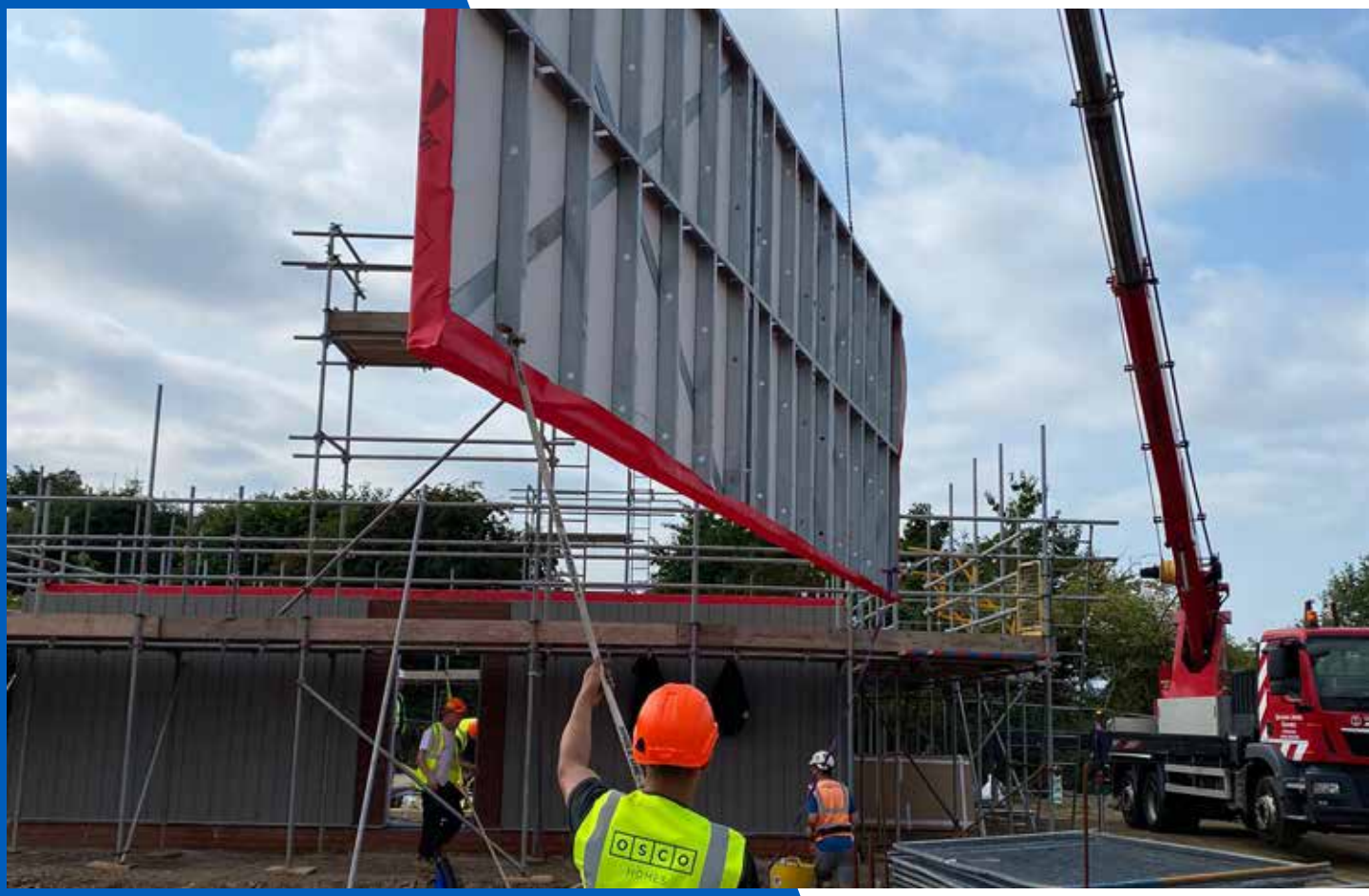
The Future Benefits of Offsite Construction

A WHITE PAPER BASED UPON A ROUND TABLE DISCUSSION



System Solution Providers

Proctor Group

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The Future Benefits of Offsite Construction

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Introduction

As part of the Proctor Group Technical presentations, a round table discussion was held with a group of UK Technical professionals, to look at the future benefits of Offsite Construction and have an open and frank discussion on the sector as a whole.

