior finishes signed off by the client.

Accio's fully demountable store structure is comprised of individual 'units' measuring 14.4m × 3.3m × 3.2m.

Transported to London in carefully routed night-time convoys, each unit was placed directly onto a unique Leg Foundation System. The leg plates sit directly on to the existing car park surface, with no foundation digging required, set to precise heights to level off the affect of the sloping car park.

This process saves an estimated four weeks groundwork time and heavy machinery disruption. This means less site traffic, less impact on residents and the fastest route to creating a fully trading store, when compared to conventional build.

Detailed geotech work is conducted prior to placement and loading on the foundation leg plates, taking into account bore hole survey analysis and compaction testing to arrive at exact loading calculations.

The Buildoffsite approach also delivers significant time savings made possible through working in a fully covered area at Accio's Cambridgeshire site. The construction program continues regardless of weather conditions, with no deviation from demanding project schedules.

The existing Sainsbury's Nine Elms store is being demolished to make way for a substantial new mixed-use development, comprising retail and residential build and a new tube station for Battersea Park which will have an entry point within the prestigious new complex.

Working with the Sainsbury's Store Development team to maximise the sustainable options, the Nine Elms demountable store has been configured in such a way that it can be reused for further convenience stores due for installation in 2015. By future-proofing the project at the outset, Accio have demonstrated how demountable retail structures can be both temporary and reusable.

Commenting on the project, Accio Group Managing Director Stephen Casey said "This is a significant project, requiring detailed design planning, robust project management and a close working relationship with all contract partners, stakeholders and the client. The scale and complexity of this

undertaking reinforces our reputation as the leading provider of demountable, modular built retail structures in the UK. We are delighted to be able to demonstrate our skills and expertise with our long term client Sainsbury's, where we have been a trusted, named supplier since 2009."

Richard Rust, Head of Programme, Construction & Delivery at Sainsbury's said: "We're delighted with the new temporary store, which is slightly larger than one of our convenience stores. It will allow our customers to continue to shop at Sainsbury's throughout the construction, and buy a range of essential products.

"We've exciting plans for Nine Elms and will be opening a larger superstore in 2016. The final project will also see around 740 new and affordable homes, and additional retail and commercial units, on top of 300 new jobs."

Contact

Stephen Casey

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Case study 2: Pump Station, Anua

Benefits

Time/cost: can be installed and fully operational within one day, reducing man power and on site build time

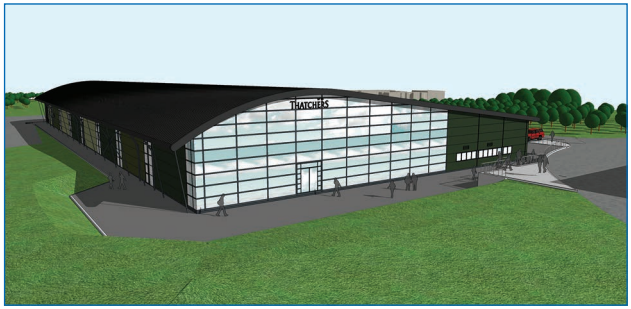
Quality: greater accuracy of components and assembly

Sustainability: fewer deliveries to site and reduced material waste

Health and safety: safer working conditions on the site as 'assembly' works reduced

The project

Thatchers have been producing cider since 1904 and currently make a wide range of different craft ciders. Based in Sandford, Somerset, the company has over 400 acres of orchards and in recent years has blossomed in popularity. As a result Thatchers have invested £3m on a new packaging facility named the Jubilee building.



The Jubilee facility will provide a smart, modern, energy-efficient building to enhance work processes and facilitate growth. In keeping with Anua's values, the facility will promote a vision for the future that is both high tech and green. Thatchers selected Anua as the perfect partner to complement its vision of a vibrant, modern building that enables the further development of the business.

The solution

Anua worked with Thatchers cider on the design and manufacture of a bespoke pump station for their new facility which has been installed beside the building, draining all wastewater from the site to Thatchers' treatment lakes.

Anua's flexible manufacturing process allows solutions to be tailored to suit all projects. In this case, expert Anua staff worked in partnership with JDP and Xylem to understand Thatchers' unique requirements and build the specification for the customised horizontal pump station featuring a chamber lined in special resin and stainless steel pipework.

Additional benefits of an off-site solution:

- reduced site-based construction time and cost
- assured quality/durability standards of final construction
- fewer deliveries to site
- reduction in material waste on site.

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Case study 3: Riverside Dene Estate, Newcastle, Armstrong Fluid Technology

Benefits

Time/cost: speed of installation on site and reduced overall project time

Quality: predictability of right first time performance, risk mitigation

Sustainability: minimal disruption to local area

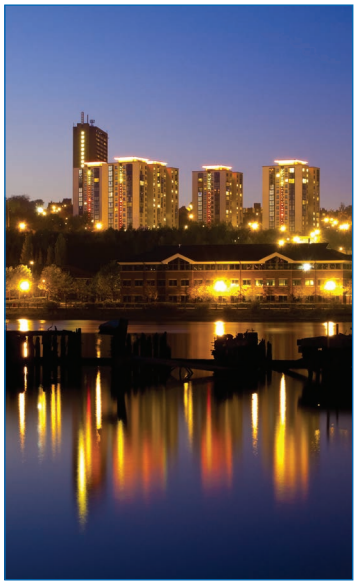
The project

Riverside Dene Estate is an iconic apartment complex in Newcastle, England. When the towers were constructed in the 1960s the local council envisioned a 'city in the sky'. The apartments have provided much-needed affordable housing for the area.

As part of a large scale refurbishment, six tower blocks of Riverside Dene have been remodelled to create 550 modern flats built to the 'Decent Homes Standard'. The project involved the creation of a sustainable district heating scheme. The solution, supplied by Vital Energi, is a highly efficient £1.7m wood-fuelled biomass scheme providing low carbon heat and hot water.

Vital Energi approached Armstrong Integrated to provide pumping capability for the project. The systems supplied by Armstrong are integrated Fluid management integrated pumping units, a complete pre-designed, pre-assembled and pre-tested fluid management system. Each unit is capable of controlling up to 18 zones. The pumps at the heart of each module are Armstrong Design Envelope Vertical In-Line 4300 pumps with integrated variable speed drives – manufactured in Halesowen, Birmingham.

The district heating scheme provides reliable heat for residents in addition to saving 1,054 tonnes of CO_2 per



year. The project has an expected pay-back period of less than eight years, and household fuel bills on the estate will be substantially reduced.

The apartments were named the Best Affordable Housing Development in the North by the Local Authority Building Control organisation.

Contact

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Case study 4: West Kowloon Cultural District Authority: Arts Pavilion Design Competition, Brock Carmichael

Benefits

Time/cost: faster on-site assembly

Quality: enabling innovative design

Sustainability: fewer vehicle movements and reduced environmental impact

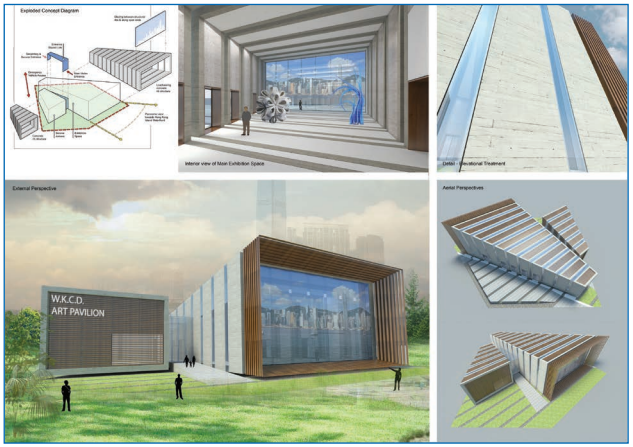
The project

Our design takes inspiration from the Greek amphitheatre as the venue for a citizen's life story to be played out against the back drop of the City at a point in time. The people, their institutions and politics, art and culture, finance and values provided the stage for the re-enactment, re-interpretation and resolution of past and current events.

The WKDC Arts Pavilion site provides the opportunity for cultural awareness and observation. We have sought to bring together art and culture with five transitional states unique to the people of Hong Kong, and to reconcile diametrically opposite aspects.

1 **Time:** from the past to the present.
2 **People:** from the individual to the collective.
3 **Scale:** from the micro to the macro.
4 **Change:** from stability and permanence to exponential growth.
5 **Value:** from art and culture to finance and trade.

The pavilion is unambiguously expressed as a man-made object in its geometry and materiality. It is a simply ordered telescopic box and container for precious objects, evoking a funnel, a portal and a screen and view finder to magnify



and amplify art, culture, history and nature against the back drop of Hong Kong. It is a time tunnel capturing past and present at a point in time; looking towards a small fishing port and to a Global City of World finance and trade. The objects within it may well point to the future.

The execution

The pavilion is arranged into the servant (the service annexe) and the served (the exhibition space), orientated around the constant, fixed and Global North–South axis. The main building services and air handling units are discretely located over the toilets within the service annexe.

The pavilion is divided into 12 structurally independent but linked 2.5M prefabricated modules or segments that can be transported by road and assembled on site to reduce onsite works and construction time. The modular nature of the structure is replicated in the service strategy to facilitate exhibition sub-division of the main space.

The pavilion is unadorned and built using the basic functional elements of concrete, steel, glass and timber. Fair faced concrete provides the thermal mass for internal temperature control with mechanical air handling and cooling integrated into the structure.

The segments are articulated with glazing bands and the last five segments employ integral black out blinds to windows and doors with a temporary movable partition to sub-divide the main space and provide a 98m^2 dark installation and presentation space. The pavilion is raised 1.0M above the general external ground level to mitigate flood risk. The pavilion terminates with a dramatic pre-assembled timber 'lense hood' to shade and focus the observer, providing a large scale projection screen viewed externally and internally.

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Case study 5: Landmark scheme, St Petersburg, Bryden Wood

Benefits

Time/cost: 20 per cent saving in construction time, and 25 per cent reduction in project cost

Quality: improved quality and efficiency in design and construction

Sustainability: reduction in waste and optimisation of materials. Reduction in vehicle movements

The project

An £800m landmark scheme to create a new district of St. Petersburg called Gutenborg, which comprises approximately 15,000 dwellings plus retail and leisure uses, schools and healthcare on a 65.2ha site. In total the scheme will house some 22,500 people.

Bryden Wood's multi-disciplinary team are developing the 'chassis', a set of components and principles that will allow maximum architectural variation across the site, while providing our usual improved quality, and H&S benefits while reducing cost and programme.

Bryden Wood are also designing eight of the buildings, to show how the chassis elements can be used and to test the rules and components. The chassis design guide will then be provided to a group of framework architects who will develop site-specific proposals across the rest of the scheme. In addition, Bryden Wood are MEP and structural engineers across the whole territory.

The scheme is the culmination of Bryden Wood's position as leaders in DFMA and BIM.

Speaking at the UK Government Construction Summit in July 2103, Chloe Smith, Minister for Political and Constitutional Reform, commented "...Bryden Wood, a British-based multi-disciplinary design and technology

company…in February won a competitive tender for a landmark construction project in St Petersburg, Russia. They beat much larger, international practices and it was their experience of working on complex projects where BIM is essential to coordinate the vast range of design, construction and handover activities that secured the contract."

The challenge

Deliver, without compromise:

- a sustainable, high quality mixed use city district that will reinforce St. Petersburg's status in the Central European region
- improved standards of quality and efficiency in construction and design.

To achieve these objectives while optimising:

- cost and schedule
- construction and logistics
- site personnel.

The strategy

- rigorously minimise the quantity of material required to support these objectives

- maximise potential for a manufactured solution to allow 'assembly', not 'construction'
- create a limited set of components that provide complete flexibility.

The result

Bryden Wood have developed a lightweight, flexible set of components that allow massive repeatability and prefabrication, without restricting the architectural design. Given that it is untested in the Russian market, the system has been rigorously interrogated from the point of view of:

- cost and programme
- construction and logistics
- supply chain engagement
- ability to demonstrate compliance with the Russian regulations
- architectural expression and flexibility.

These studies have revealed some interesting statistics. Compared to traditional pre-cast construction, the system has demonstrated:

- 60 per cent reduction in building mass
- 40 per cent reduction in vehicle movements
- 42 per cent reduction in craneage
- 25 per cent reduction in cost and programme.

The project is now programmed to finish a year earlier than originally planned (reduction from five years to four years).

Proof of the system's flexibility is the way in which the architectural teams have been able to readily develop unique, plot specific buildings with a range of architectural expressions. To date Concept designs (approximately RIBA Stage) have been developed for over 20 of the 40 plots, while the first of the plots (a Bryden Wood scheme) has been submitted for regulatory approval (the equivalent of UK detailed planning permission and building control approval).

Coordination of the schemes has taken place using data rich models built up, like the real buildings, from virtual components developed by Bryden Wood.

These same components can be used from the earliest stages of the project to extract cost and procurement information, plan the construction phase and develop detailed logistics plans.

Work is anticipated on site Q1 2014, with phased completions until the final handover 2018.

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Case study 6: Rainspan rainscreen project, Eurobond

Benefits

Time/cost: speed of installation and reduced construction programme. Cost savings including eliminating the need for secondary steelwork, wet trades and scaffolding

Quality: high quality appearance and functionality

Sustainability: high performance solution and reduced time on site

The project

Eurobond's Rainspan rainscreen support panel has been used on the Prestatyn Retail Park development in North Wales. This is a large scale retail development and includes major brands such as Tesco, Marks and Spencer, River Island, Boots, Next, Costa and New Look.

Eurobond's extensive experience in the retail sector meant that we were set a challenging design brief based on a number of different finishes, requiring high performance solutions installed in a short time, and on a tight budget. Standardising the wall system simplified the design and construction process and provided the client with the functionally, quality and value that is demanded from modern building envelopes.

Specified for its flexibility in architectural design and speed of installation, Rainspan has improved the retail experience and welcoming feel for the thousands of shoppers who visit the retail park each week. By using Rainspan the construction programme was reduced and significant cost savings were achieved over traditional methods.

Once installed, the Rainspan panels delivered an excellent thermal performance and an air tightness of less than 1m^3/hr/m^2. Utilised in this way, Rainspan provided a means of combining the high performance advantages of composite panel construction with the design flexibility offered through the use of a variety of architectural façade finishes.

The product

Attributes of Rainspan include high performance, rapid build speed and convenience. This allows rapid construction (up to 400m^2 per day) of a weather tight building and the early commencement of internal works, which reduces time and cost. The product reduces both the numbers of component parts needed and also reduces the thickness of the overall wall. Rainspan provides a clean uninterrupted internal surface with minimal secondary steelwork.

Rainspan removes façade installation from the critical path. The system creates a flat external metal face ready to receive the system carrier. Costs are reduced by eliminating the need for secondary steelworks, wet trades and scaffolding.

The Rainspan support panels are manufactured in Eurobond's ISO 14001 and ISO 9001 accredited facility in the UK.

Members' featured projects

Eurobond panels are manufactured with a non-combustible, non-degradable stone wool core, which has been tested to BS EN 1364-1 and can achieve two hours fire resistance (integrity and insulation). In addition Eurobond is the only composite panel manufacturer in the UK to hold BES 6001 for responsible sourcing and has achieved a 'Very Good' standard.

Eurobond composite panels are 100 per cent recyclable. All components can be returned to their respective manufacturers and re-entered into the supply chain, offering a 'cradle to cradle' approach to manufacturing.

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Case study 7: The Piggott School, Foremans

Benefits

Time/cost: use of refurbished steel frame modules, 70 per cent saving in programme time

Quality: high quality solution to meet client requirements

Sustainability: use of refurbished modules, reduced work on site, no impact on day to day running of existing school

The project

A second refurbished modular building to expand academy's teaching facilities.

The requirement

New teaching facilities were required at The Piggott School, an OfSTED outstanding academy in Reading, following the success of an earlier Foremans contract to construct a sixth form centre.

The purpose-designed building will improve specialist teaching facilities for pupils, and particularly the classrooms for mathematics which had previously been split over two separate parts of the school.

The project had to be complete to a challenging timescale, ready for the start of the new academic year as it was replacing a number of temporary classrooms.

The solution

Foremans constructed the building from refurbished steel-framed modules and handed it over after just six weeks on site. The use of a recycled modular building allowed the scheme to be constructed during school holidays and reduced the programme by around 70 per cent compared to traditional site-based building methods.

The two-storey scheme was constructed from 44 refurbished modules which were reconfigured to create eight classrooms, a science laboratory, office accommodation, beverage point, disabled access lift, PE changing rooms, and a fitness suite which the community can use outside of school hours.

A purpose-designed and flexible teaching environment

Externally, the teaching block was designed to replicate the sixth form centre in line with school's specific requirements. It has a blue and white colour scheme with The Piggott School emblem featured on one elevation, timber cladding, brise soleil and a canopy over the entrance.

The modules were delivered to site around 70 per cent complete with wall linings, partitions, M&E services, doors, and windows already in place.

Foremans also installed a folding wall between two classrooms which has created a more flexible teaching environment that can be opened out for examinations or large group activities.

Nadine Doble, Business Manager, The Piggott School said: "We were very impressed with the delivery of our earlier sixth form building and have a great relationship with the company, so Foremans was a logical choice for our next scheme."

"As a school, we are very passionate about the environment and it really appealed to us that Foremans buildings are a highly sustainable alternative to new build because the steel structure is recycled. I am delighted to report that the building work did not impact on the day-to-day running of the school at all and that it was delivered on time and on budget – a key requirement for us. The finished scheme has been really well received by staff and students and the fitness centre is being highly used and valued by the local community."