Executive summary

This report calls upon leading voices from the offsite sector, covering digital design, the building envelope, Passivhaus, building systems, manufacturing, product solutions and the supply chain to consider the future of offsite construction in the UK. Together the panel explores the critical benefits that offsite provides the industry and how this complements and enhances traditional build, improving the performance of efficiencies, sustainability and the supply chain. A summary of some of these benefits of offsite construction is given below:

The benefit of opportunity - a new model to sit alongside existing methods

The future benefits of Offsite construction are positive, but only if those involved capitalise on the opportunities that this can bring. It's a chance for the construction industry to step aside from current construction methods and create a new model with clear rules and governance to run alongside existing methods. It doesn't matter how we package it, offsite, modular, platform, or MMC, we have the chance to embrace quality, repeatability, reliability, accountability, innovation, speed, value and skills.

The benefit of quality

We need to ensure that we're delivering the best possible standard. An example of this can be demonstrated by the approach of Beattie Passive Build Systems. On each build, the aim is to achieve Passivhaus standards as a minimum. All U-values are 0.11, and airtightness is below 0.6. To achieve this requires that the highest quality build is met. To achieve this, all engineers follow standard operating procedures. They're not allowed to move on to the next build stage until a Technical Supervisor has signed the build off to ensure it's built to the correct requirement. This can't happen effectively on site and is a massive benefit of offsite construction.

The benefit of speed

Offsite construction can significantly increase the delivery of new homes and buildings, speeding up the build process and minimising delays on site, through bad weather etc. Offsite construction drives efficiencies within the build process, which aren't possible through traditional build methods.

The benefit of the certainty of cost

Another major benefit of offsite construction is the ability to give price certainty to clients on precisely what the house or building will cost. Because you are working in a controlled environment striving to improve efficiencies, you can guarantee the price and stick to it. The current prices in the UK at present are spiralling and uncontrollable. So this can create a very difficult environment for traditional builds. Those working in offsite construction can maintain prices and give clients certainty.

Reduced waste in the move to net zero

As we move into a NetZero transition economy, offsite construction can offer benefits through BIM modelling and material optimisation and minimising waste material. Offsite can also take full loads of materials instead of buying materials in smaller batches. So offsite can reduce the number of deliveries.

Simplification of procurement and supply chain

The simplification of procurement and supply chain relationships and the benefits of product repeatability within controlled manufacturing environments is a real focus of offsite construction. The supply chain strategy can be kept simple. At Modulous, for example, the aim is to remove duplication and any unnecessary or non-value added margin and have long-term relationships that deliver value and innovation. In construction, there's still plenty of over-complication within the supply chain, such as the more traditional approach of tendering rather than partnering as relationship management. Ultimately, this limits innovation and the sharing of ideas. Modulous seeks to address this, engage more broadly across the industry and collaborate with like-minded people on how to share ideas. How do we simplify things, and how do we optimise? Modulous uses a decentralised model, which effectively means they are asset-light and don't have their own factory. They partner with the supply chain and collaborate, innovating to deliver sub-assemblies and repeatable products. All of this is in a controlled environment that mitigates risk and ensures quality.

Removing the barriers to expansion

Offsite is still a rapidly expanding market because the construction sector is still continuing to expand. Also, offsite construction is a very dynamic form of construction. When we consider the potential of the construction sector to expand, we need to take into account what the restrictions are. What's stopping it from being able to expand or be able to expand quickly and to be able to react? With offsite, many of those barriers are removed, and you're resetting the norm. Let's look at an example using labour requirements. If you needed 15 skilled electricians on the traditional build of a large house, the same project in an offsite or modular factory will need nowhere near that amount. So the labour resource is a benefit, and the training of that labour is far easier to do in a controlled factory environment. So, the benefits of offsite are massive to the entire supply chain, from the top down.