High quality teaching accommodation to meet the demand for school places

Foremans has extensive experience in the provision of high quality accommodation to primary and secondary schools, further education and sixth form colleges, and universities. It offers a wide variety of modular building solutions to help meet the increasing and urgent demand for school places, from interim classrooms for short-term use to fully refurbished teaching blocks and extensions to existing school buildings.

The refurbishment and recycling of relocatable buildings is one of the most environmentally friendly methods of construction – helping to reduce carbon emissions, waste sent to landfill, and improving a building's carbon footprint, with no compromise on quality.

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Case study 8: The Nano Whare, Howick

Benefits

Time/cost: repeatibility without the need for moulds

Quality: requires minimal finishing

Sustainability: relocatable solution, minimal waste

The project

When Design Tribe were given a brief to design stand-alone transportable modules to act as permanent and part-time accommodation for kuia (elderly lady) or kaumatua (respected elders), and short stay accommodation for tourists on or near a Marae, their immediate thoughts were for quality, longevity, repeatability, and transportability as it was likely the units would be relocated several times over their lifespan.

The traditional domestic Maori whare (home) with an earth floor was both warm in the winter and cool in the summer. Modern housing solutions with timber floors have typically little passive thermal capacity. The Nano Whare needed to include passive thermal qualities.

The solution

The decision to build off-site and the need for transportability, lead them to select a Speedfloor lightweight transportable concrete floor which would give them all of these qualities plus more. This floor uses an 80mm thick litecrete slab providing substantial thermal mass for storing daytime heat and releasing it through the night. The litecrete slab also provides insulation and is water resistant negating the need for extra floor coverings in the kitchen and bathroom areas.

The product

Speedfloor's Transportable concrete floor is a unique combination of a light gauge rollformed perimeter channel and a composite floor joist. The rollformed sections are formed, punched, pressed and cut accurately to length in a one pass rollformer built by Speedfloor's parent company Howick Ltd. The units are packed together with all required components and shipped to the builder's factory. The assembled kits are placed upside down on a flat surface or pre-cast bed. Step-downs or falls for bathrooms are formed using rubber moulds positioned on the flat beds during assembly. The mesh and or any

reinforcement is positioned and the concrete is placed and levelled with little or no finishing required. Pre-plumbing and the fitting of any extra insulation can be undertaken before the unit is flipped to produce a flat, high quality finished floor module ready to accept the building structure.

Additional benefits of an off-site solution

- the perimeter channel has threaded inserts pressed into the frame during the manufacturing process at predetermined spacing saving set-out time for the builder and eliminating the risk of measurement errors
- the engineered lifting points which are established using the software are also pressed into the frame eliminating the need to set these out. Reinforcement bars connect the lifting inserts to the slab
- the build process provides repeatability without the need for expensive moulds and flexibility in that any size within the limits of the 3mm thick perimeter channels can be accommodated
- the 'kits' can be delivered directly to the builders factory where the concrete is added in a safe, controlled environment saving on transport costs and giving the builder complete control of his program.

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Case study 9: HMYOI Cookham Wood, Rochester, Interserve Construction

Benefits

Time/cost: Ministry of Justice set a target of 10 per cent cost savings between selection of Interserve and commencement on site. Taking into account value indicators of similar projects, a cost saving of 20 per cent was achieved in relation to Cookham Wood by the time of establishing the agreed maximum price. Collaboration between Interserve and its concrete specialist SSC resulted in a pre-cast volumetric cell proposal for the construction of the project. As a result, the construction programme was reduced from 50 to 44 weeks with a saving of £85,000 in time-related site overheads

Benefits of BIM include improved collaboration and design co-ordination, design efficiencies, and greater benefits for asset management, custodial operation and ongoing maintenance of the facilities

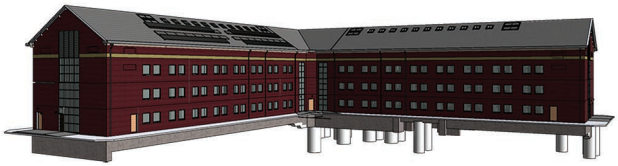
Sustainabillity: reduced wastage in design, materials and on-site production

HMYOI Cookham Wood, Rochester – the first UK Public project to be tendered, built and operated using comprehensive BIM and 6D modelling.

The project

The project, for the Ministry of Justice, comprises a new three-storey houseblock to house remand and convicted juveniles, together with an education facility at HMYOI Cookham Wood, part of the Rochester cluster of prisons.

HMYOI Cookham Wood is also the first 'pilot' Government project to use a Project Bank Account, to ensure efficiency of payments through to the supply chain and SMEs.



The houseblock will accommodate 179 young people in single cells and will replace existing substandard accommodation, which will be 'mothballed' on completion of the new block. An adjacent new two-storey regime building, which will house the prison's main library, is to provide skills education and training in 15 classrooms and workshops. External works include three new fenced exercise yards, access roads and new security fencing. The facilities are being built on land adjoining the existing prison.

Project drivers

The Ministry of Justice have created a collaborative culture to bring together the Consultants, Tier 1 and Tier 2 contractors at the earliest stage and to develop cost savings innovations and improved efficiency prior to start on site.

The Cookham Wood Trial Project combines collaborative working under two stage open book with the adoption of BIM, project bank accounts, off site manufacture and government soft landings. A fully integrated team have worked to a tight timescale to commence delivery on site of a new build Young Offenders Institution that to date has exceeded cost saving targets.

At HMYOI Cookham Wood by building offsite in conjunction with BIM the project has achieved comprehensive information for the design co-ordination phase. In turn, this has given greater confidence and ability to build off site particularly when using a pre-cast volumetric cell system.

Interserve has undertaken £750m modular construction works with the Prison sector over the last 12 years. We have delivered 6,000 prison cells using volumetric modularisation systems – this represents approximately 12 per cent of the total number of prison cells in England and Wales. Across the Ministry of Justice Framework we have reduced programme delivery from six years to 28 months by adopting modular construction.

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Improving project delivery

Terry Stocks

The Ministry of Justice Project Delivery Unit has been implementing BIM with our supply chain partners for almost two years. We have developed benchmarking practice and collaborative delivery processes over a much longer period.

It is essential for us to drive efficiency in what we deliver against a back drop of decreasing budgets. We need 'better for less'. The Government Construction Strategy echoed a lot of what we have been doing and, in addition, requested that all government departments adopt BIM by 2016. BIM for us was a logical step and Cookham Wood became our, and the Government's pilot for BIM implementation.

Project delivery

The use of BIM supports collaborative delivery and improved stake holder engagement. Emily Thomas, Governor HMYOI Cookham Wood said: "For the first time I could understand a building design. It allowed me to contribute and comment (both positively and negatively) for the first time rather than having to look at a flat drawing."

Client and constructor team working commenced at an earlier stage using the BIM model as the focal point.

The Cookham Wood Project has been independently monitored and shown to have achieved a 20 per cent reduction in the cost of delivery.

The project has initiated the development of standard BIM libraries of solutions, fed into the development of new working practice across the office with all major projects now using BIM exclusively. Smaller refurbishment projects are now also using BIM where practicable.

Cookham Wood and its use of BIM together with government soft landing principles provide an easy fit and enhanced our continuous improvement model. The MoJ is committed to delivering projects more efficiently with less disruption to our operators. Offsite solutions, DFMA designs and improved transparency of delivery are key to us.

Cookham Wood has shown how all this can come together and produce results that offer better value, delivered more quickly (through collaborative delivery and transparency – the project end date is always clear), enhanced quality (through BIM and off site factory manufacture with less re-work, and improved inspection of design and structural elements at the right time)

The Cookham Wood project has provided MoJ with a blue print of effective delivery process that is changing the way we do things.

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Case study 10: Kent initiative, Kier

Benefits

Time/cost: to deliver homes to time and at predictable cost

Quality: high level of right first time quality to minimise financial and project risk

A pioneering land deal

Kent County Council, like many local authorities, has a high housing need. They have been considering how the public and private sectors, working together, can support new housing growth through the innovative use – and disposal of – public and private land assets and in securing investment.

Following a review of their land holdings and following market testing of a number of these sites, many were considered unviable for development in the current market. The challenge for Kent was how to utilise the land and deliver new homes whilst ensuring that best consideration was achieved throughout the process.

Three sites were selected to form the basis of the initial tranche and Kier worked up proposals to deliver 152 new homes providing a mix of affordable, intermediate, (homes for sale and rent provided at a cost above social rent, but below market levels) market rent and some market sale. The proposals will deliver higher levels of affordable housing without the need for public subsidy, whilst creating a balanced tenure mix.

Raising finance

Kier will use institutional investment to deliver new homes on land acquired from Kent County Council, under the initiative. The homes will be a range of tenures and will be delivered without government grant.

The use of public sector land within the Kier-Kent model is vital to its success in a world of diminishing public sector finances.

The open market sale housing will be directly funded by Kier using its own internal facilities. The affordable, intermediate market rent will be funded using institutional investment, under a lease for 45 years.