High-performance products for offsite

As a supplier of construction membranes, such as acoustic flooring and high-performance insulation, the A. Proctor Group say that it's important that material manufacturers understand not just how offsite projects are built but how they're designed and how they can add value. How do we mitigate condensation, improve air tightness, and protect the finished product from water ingress and UV transportation? Offsite construction can improve the construction industry, the economies of it, the spatial aspects, the timings of the installs and the building, but most of all, performance. The focus and benefits of high-performance are so important for offsite and offer a great foundation for the future of the UK construction sector.

Learning Points

- Learning and benefiting from repeatability
- Adopting a Passivhaus approach to offsite
- Using offsite to close the performance gap
- How can offsite help us to achieve our sustainability targets?
- Offsite benefits to the supply chain
- Controlling costs through offsite
- The speed and control of a decentralised model
- The suitability of products for MMC
- Offsite manufacture for public sector projects
- Insurance and mortgages for MMC
- Driving the uptake of offsite construction

Learning and benefiting from repeatability

Repeatability is key to the future of offsite construction. Every time we start a new project on a traditional build, we start from scratch. Repeatability allows us to learn what went well, what didn't and why. It allows us to shore up supply chains, by consistently ordering the same parts. As an example, when we use an angle support, we can seek to standardise by finding common repeatable parts. Instead of a designer detailing a 50 x 50 angle and a 40 x 60, you find a size that works in both instances, and then you always use that size. This stops fabricators from making these simple pieces, bespoke to order; they have them on the shelf because the regular demand has been established. If manufacturers like the A. Proctor Group adopted the bespoke manufactured approach their business model would fail, but because they have adopted the repeatable model, it's enabled them to innovate. We just need our industry to realise that this business model is much more sustainable and would undoubtedly help shore up the supply chain.

How does the offsite sector try and move away from outdated modular buildings that are like copy and paste and therefore repetitive? Doesn't repeatability just give us lots of buildings that look the same?

Inherently we want to have a copy and paste structure, but with the internal layout within the building and the actual external facade looking completely different. Modular construction is limited by the size that you can transport. So, the models are likely to be 4.3 meters wide and can be up to 12.5 meters long. So effectively, that means that lots of these boxes are going to be standardised and will be the same, but actually, the end finish and the internal layout can be completely different.

Repeatability could give us buildings that look the same, but is that a problem? Consider the example from the TV series Grand Designs: The Street. It's a development in Bicester, where everybody is given their own plot, and they can build whatever they want. At the program's start, they pan out and show an overview, which looks like a higgledy-piggledy mess. If we then consider cities like Edinburgh, Bath, and Cheltenham, and the rows of Period terraces of all repeatable buildings, they look beautiful, with the same windows or different versions of the same building.

When we think of offsite, we can get too hung up on holiday parks. Holiday parks are an evolution of caravans, which were for a purpose; it was short stay holidays, and it suited. If we get offsite right, then the design elements can be focused on what really looks good. Let's look at quality components, not cheap, easy parts.

So, what is wrong with the concept of copy and paste? It goes back to repeatability. If something works, you know it works, you've got good data, why not stick to it? We do it with cars and aeroplanes, everything is a similar model with a different version. Construction seems to be the only industry that pushes against it. So in my view that says, give me your Period terraced house any day over your Grand Designs: The Street self-build.

Regarding repeatability, we're kind of doing that already anyway. If you look at most of the major house builders and go on to a housing plot with, say, 100 to 150 houses, you'll see repeated buildings. You'll see four or five house types, and they all look the same, so, we're already doing this. There is a different way of understanding this. If we take a module, a panel, whatever it might be, we have flexibility with that. It's not a case of it's a box, it's going to remain a box, and they are all going to look the same. Consider building blocks, like Lego; you can build all sorts of shapes with them. That is where there sometimes seem to be barriers between the market, what's possible and what people believe MMC modular offsite actually is. We are already doing it anyway. By moving to an offsite solution, we can do it even better.

On a new build housing estate, there is repeatability. The way house builders try to do it is often through variations through a kitchen finish or a tile finish. So it's already at the heart of what we're doing as an industry. If we can repeat the core bit, the bit that gives us the structure of the building and then let the architects and designers work their magic on the bits that people see, that's where we can move away from the cookie cutter mentality or the view that people might have of MMC.

Adopting a Passivhaus approach to offsite

How do the costs of passive houses compare to those built using traditional onsite methods?