Kier is currently in negotiation with a registered provider who will underwrite the lease for the rental properties for the full term, although this would normally be undertaken by the local authority. At the end of the lease, the reversion value of the properties will be shared between the participants. However in the case of an underwriter

from a local authority, it is anticipated that the majority of the reversion value will go directly to the council.

Kier undertake to secure all consents for planning and to deliver the units to practical completion under a turnkey package, receiving payment from the fund on completion.

The model is both flexible in its tenure and funding options.

Outcome

Contracts between Kier and Kent County Council, in relation to the land deed, were signed on 21 December 2012.

Discussions with funders and a registered provider are ongoing and we expect these to be finalised shortly. Detailed consultation with planners is underway. After detailed planning consent is received, in the spring of 2014 work will commence to deliver all 152 homes within 18 months of the start on site.

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Case study 11: The Leadenhall Building, Laing O'Rourke

Benefits

Time/cost: substantial use of offsite solutions to meet project requirements

Quality: exceptional levels of quality enabled through BIM modelling and factoring manufacture

Sustainability: project substantially delivered through on-site assembly reducing impact on local community

British Land and Oxford Properties understood that the construction of The Leadenhall Building required a sophisticated response to the architecturally inspired engineering that had been designed by Roger Stirk Harbour and Partners with ARUP.

Laing O'Rourke (LOR) demonstrated their understanding of the building with the support of advanced digital engineering models, and devised smart engineering solutions to demonstrate 'surety of delivery' for the creation of a world class asset.

An animated methodology was presented by the team at tender stage to clearly communicate how the building would be delivered to the client. The animation may be found on Youtube and when viewed alongside images of the actual construction on sites such as skyscrapercity.com, it is remarkable to see how many of the concepts and ideas were employed and successfully executed.

Eighty per cent of the project was Designed for Manufacture and Assembly (DFMA), a key feature of the LOR approach that facilitated the extensive use of offsite manufacturing.

The manufacture of the structural steelwork by Watsons was a key element of the prefabrication approach, as was the unitised façade components by Yuanda. Such methods are not unusual for modern construction. However, LOR moved the agenda forward even further by pre-assembling structural steelwork elements with integrated service modules and complete pre-cast floor such as the North Core Tables. LOR's in-house manufacturing businesses, Explore Manufacturing and Crown House Technologies, provided complete modularisation of plant rooms and services risers, and pre-casting of the concrete floor using the first version of their innovative and patented 'e6' system. These new offerings in pre-cast and services components were made in factories based in the East and West Midlands respectively.

By focusing on the key critical path elements, particularly those necessary for commissioning, LOR were able to de-risk the project's delivery more safely, and without compromising on the architectural or structural ambitions.

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Case study 12: Bond Street programme savings, LU

Benefits

Time/cost: faster installation of frame with positive implications for programme

Quality: consistent compliance with standards and specifications

Sustainability: less waste, reduced transport to site

Health and safety: reduced number of operatives on site

Applying off-site construction techniques to LU stations

After 150 years in operation LU still faces the same challenges associated with an ever growing demand for transport services. To solve these challenges LU is focusing on innovative, quality solutions that maximise value added. As a testament to LU's commitment to off-site construction opportunities within the future stations upgrade programme, a feasibility study has been conducted to explore opportunities and perceived benefits of utilising off-site solutions. The study presents a guidance table for applying off-site construction techniques across the LU stations and reports on the maturity of existing off-site products within LU and the supply chain.

Bond Street Station case study

LU is currently underway with a considerable upgrade programme to increase capacity, reduce passenger journey times and improve overall reliability of our assets and services. At present LU is in the delivery phase for three major station upgrade projects with numerous more projects in the future stations programme.

Bond Street is one such station upgrade project currently in the delivery phase. 150,000 passengers use the station daily with a forecast 45 per cent increase in daily passenger use once Crossrail is complete in 2018.

Whilst predominantly designed as a conventional on-site construction project, in order to optimise the Over Site Development (OSD) delivery programme, the project has embraced a 'buildoffsite' construction philosophy. To optimise the OSD delivery certainty and de-risk the programme the contractor developed an alternative prefabricated OSD design. This provided significant health and safety, environment, programme and quality savings.

The original OSD *in situ* frame design was adapted to comprise pre-cast reinforced concrete columns, steel Deltabeams, pre-cast concrete floor slabs and structural *in situ* RC walls. This alternative 'buildoffsite' design was split into two key phases. The first 'temporary' phase excluding some beams and slabs in the first and second floors to enable access for a gantry system to facilitate the tunnelling works. In the second 'permanent' phase the building would incorporate these structural elements once tunnelling works are completed. The realised benefits to the Bond Street project were as follows.

Health and safety

- reduction in overall time and number of operatives on site
- reduction in the need to install and strike temporary framework on site
- reduced risk of accidents on site in consequence of fewer construction components and associated movement of materials, plants, and tools.

Environment

- more efficient use of materials in controlled factory environment producing less waste
- reduced transport in the form of deliveries to and from site.

Delivery programme

- manufacturing off-site removed work elements from the site delivery programme which would have consumed valuable site space and resource
- the erection of prefabricated steel elements for the frame was substantially quicker than the original *in situ* design
- the constructed frame was able to take the loads of the gantry system quicker than conventional *in situ* construction.

Quality

- prefabricated elements are manufactured in controlled factory environment
- consistent compliance with standards and specification
- highly skilled resources producing standardised products.

Next steps

To achieve the objectives outlined in the LU feasibility study, offsite construction is being included as an efficiency work stream within Station Asset Group Strategies along with the creation of an offsite construction knowledge repository. An in-depth 'offsite approach' study will also be undertaken to assess the quantification of value within future station projects.

Additionally, the LU Offsite Steering Group are developing a campaign to raise awareness of our report and findings through a series of articles and presentations within the business and externally within the Buildoffsite community.

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Case study 13: Thames Valley Free School, Reading, McAvoy

Benefits

Time/cost: faster construction time

Quality: High quality of design and finish to meet client requirements

Sustainability: reduced waste, reduced impact on the local community

Client: National Autistic Society

The project

Custom-built classrooms built for special needs children, which include design-led elements aimed at nurturing and encouraging educational development. The project for the National Autistic Society included mechanical, electrical and landscaping packages.

The brief was to construct the school building for children with autism. The eight classroom, two storey facility also needed specially assigned and general use areas,

catering and staff administration accommodation as well as welfare facilities and circulation space.

McAvoy's experienced off-site construction team manufactured the 65 steel framed modules needed for the project at their production plant in Northern Ireland. As the principal contractor, McAvoy co-ordinated and managed all aspects of the project.

The building was designed over two floors to create a separation between the primary and secondary school as well as provide 'chill-out' space and calm rooms to help reduce anxiety among pupils. Specialist classrooms catering for subjects such as art, science, food technology and design technology were also created as part of the overall accommodation. The 50 pupils, who have extremely challenging behaviour and complex needs, also needed a dedicated entrance to access the school. Other features include individual tutor rooms, soft play and sensory rooms and a skills base where pupils will learn independent living skills.

An open day which the pupils and their families attended allowed the children to witness the units being delivered ready to begin the construction of the new school.

This was important for all involved to see first-hand the sophisticated nature of the build and to take ownership from the outset.

Challenges faced by the team included demolishing an existing school on site and asbestos removal as well as working with live utilities and crossing the site to service another school.

The project was completed in a much shorter time than would have been the case if traditional site based construction methods had been used. The project was delivered within budget.

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Case study 14: Churchill Special School, Haverhill, Suffolk, McAvoy

Benefits

Time/cost: a complex project delivered within budget. Faster delivery than would have been possible using traditional construction methods

Quality: high quality design and finish to meet client requirements

Sustainability: minimal disruption on site

Client: Samuel Ward Academy Trust

The project

The team from McAvoy constructed the 2,100 sq m school for the Samuel Ward Academy Trust with minimum disruption on site. The SEN school will accommodate 70 pupils aged eight to 18 providing specialist education for children with autism and other communication and language difficulties. The high specification build has separate accommodation for primary and secondary pupils with a variety of classrooms. McAvoy was also responsible for landscaping, turning and parking areas as well as play areas.

Using off-site construction technologies and modern construction methods to deliver educational facilities within a reduced time frame ensured that the challenging project was delivered successfully within time and budget.

Bespoke classrooms and welfare facilities were requirements at this purpose-built school. The highly specialised needs of the pupils required a spacious layout with good accessibility inside and out. The site had to be fully landscaped in a way that did not stop light reaching all the classrooms or impede access.

Parking and play areas also had to be well designed to accommodate both pupils and staff without affecting access to the school or interfering with the landscaping process.

McAvoy Group timed their deliveries to avoid peak operational times at the school. Total segregation between pupils from both schools and the team was maintained at all times.

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Case study 15: Doing more for less, Mott MacDonald

Benefits

Time/cost: 20 per cent faster build without delays due to extreme weather

Quality: improved performance in use

Sustainability: reduction in materials

In Ontario, Canada, continent-first use of pre-cast, ultra-high performance concrete elements enabled construction of an unusually slender bridge, 20 per cent faster than normal and better able to withstand extremes of climate.

"The Hodder Avenue project is proof that the extensive use of UHPC in a modular construction project delivers versatility, durability and design excellence" (Precast/ Prestressed Concrete Institute)

Just outside the city of Thunder Bay, Ontario, a CA$9M new bridge was required to carry Hodder Avenue across the six-lane Highway 11/17 – a strategic transport link that carries up to 10,000 vehicles every day as part of a CA$2.4 billion repair and expansion project.

But the challenges faced were far from simple:

- **extremes of climate:** temperatures can plummet from an average of 24°C in the summer to lows of -58°C with wind chill in the winter
- **corrosive de-icing salt spray:** applied to the roads throughout the bitter winter months, the chlorides in the salt can penetrate concrete infrastructure and attack steel reinforcement, weakening the structure
- **maintenance:** checking, maintaining and repairing the bridge could disrupt the busy highway below, so keeping these operations to a minimum is critical
- **construction window:** the new bridge had to be installed around the biting winter, which made concrete pouring on site all but impossible.

For speed of construction and quality assurance, pre-cast construction was the natural choice. However, the client, Ontario Ministry of Transportation, stipulated that the bridge needed to be aesthetically pleasing because it would become the first sign of the city that approaching visitors would see.

Creating the sleek look that the client had in mind with the pre-cast method required close attention to detail and innovative use of materials. The conventional approach would have been to use pre-cast girders with a cast-in-place deck, using high performance concrete, and would usually take at least six months. To reduce the typically bulky look of pre-cast concrete bridges, many of the components we specified were made from prestressed, ultra-high performance concrete (UHPC) which, at 200MPa, is four times stronger than concrete normally used in structural applications.

The combination of prestressing and high strength concrete allows the components to be put under high pre-compression during fabrication, which creates stronger and more durable structural elements. By working closely with supplier Lafarge, it was possible to design elements

much more slender than conventionally possible, without compromising structural capacity.

To create a smooth visual line from end to end, the inverted T-shaped pier cap beam was embedded in the superstructure. This component sits across the vertical pier columns, locking them all together into a strong central structure. Each of the two spans of the structure is formed of 16 concrete box girders laid side by side. Girder ends sit on the lips of the T-beam at the centre of the bridge, and on pre-cast UHPC abutments at either end. The piers, pier cap beam and girders were bonded using in situ cast UHPC to create a monolithic structure that carries load in a two-way action – longitudinally between the girders as well as transversely between the pier columns.

As well as its superior strength, UHPC is almost impervious to water penetration, a vital factor in protecting the bridge against the area's harsh winters and de-icing treatments. It was realised that designing the bridge piers completely from UHPC would be cost prohibitive. The solution was to create a UHPC outer shell for each column. This acted as formwork for *in situ* poured high performance reinforced concrete cores and, in the long-term, provides a protective suit of armour against the elements.

Using UHPC allowed for a reduction in the number of piers from four to three, saving materials and build time and better meeting the minimalist aesthetic goal of our client. The use of UHPC for the joints helps assure the bridge will achieve its 75 year design life.

The project is the first in North America to incorporate pre-cast UHPC pier caps and pier column shells, together with pre-cast high performance concrete box girders, abutment caps, ballast walls, parapet walls, slope paving panels and approach slabs. The solution led to the project winning a raft of accolades, including the Precast/ Prestressed Concrete Institute (PCI) Harry Edwards Award for industry advancement.

The unusual nature of the project required significant collaboration between our design teams, contractor Teranorth and UHPC supplier Lafarge, to ensure a seamless fabrication and construction process that lasted just five months. The overall schedule was cut by 20 per cent compared with conventional construction techniques.

"We are extremely proud of the finished structure," says Ray Krisciunas, head of bridge engineering at the Ontario Ministry of Transportation. "The use of UHPC enabled us to achieve our intended objective of an open, aesthetically pleasing and welcoming bridge which was also economical and durable. It will now form the baseline design for other planned overpasses."

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Case study 16: 'The Spine', Birmingham New Street, NG Bailey

Benefits

Time/cost: rapid construction on site. The project was delivered in just eight weeks with no disruption to services and no inconvenience to passengers

Quality: a right first time solution that delivered exceptional value to the client. Use of a comprehensive BIM model ensured highly accurate 3D modelling, precise Bills of Materials and the adoption of a precise logistics plan for delivery and installation

Sustainability: reduced number of personnel on site. The project required an installation team of just eight. Health and safety planning was enabled through the use of the BIM model

The project

Transforming Birmingham New Street Station generated unprecedented challenges and demanded innovative engineering solutions.

NG Bailey was tasked with replacing the station's 'engine room' which carries all the mechanical and electrical services to each of its 12 platforms.

The age and infrastructure of the 19th century station ruled out traditional onsite construction, which would be beset by safety problems, prove costly in terms of onsite hours and – crucially – inconvenience travellers.

NG Bailey's specialist offsite manufacture division engineered a viable solution – designing and building a set of service modules that harnessed the benefits of offsite manufacturing.

Nicknamed 'The Spine', it measures seven metres wide, three metres high and 126 metres long – weighing 300 tonnes. Spanning the width of the station, it consists of 11 modules and five risers linked together – with zero day-to-day disruption to passengers.

The most complex challenge was the weight of the modules. Delivered in 24 separate sections, each weighing more than eight tonnes, they were too heavy for the station floor. To get round this, NG Bailey created a temporary lattice frame, which took the weight of the modules as they were craned over the tracks and installed on site.

The project:

- broke new ground in the way it maximised innovation and minimised disruption
- demonstrated the increasingly important contribution that an offsite solution can bring to quality, safety, efficiency, client value and to the bottom line
- accelerated the timetable from contract award to completion
- took environmental sustainability to new levels with 'The Spine' having a design life of 60 years
- improved health and safety by having fewer people working on site – average labour force was just eight
- lowered our carbon footprint by reducing waste and mileage to and from the site

- delivered exceptional value to the client
- the project demonstrated NG Bailey's innovative approach to engineering with the offsite solutions delivering substantially reduced installation time and shortening the overall project length – resulting in both time and cost savings for client Network Rail.

The project took just eight weeks to complete and was delivered within the £2.7m budget. It was also delivered with no disruption to services or passengers, ensuring no lost revenues, fines or complications for Network Rail.

Critical to the success of the project was the use of offsite solutions and BIM technology, which NG Bailey embraces on all offsite projects, enabling it to create 3D models with pinpoint accuracy. The model generated a Bill of Materials (BoM) identifying every component and cost. It also weighed the modules precisely, shaping a logistics plan to ensure a successful delivery and installation.

Overall, the project demonstrates how NG Bailey's approach created a solution that benefited the client, passengers and the train operators – all within the agreed budget.

The Spine was the biggest offsite manufactured service solution the company has created and positioned us as best-in-class. We have already delivered and been commissioned to deliver further offsite solutions for the rail sector on the back of this job.

Success needed the buy in and cooperation of stakeholders. Strong supply chain relationships were nurtured and maintained throughout. This ensured any issues were tackled immediately so nothing was left for those on site to solve.

The client's view

Chris Montgomery, project director at Network Rail, said: "The 'Spine' project demonstrates NG Bailey's bold and pioneering approach to engineering and clearly highlights the benefit that BIM and offsite solutions can deliver."

"Their engineering skills ensured passengers and trains remained undisrupted. The team also managed to shorten the overall project time, creating time and costs savings for Network Rail."

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Case study 17: Using offsite construction methods to deliver for Arla Foods, NG Bailey

Benefits

Time/Cost: 40 per cent faster installation of service distribution corridor compared to traditional methods plus accelerated delivery of the energy centre

Quality: quality installation ensured through the use of 3D modelling

Sustainability: reduced vehicles on site and significantly reduced levels of waste materials

Arla Foods' new £150m flagship dairy in Aylesbury, Buckinghamshire, is one of the biggest in Europe and with plans for it to be the first ever zero carbon milk processing facility, it will be one of the most environmentally advanced in the world.

It is also the world's first dairy with the capacity to process one billion litres of fresh milk a year.

Off-site construction proved instrumental in the construction of the dairy, with NG Bailey playing a crucial role in its development. By using off-site construction methods, NG Bailey delivered the dairy's main services distribution corridor project in just five weeks – compared to the usual 12 weeks it would have taken using more traditional construction methods.

Off-site methods also helped deliver sustainability benefits by reducing site traffic and material wastage during construction.

The company was contracted to provide all mechanical and electrical work, as well as facilities management services, at the next-generation dairy, which spans a 70-acre site at Aston Clinton.

Completed over two phases, the initial stage involved the development and construction of the dairy's main services distribution corridor. To meet the brief, NG Bailey incorporated a variety of innovative methods into the design, which included special pipework made from modern and progressive materials such as thin-walled stainless steel.