Research studies comparing the costs of Passivhaus vs Traditional build have been undertaken by Beattie Passive with Chartered Quantity Surveyors, Derek Gough Associates. For the last two to three years, Passivhaus has been more expensive, probably 10 to 15% more expensive than a traditional build. But now, with the rising costs of traditional build, the latest findings show that Passivhaus is comparable and, in some places, coming out cheaper than traditional. So, that is a massive shift where Passivhaus is comparable or, if not cheaper, and is also delivering Passivhaus Net Zero to achieve a much better product.

Will the number of projects requiring Passivhaus significantly increase over the next few years compared to net zero requirements in offsite projects?

There is a drive to Passivhaus. To achieve Passivhaus standards is a bit clearer than achieving net zero. Everyone's got a different opinion of what Net Zero is, whether it's in operation or whether it's in build or how that's actually created. Passivhaus is a set of principles, a set of standards that you either achieve or not. There is a massive drive in Scotland to make all of their buildings Passivhaus standard. Trying to achieve this in an offsite manner is difficult, but it is achievable. It's making sure you design correctly and test correctly.

How do you avoid or deal with overheating and Passive House buildings?

Overheating can be a concern in Passivhaus buildings, but it's about designing correctly from the outset. As soon as Beattie Passive get a project, they carry out a Passivhaus planning package PHPP, and that will determine whether there's any chance of overheating. If there is, they can incorporate shading on the building or set the windows further back within the envelope. Generally, these modular items are relocatable and can later be moved to a different site. Another example is the use of sun tint windows, which stop the solar glare and the amount of heat attracted and reduce overheating.

It's all about planning and designing at the early stage to make sure that overheating doesn't happen. Generally, in a passive house, you should live at 21 degrees all year round. In very high-temperature conditions, it can vary slightly, but you can do night purging where you open your windows to let the building cool down.

Using offsite to close the performance gap

Can offsite construction improve the performance gap between what is designed and what's achieved on-site?

Currently, there's a massive performance gap between what is designed and what is achieved on-site. There's a study done by the New Economics Foundation (NEF) about house building. The study examined the houses built by 100 housebuilders supposedly designed to meet building regulations. During the research, they did a test on every property, and none of them achieved building regulations. It's shocking to consider the gap between what was designed and achieved on-site. So, offsite has a massive role to play.

Offsite provides a quality-controlled environment that ensures good quality and ensures the standard is met. Testing can be done at the right time, with tests in the factory, air testing, thermal testing, and structural testing, and then additional air and thermal tests can be carried out once it's got to the site. This way, we know that what's produced in the factory and what's delivered on site are exactly the same. If there is an issue, then it can be put right immediately. In addition, there are also the procedures of BOPAS (Buildoffsite Property Assurance Scheme) and ISO 9001. The offsite industry is being pushed to follow these really strict procedures that just aren't followed on site. That will inevitably improve the performance gap between what is designed and what is delivered.

Another thing is monitoring, and including monitoring within buildings is key. We don't monitor enough, so we never really get enough real data about how buildings are performing. Beattie Passive installs monitoring into every building that they construct. The industry will be moving that way to obtain real data on how the buildings are performing.

On the subject of testing, it's this repeatability and understanding that is important. Still, we mustn't take it for granted that just because something is built in a factory, when it lands on site, it will work, so secondary testing on site is imperative. Thermal performance testing is now available, as well as monitoring and overnight testing. There is no reason why these can't be integrated, and hopefully, that will be mandated before long. If we can all move towards this and start evidencing that what we're building offsite far exceeds the quality, then you will find that the market will start pushing.

One thing we haven't touched on is the increasing energy prices. Whereas before, it wasn't such big a deal, now it's a massive deal. The savings can be calculated and known. It will also be easier to size heating; if we're providing quality buildings that we're testing, we will have heating systems that we can rely on as we move towards air source heat pumps, etc. There is still a lot of negativity around sustainable heating systems because of the performance gap. So, if we can close the performance gap and instil confidence, we can start making a move towards our net zero future.

Air source heat pumps work if you've got the fabric right. If the fabric isn't right, they cost just as much as a normal heating system. So it is important to ensure that the fabric of the building is correct before installing an air source heat pump.

The new part L is designed to close the performance gap by requiring installers to prove that they've maintained installation continuity and achieved quality and installation on-site with photographic evidence required. Will this also apply to offsite construction? If so, this has the potential to make offsite manufacturing systems much easier for building control to evaluate and sign off if they arrive on site.

With regard to emissions, people feel that modular offsite is different to traditional, which of course it is. But offsite still has to comply with building regulations. So there's no difference there. It should be easier to achieve compliance, especially by building in a factory environment. It's easier to assess what's being done in the factory because you're not worrying about inclement weather or potential impact on timescales. Offsite manufacturing can lead to improvements as designed and as built on-site. So, clearly that is a massive benefit of offsite manufacturing in closing the performance gap.

How can offsite help us to achieve our sustainability targets?

There are many elements to sustainability, and we come back to repeatability. The repeatability and predictability of what we're doing. This is the main driver because it helps us slim down on all other aspects of the job. When we look at materials and wastage, the control in a factory environment compared to traditional construction and on-site is mind-blowing. If you take one element, fixings within panelised or modular construction. Not only do you know how many are being used, but you know what types are being used and where they are within the factory at any time. You can control it to the level that if there's a fixing left somewhere, you can stop production and know that the fixing needs to be included elsewhere. So that's a great level of control.

On a traditional site, there are pockets of fixings all over the place, and you never really know how many you're going to be using. You're never able to accurately cost it in. With the estimate at the start of the project, you can say there will be 1000 fixings, based on the square meterage, and you will probably use two or three times that and have no idea where they went, which has a knock-on effect on to all elements. Offsite construction gives greater control. You know the labour element, you know the transport element, you know the fuel that's going into the transport and the coverage that those vehicles are doing. You know the time spent by the design team designing it, so you know the hours that they're doing backwards and forwards to their office. There is a massive amount of control compared to traditional where control cannot be achieved because there are so many elements that are outside of your control. This can be further complicated if there are different subcontractors involved. The weather has always had a big effect on traditional construction projects that you can't control. The last few years have shown us that being able to predict things is extremely difficult. Having a global pandemic, and then the situation in Ukraine. The global logistics of components have been horrific. One month it will look fine, and then the next, it is entirely different. All of these impact sustainability, and having greater control over these elements help you in achieving a greater level of sustainability.

We also need to consider safety. On-site, there are always fixings leftover, and workers will use the fixings that they find, quite often in the wrong instance. Detailers and designers have made great efforts to get calculations done to say that fixing needs to be fixed at certain centres. In a controlled environment, you've got the opportunity to ensure that's been followed through. Taking it to another level, there are fire checks like the BS8414 , you can have confidence in the panel that's going to site reflects the data that's on that safety sheet. Whether it's fixing calcs, whether it's fire you can give that assurance when products leave the factory. It brings the quality and safety elements to the fore.

In relation to sustainability, where can we see significant improvements when we look at offsite versus traditional?

When we compare offsite to traditional, significant improvements can be made in waste and sustainability. Sustainability isn't just about the build. It's about the operation of the building too. If the building's quality is improved, then performance improves. This reduces emissions, which then has a direct relationship with running costs. We should be testing our buildings. We shouldn't just be relying on photos and dates. We now have the technology to do this. When it comes to waste, in a factory environment, you have a lot more control over waste than you do on-site. For example, if we take one area, flashings. Flashings often come in three-meter lengths, but a door is typically 2100 high. This leaves a 900mm offcut. In a factory, it's easy to think, well, that 900 offcut could be used for a jam for a vent or something similar. It allows you to optimise what you do with your waste. Whereas the same situation on-site can be totally different. In detailing the job, the designer has to put themselves in the mind of the person on the site. Are they going to run around to find a little bit of 900 offcut to use for that small opening? It's very doubtful. Even if the designer marks it on a drawing saying, please use this here, they might be working on two revisions earlier. So, it's marginal gains that make a big difference over time. There's a big amount to learn from the sustainability element but also in managing our waste.