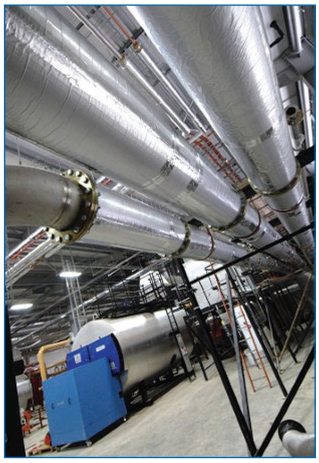
When it came to the corridor's construction, in line with Arla's commitment to use the best available construction

techniques and the most advanced technologies available, NG Bailey utilised off-site manufacturing techniques to create 17 prefabricated modules, in order to deliver the project as quickly and efficiently as possible. These modules were bolted together on-site to form a 204 m run of main services for the new dairy. This equates to close to 70 per cent of the total main services distribution required to operate the dairy.

Each module at the Arla site contains all process piped services including:

- chilled water
- low temperature hot water heating
- steam and condensate
- process ice water
- glycol circuits.

They also include high and low voltage distribution, and separate containment runs for data and building management system control cabling. Pre-wired lighting trunking with plug-in rockrose connections were also included in every module. This enables the light fittings,



which will provide the corridor lighting, to be easily installed.

The second phase of work saw NG Bailey deliver an innovative, high-specification purpose-built energy centre, using off-site manufacturing techniques and 3D modelling. Providing a bespoke service to Arla, the energy centre measures 90 m long by 60 m wide – equivalent to 20 tennis courts – and will generate the services required to operate and support the dairy.

The purpose-built energy centre includes steam and low-pressure hot water. Utilising the waste heat from two combined heat and power plants, it can produce more than 14 mega-watts of connected heat output, which is enough to heat more than 2,000 homes.

In addition, ammonia refrigeration provides iced water for the process and cooling of HVAC loads. This delivers more than 7.5 mega-watts of cooling capacity – enough to cool 150,000 fridges. Power equivalent to operating 130,000 televisions is provided by the 11KV sub-station, which generates an electrical load of 6.5 mega-watts for the energy centre alone.

Six heavy duty plant skids, six high level multi-service frames and two heavy duty, floor standing, multi-service frames were also used in the construction of the energy centre. The second phase of NG Bailey's work was installed by a team of two operatives in less than two weeks.

Following the completion of the Arla dairy, NG Bailey's Facilities Services division will now maintain the site for the next 15 years.

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Case study 18: LCC Children's Services – Roundhay School, Premier Interlink

Benefits

Time/cost: fast overall construction time

Quality: high quality, right first time construction

Sustainability: minimum disruption on site

The scheme consists of a new Primary School Campus for 4 to 11 year olds, developed as a second site for Roundhay School to extend their overall age range from 18 years down to 4. This former school site on Wetherby Road lies within the Green Belt and also falls within the Roundhay Conservation Area. A key feature of the site is the difference in levels across the site, which slopes up from Wetherby Road.

The new building with a floor area of 1453m provides 14 classrooms, one large hall, one small hall, a learning resource centre, design and technology space, group rooms, office and staff areas, storage, toilets and kitchen and plant areas.

Members' featured projects

The school is planned over two storeys with an approximate 7.5m to the eaves and 9m to the ridge. The double height volume is repeated in the main hall space.

The 106 steel-framed modules used for the project were manufactured and fitted out off-site at Premier Interlink's modern manufacturing facilities in Brandesburton, East Yorkshire.

The modules were then delivered by road, craned into position and assembled on the prepared site for final fitting out. This modular method of construction has provided the highest quality, energy efficient educational facilities in the fastest possible time with minimal site disruption for the pupils, staff and visitors. Factory manufacturing took 10 weeks with site assembly and completion taking 37 weeks.

The end result altered the age range of the school, making Roundhay School one of Leeds City Council's first two form entry schools, providing education for a child from the start to the end of their school career.

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Case study 19: Nursery facility – Ewell Castle School, Surrey, Roan Building Systems

Benefits

Time/cost: faster construction. Effective solution to restricted access to site

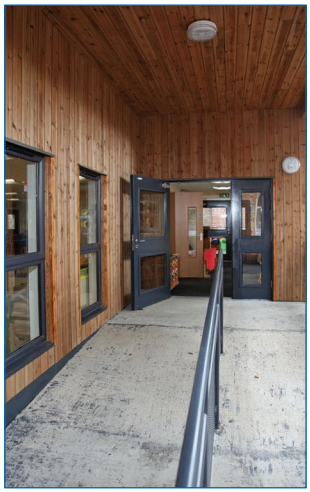
Sustainability: reduced waste on site

The project

Roan was appointed directly by the client to undertake the works to replace their existing nursery building. The site itself posed many challenges, in particular the tight access and removal of materials from site. With only a small window of opportunity over the summer holidays the scope of works included the demolition and disposal of the existing nursery, delivery and installation of the modular units and roof system and the associated landscaping and connections.

The building is situated in a conservation area with many protected trees in close proximity. Regular liaison with the neighbours and school ensured a smooth construction process. The building was open plan with a sliding partition, dimmable lighting and spotlights for performances integrated in the suspended ceiling. Children's and accessible WC facilities and storage for all the nursery equipment were included as part of the project.

Project date	Order to completion	Project size	Project value
Summer 2013	12 weeks	278 m^2	£340k



Case study 20: Atlantic Yards project and flying factory initiative, Skanska

Benefits

Cost/time: construction is 30 per cent faster than traditional construction. Cost savings of 10 per cent

Quality: very high quality of finished units. Engineering industry level of accuracy for module manufacturing

Sustainability: reduced vehicle deliveries to site. Only 30 people working on site at any one time. A module manufacturing factory designed for relocation and reuse

FCS Modular has been established as a joint venture between Forest City Ratner, Skanska and Arup to develop the Atlantic Yards Project in Brooklyn, New York. The development plan is to construct eight buildings over a number of years to provide 4,000 new apartments for mixed tenure occupation. The project site already features the Barclays Centre Sports Facility with B2 being the first high rise apartment building to be constructed on the site using the innovative modular construction system developed by FCS Modular.

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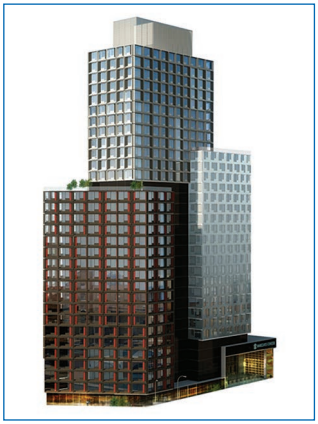
Members' featured projects



B2 is a 32 storey block providing 363 apartments all constructed from steel frame modules. The modules built to a very high level of accuracy were fitted out in a locally established facility prior to delivery to site for final assembly into the structural steel frame. Pre-construction started in December 2012 with modular pre-production commencing in July 2013. The modules were constructed in 32 weeks. The project will complete in summer 2014. Future phases of the development will rise to 80 storeys with the innovative modular system capable of achieving 100 storeys.

The Atlantic Yards B2 building will be the world's tallest volumetric modular residential development.

Key innovative features incorporated into the project include the module to module jointing solution, the factory fixing of cladding and the incorporation of lift shaft and staircases within the modules – eliminating the need for a structural core. No concrete was used in the construction above ground level and no hot works were used on site. The project construction methods allowed for fast onsite assembly delivering approximately one floor a week and employing on-site workforce of less than 30 people.

The project will be delivered 30 per cent faster and will deliver cost savings of 10 per cent. Eighty per cent of the building will be delivered offsite.

B2 is a prototype development for the subsequent phases.

The manufacturing facility was itself constructed in six months with the capability to be dismantled in 10 days

and relocated to serve the next project. This is the 'flying factory' concept that Skanska has been developing.

Skanska is now looking to exploit the learning in the UK including identifying a UK supply chain that can meet the project requirements for quality and flow that have been demonstrated at Atlantic Yards.

Skanska has developed an innovative idea – modern flying factories – which can reduce costs, speed up construction, and cut the impact on the environment. They can be used to help build low or zero carbon buildings.

A modern flying factory is a fabrication assembly facility which can be set up close to the construction site. Skanska view it as an extension of the construction site but enhanced with the benefits of a controlled factory environment. The factory is used to assemble raw materials into components and panellised systems for installation on site. This approach reduces transportation and the amount of waste, and supports the employment of local labour. The idea was developed by Skanska in conjunction with a number of other organisations including Modcell, sustainable, prefabricated straw bale panel construction specialists.

Classroom extensions at May Park and Glenfrome primary schools in Bristol were built by Skanska using modern flying factories. This approach secured programme efficiencies in excess of 30 per cent compared to traditional techniques. It also enabled the delivery of additional primary school places for the local council.

This is part of a grant-funded project led by Skanska's innovation team incorporating an integrated supply chain, technology and lean techniques to make the process as efficient as possible. The whole process links into and is underpinned by building information modelling.