When we're talking about offsite, do we really mean controlled environments? It doesn't necessarily have to be offsite, you could have offsite on site, and you could create your own flying factory. Many of these savings don't require transporting your materials from 100 miles down the motorway. It might be that you've got a patch of land that's 10 miles around the corner, or the playground on a development has a big marquee or something. It's the control element that's important, and that will allow us to look at sustainability, quality and waste.

Beattie Passive has worked with its partners to set up flying factories where they will set up a factory on the site to manufacture studs and components and also use local employment and local labour within that actual site. In this way, creating a controlled environment where these fixed stud panels will be local to the site. This controlled environment could be

miles away in the north of England, yet localised to the site, bringing that controlled environment and benefits to the wider economy.

In controlled environments offsite, a fixed location is going to be better for employment. You have people you can employ locally that go to one place and aren't travelling all around the country and being exposed to all the elements. So once you've got a consistent workforce, you get repeatability and skills, and those are going to be improved. We've also got a better working environment for them. They're not exposed as we worry about the materials being exposed to the elements, surely, we've also got to consider the workforce surely, and on a cold day or a wet, windy day, your quality will be compromised. So again, that's another win for offsite.

Local assembly ticks a lot of boxes. We don't want to be shipping big volumetric modules hundreds of miles around the country. It's about reducing that last leg, using local labour, and training them to assemble modules that are effectively a kit of parts. It's not complicated, and whilst there are heavy products, it's simplified as much as possible. You get more engagement with local authorities by being able to employ local people, without the carbon footprint.

Are you, as modular manufacturers, able to control the amount of plastic packaging on-site from your suppliers? How do you address plastic waste in the supply chain? And similarly, do you calculate embodied carbon for each project as we move towards net zero?

Answers from the panel are provided below:
Nathan Beattie from Beattie Passive
"I think that packaging is a huge issue. We certainly aren't where we want to be yet with the amount of single-use plastic that we receive. That's something that we are working on with our suppliers, and they're keen to do it, but there's a cost to that and how we get around that. So yes, single-use plastic is still a problem. We don't use single-use plastic when we're transporting our modules. We've got heavy-duty uPVC covers that last up to 20 or 30 trips. They are more expensive, but we feel that it doesn't fit with our ethos to have single-use plastic in the shrink wrap of our modules for transporting them.
Regarding embodied carbon, yes, we do the carbon calculations on pretty much every development that we do. As we are Passivhaus standard, we are finding that embodied carbon is around about 50% less than a traditional build. But then our whole life carbon is massively better. Our operational carbon is 90-96% better than a traditional build. That's where the massive benefit is. Embodied carbon is still carbon in the construction process. However, operationally, we find that because our heating demand is down to below 20-kilowatt hours, and we've got MVHR which has continuously been using that energy."

Sean Gilbert from Modulous
"We're always striving to eliminate single-use plastic in all parts of the supply chain, but I think there's that real balance of how you protect your products in transit. When we move our modules around, we rely on A. Proctor Group products, and that's serving us well. But I think when you're moving around the service elements as we are, ultimately you try and design it so that it fits within the standard lorry within a normal protection curtain. A better balance of cost versus the drive to reduce single-use plastic is a topic that a lot of businesses are battling with, especially when there's a real focus on the total cost of the product. At some point, that's going to get painful. We need to work together within industries to think of ideas. We're collaborating with logistics partners to try and find ways to package products that don't need single-use plastics. We recognise it's a real challenge and something we all need to keep sharing ideas on."

Steve Chesters from the Hadley Group
"Hadley are a CCI cold-rolled steel manufacturer, so we take cold-rolled steel and use that to manufacture the sections we sell into the industry. It's not just about the product; it is now about the amount of carbon in that product or the construction of that product, so the whole life. A lot of modern products that we're using are making the structures themselves more recyclable. When it comes to the end of life, in a lot of cases, there are large elements of adhesives as well, which is also becoming more important to that embodied carbon count."

Clare Fenton from Fenton Partners Limited
"The repeatability elements of this are key. If we learn from project to project, and what arrives on site, completely undamaged, and what doesn't, we can start to collect data to take towards the next build over time, hopefully, we can adopt a lessons learned approach. At the moment, with standard construction, we can't do that because every build is different. With the government drive, we've got to reduce embodied carbon by 40% by 2030, and net zero by 2050. We need to start

making changes but the only way that we can do that is through repeatability and learning. There is also the opportunity to use some of the delivery items as part of the build. I have been working on some projects where they will use a component of the delivery as a part of the finished project. May be as part of the playground. It's the re-use approach, but it needs to be thought about front-end."