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Case study 21: Using BIM to promote health and safety, Skanska

Benefits

Time/cost: shorter build programmes at lower cost

Quality: improved quality and performance in use

Health and safety: BIM enabled safety planning

We use BIM and offsite manufacturing to improve safety as a priority and create an injury-free environment.

Using integrated BIM we can fully co-ordinate services on a 'just in time' basis to ensure that we minimise on site work and maximise work process through our collaborative planning process. Clearly the co-ordination of different trades is a safety issue on site and through BIM and offsite manufacturing we can reduce labour on site by up to 20 per cent.

On our Viaduct project in the Borough market area of central London; the utilisation of BIM allowed us to fabricate the bridge off site and we also performed the

onsite assembly in virtual reality before getting to site.

As a result the bridge was positioned late at night and did not put the general public at risk.

The central London area of the project also had major impact with the general public in many different aspects on a daily basis and interface and refurbishment of listed buildings was a major challenge. We used Virtual Utilities mapping to check existing underground services and this information was fed into the BIM model to drastically reduce the need for excavations.

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Case study 22: Student accomodation, University of Essex, Colchester, Stewart Milne Timber Systems

Benefits

Time/cost: 19 four-storey student accommodation blocks delivered in just 11 weeks

Quality: high quality construction to meet client requirements

Sustainability: use of prefabricated structural frame, floor cassettes, stairs and bathroom pods minimised waste on site

In November 2012, Stewart Milne Timber Systems began work on a new £65m student accommodation project for the University of Essex at its Colchester campus.

Designed to BREEAM Excellent standard by Lewis Hickey Architects, the site comprises of 228 bedrooms across 19 four-storey townhouses.

Stewart Milne Timber Systems was selected for the timber frame contract, which is part of a wider project

known as 'The Meadows', part of the University's Knowledge Gateway site.

Keen for high-quality, simple and fast to build, energy efficient and cost effective student accommodation, the university placed an emphasis on using innovative building materials and systems.

Timber was a natural fit for this as the lowest carbon embodied commercially available build system around. Timber can reduce the embodied carbon dioxide of a building by up to six times compared to other materials.

By adopting a fabric first approach over the course of the build programme, Stewart Milne Timber Systems supplied and erected Sigma® II pre-insulated closed panel build system which achieved a U-Value of just 0.23 W/m2K, representing a low level of heat loss and maximising energy efficiency. Additionally, the project achieved Y-Values between 0.05 and 0.06 as well as an air tightness of three.

For student accommodation projects, speed of build is an important factor, and it was crucial to the university that the accommodation was built in time for students arriving for the new academic year. Stewart Milne Timber Systems delivered 19 four-storey units in only 11 weeks, significantly quicker than projects delivered with concrete or steel frame systems.

The timber frame was erected using a mobile crane, with prefabricated bathroom pods pre-assembled floor cassettes simultaneously loaded into place which helped maximise productivity and kept waste to a minimum. In addition, Stewart Milne Timber Systems manufactured, supplied and fitted fire retardant, class O treated stair flights as the building was erected.

With tight budgets a perennial feature of the higher education landscape, it's important to be able to demonstrate that you can deliver excellent energy efficiency and sustainability credentials without impacting

on the cost of projects. Stewart Milne Timber Systems' work with the University of Essex demonstrates well that by adopting the Sigma® II Build System, and by taking a fabric first approach, it's possible to have one without impacting on the other.

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Case study 23: Building London Bridge Station with BIM, Tekla

Benefits

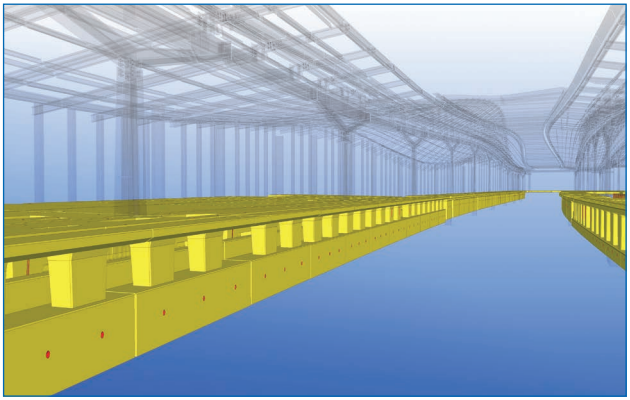
Time/cost: enabled by BIM model the optimisation of offsite and standardisation delivered significant programme and cost benefits

Quality: high degree of accuracy leading to time and cost savings

London Bridge Station, built in the 1830s is one of the world's oldest stations and is currently undergoing a refurbishment as part of the £400m redevelopment of London Bridge train station and will be the foundation of the UK Government's £6 billion Thameslink rail network improvement programme.

The centre-piece of the new station design is a huge street-level concourse, 70m × 150m, and will increase the space by two-thirds, providing new retail and station facilities that will unify the station for the first time with access to all platforms from one place.

While the London Bridge project has many different components, at least three of them – the canopies, platforms and concourse columns – all used the benefits of Building Information Modelling (BIM) and offsite construction to help complete each respective aspect of the project.



Station canopies

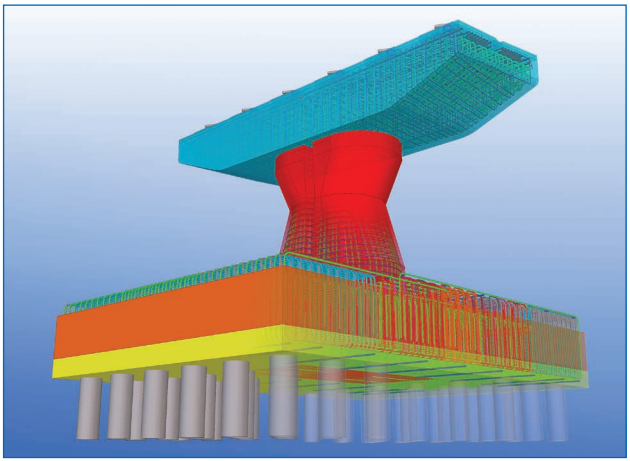
The London Bridge canopies consist of a series of plated columns, spine beams and Y-shaped arms. These columns support a series of roof cassettes made up of the varying shaped rafters and associated beams and cold rolled sections which can be delivered to site as one assembly. Working on behalf of Severfield-Watson Structures, sub-contractor MBSI Detailing utilised the architects geometry to describe a series of cross sections with parametric properties which were then used to calculate the positioning of standard components in the Tekla model therefore minimising the amount of differing pieces of steelwork. The programme constraints meant the opportunity for modularisation and offsite methodology was maximised.

The steelwork construction model was regularly shared with the main contractor, Costain and the rest of the design team for co-ordination. The models became a central part of meetings and were regularly used as a communication tool to resolve conflicts in design.

Station platforms

The refurbishment of the London Bridge Station will require more than 4,000 pre-cast concrete elements of platform structure manufactured offsite and engineering consultant Waldeck Associates Ltd was brought in to produce the engineering drawings on behalf of pre-cast concrete manufacturer Charcon Specialist Products.

To date, they have provided information for the prototype area and the detailed stage 1 construction and manufacturing drawings of the project, which is being used to enable assessment of the constructability,



maintenance and co-ordination of drainage and electrical services to the platforms. Having the structural steelwork model available meant Waldeck were able to fit the pre-cast platforms accurately around the canopy columns in their Tekla model. By using their early conceptual models delivered at the tender stage and evolve them into manufacturing models shaving six weeks off the programme and go to manufacture ahead of the planned date.

Column reinforcement

The London Bridge project involves a total of 24 concourse mega columns to be installed into the station to support the line decks and Midland Steel Supplies, a specialist reinforcement steel fabricator hasd been tasked with detailing and engineering the various elements of the columns.

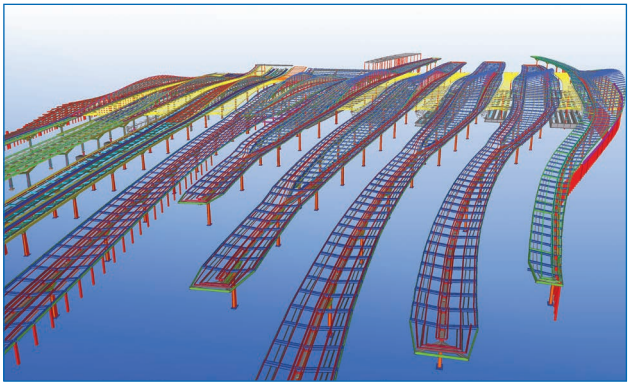
The columns and crossheads involved on the project are extremely complex in design and every reinforcing bar is unique while also all being on different planes meaning the BIM model became an invaluable visualisation tool.

To achieve the accuracy on this in both detailing and engineering, Midland Steel shared information primarily through BIM deliveries from the models developed in Tekla.

The cages for these columns were sent directly to the cut and bend machinery directly from the Tekla 3D model eliminating any potential human error and then prefabricated for delivery to site and installation. Throughout the project Midland Steel used BIM processes to prevent clashes between reinforcements in the column and also with other trades that needed to also place embedded parts in the columns. By leveraging the information in the Tekla model the company was able to visualise and solve problems with design and fabrication prior to commencement.

Overall, Midland Steel turn spent 20 per cent less time designing and engineering drawings and cost savings respectively. Midland Steel also noted that they saved in the logistics of transporting safely and lifting the elements into position with complete accuracy, resulting in time saved with setting out on site and programme time achieved on the elements approximately 40 per cent.

While the construction of London Bridge Station is still on-going the above cases speak to the complexity involved, from designing through to detailing and construction.



While each are a separate component of the overall project, all used BIM to ensure increased constructability – ensuring each projects was able to be completed as efficiently as possible, both in terms of time and money and all using the benefits of BIM and offsite construction.

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Case study 24: Train care depot buildings, Reading Station, Network Rail, Yorkon

Benefits

Time/cost: 50 per cent reduction in programme

Quality: certainty of performance in use. Reduced cost of maintenance

Sustainability: minimised disruption on site. Opportunity for future adaptation. Reduced waste

"The new depot is located on a track-side site so it was a major benefit to have each building structure and envelope all in place in a matter of days and much more quickly than with a site-based construction solution."

The requirement

Every day over 50,000 people use Reading Station and more than 700 trains pass through it. Passenger numbers are set to double by 2030 and freight business has

increased by 60 per cent – making Reading one of the busiest and most important rail hubs in the country.

The £850m redevelopment of Reading Station aims to improve train speeds as they pass through the station, which was originally designed by Brunel, and to reduce delays while trains wait for vacant platforms or for conflicting train movements to be completed.

Five ancillary buildings were required to form part of the new £54m Reading Train Care Depot for Network Rail.

The solution

Working for main contractor VolkerFitzpatrick, Yorkon provided:

- a three-storey depot administration building
- two ancillary buildings for train maintenance and cleaning staff
- a security gate house
- a further train care accommodation building.

The steel-framed modules for each building were manufactured off site at the Yorkon production centre in York to minimise disruption on this very busy track-side site.

The facilities form part of Network Rail's Reading Area Redevelopment Scheme and are now occupied by First Great Western.

Designed to stringent Network Rail Building Standards

The buildings were designed to stringent Network Rail standards and to meet the specific project requirements. The main office building features an architectural 'butterfly wing' roof and a rainscreen cladding system finished in white with bands of bright green for a distinctive

appearance. The other buildings have mono-pitch roofs and rainscreen cladding in other colours.

The depot maintains and services the existing rolling stock and will provide future capacity for the expansion of the rail network in the South West, which will include the new Intercity trains.

The new 6,500sqm depot, built by VolkerFitzpatrick, is now fully operational, and was moved to the west of Reading Station. The existing depot has been demolished to make way for new lines to accommodate freight traffic which will pass under the main lines to continue through the station area without impacting on other trains. Built with enhancements to allow for future stabling and servicing of electric trains, the depot will provide capacity for 147 vehicles.

Ian Simmons, Project Manager, VolkerFitzpatrick said: "The new depot is located on a track-side site so it was a major benefit to have each building structure and envelope all in place in a matter of days and much more quickly than with a site-based construction solution. This reduced risk and improved safety – key factors when the site is located next to a live rail line. The approach

allowed work to continue inside the buildings in a much safer environment."

The benefits of off-site construction for rail projects

The advantages of off-site construction for transport schemes include:

- programme times reduced by up to 50 per cent for earlier handover and occupation
- reduced disruption with safer, quieter and cleaner construction
- a robust pre-installed concrete floor option for enhanced performance for high traffic areas
- buildings can be easily extended vertically or horizontally and expanded without decanting
- material wastage reduced by up to 90 per cent
- up to 90 per cent fewer vehicle movements to site
- Improved quality and reduced future maintenance
- a high level of design flexibility internally and externally

- improved thermal efficiency for lower running costs and reduced carbon emissions
- greater assurance of delivery on time and on budget.

Yorkon is a market-leading supplier of off-site building solutions across the public sector, which includes transport, airports, health and education. It provides bespoke steel-framed buildings, which are manufactured off site in significantly less time, with less disruption and less impact on the environment. Its projects have been recognised by numerous independent awards and accolades for design, build quality, project performance and health and safety.

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About

Buildoffsite is a not-for-profit organisation wholly focused on the development of UK off-site construction.

Vision: a commercially viable UK offsite industry, achieving national construction objectives, competitive internationally and delivering quality, predictability, value-for-money and a sustainable built environment.

Mission: to bring about a step change in the exploitation of offsite applications in construction.

Governance

Buildoffsite is an independent, Membership based, Membership driven, organisation managed by an executive group drawn from its Members.

Buildoffsite Executive Group

The executive group draws on advice and support from two key Buildoffsite managed groups namely, the client executive advisory group and the direction group. These groups provide direction and insight into the potential opportunities and challenges for the development of the UK offsite industry. These groups have a rotating Membership drawn from the Membership and industry to help support continued development of the organisation and its activities.

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M4I

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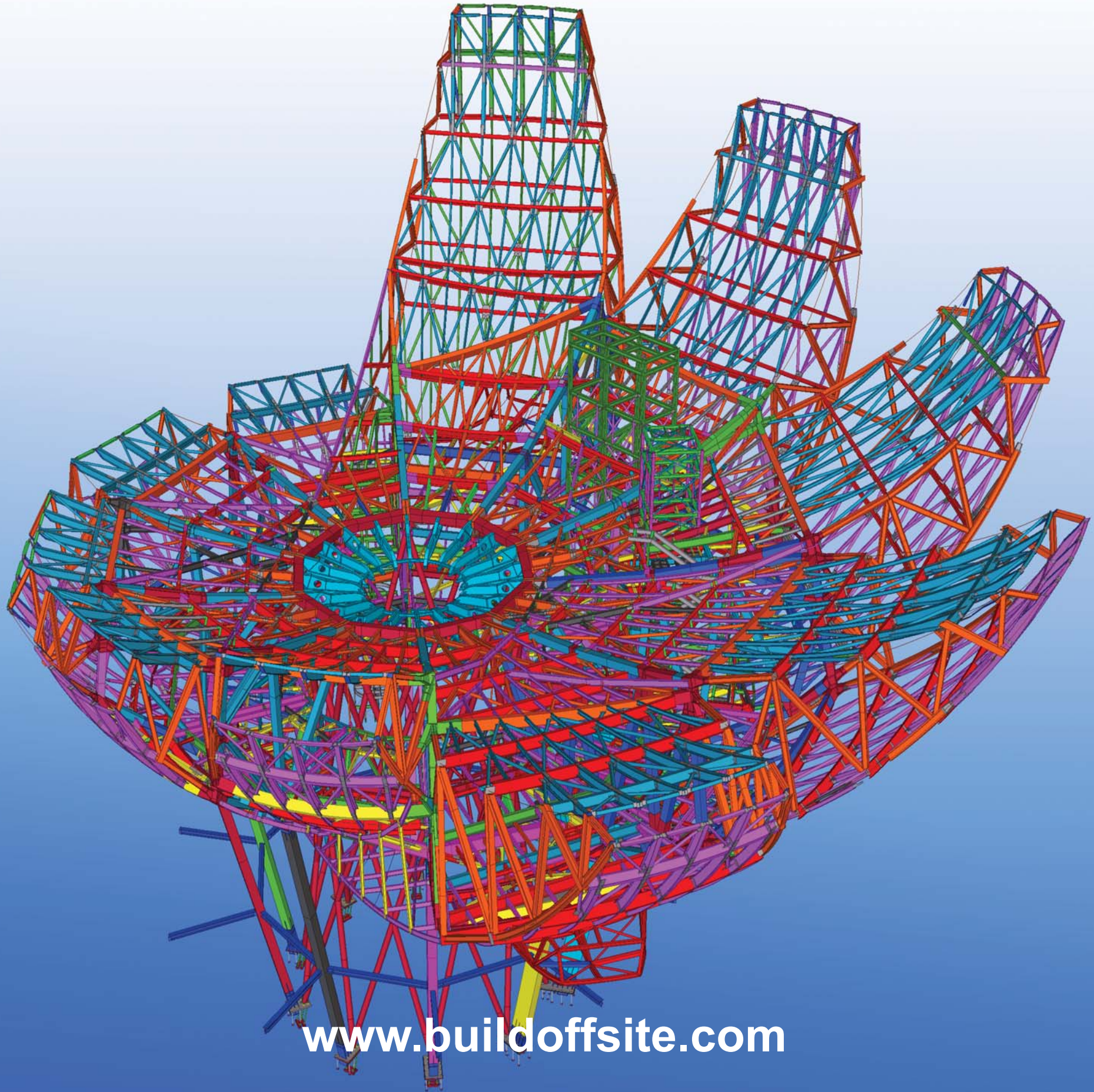

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