Offsite benefits to the supply chain

How do you see the benefits of offsite changing the relationship with suppliers?

The crucial benefits of repeatability offered by offsite construction are to allow the shoring up of the supply chain. It puts organisations in a position where they can predict what a build needs well in advance, the supply chain can react to that. In addition, when we find commonality, we can create standard components. It's already happening with rainwater goods. Rainwater goods, for a long time, have moved towards standard component parts. Some years ago, you would be required to design and draw each individual part of a rainwater pipe. The Metal Cladding & Roofing Manufacturers Association (MCRMA) often discuss shortages. What the members are doing is bulk buying sheets of metal, however, they still don't know what the demand is going to be, what length of panels, what profile, so it doesn't ease the strain.

With the current shortages, on a Traditional build, when a contract lands the first request is for material schedules. So let's say it comes in on a Thursday, they want the schedule by Tuesday, and then the drawings can follow afterwards, which isn't good practice. So although the manufacturer is ordering the raw material, they still don't know what the demand will be, and that's what we need to try and shore up. These repeatable items can be standard components. If we look at a platform approach, a kit of parts, you know that the middle of the building is usually pretty consistent. So you know, right from the start, we need 10 of those particular types, then the manufacturer knows they need to start to manufacture all the component parts for those. When you do a traditional build, you don't have that heads-up; you've got no idea. It is pretty much guesswork, and it's a big black cloud hanging over designers that may be thinking, is there an area I have missed? Have I overordered, and are they going to change something?

Repeatability is also going to help the supply chain to innovate. We can come up with new products because we know what the challenges are, we've got guidelines in place, and we can innovate around that. When we talk about innovation, we talk about systems as well. You can innovate the systems to work better. So in the example of the job landing on Thursday and needing to put the order in on Tuesday, it might be that the architect already knows what the material is required because the standard component parts are known. They've created their own schedule right from the start and removed all those worries. It's certainly again a good way to shore up the supply chains when everything at the moment is so unpredictable.

What does supply chain optimisation mean?

Supply chain optimisation can be summed up in one word, digitalisation. That might be a bit alien to some, especially in comparison to the traditional market. What it means is, digitising the supply chain for generating transparency and accountability. It gives us what we would love the whole industry to have, greater visibility on lead times and supply performance, and gives us the information to make great decisions. So to the example around fixings, having all that control and not all the worry because you have a system that automates it for you, meaning that we can focus on more important things. It also gives us greater visibility of price volatility. From a day-to-day basis, what does digitalisation mean? It means that we can show our product pipeline forecast schedules, which you wouldn't typically have at that granular level within the traditional world. The initial basics that we need to make a manufacturing process work, we can start to automate, allowing us to focus on the value-added bits.

Controlling costs through offsite

What sort of savings can be made by engaging a design team earlier in the process?

At Hadley Group, the in-house design team engineer can lead on detailing and is part of the wider design team with the principal engineer and the architects. Commercially, the bottom line across construction is net profit. So, you've got to look at net profit and predictability. You need to understand your costs as early as possible and have a strong, reliable budget. In addition, you need to be able to control the variations in costs which are outside of your contracts. These two things are the lifeblood of any construction project. When you engage early in offsite projects with the design team, you're giving yourself the absolute best opportunity to firstly understand that budget very early and then be able to control it. Building in an offsite environment is very repeatable, so the designs are very repeatable. You can control that very early on. The design team can identify the factors that will affect the cost and drive them down or hopefully eradicate them completely. You can consider things that might become a factor later on. You're always coming back to costings and ways of avoiding costs and places you're going to get tripped up when going into a project.

Do you find that those cost conversations are purely focused on material, or are other people looking at it in broader overall project delivery?

Ideally, you should be looking at the overall costs. If you're going to look at the actual costs, especially with offsite, you need to look at the benefits across the whole duration of the project. Whether you're saving time in the ground or saving complete total program time, it needs to be viewed as costs on the whole. Typically, you're just taking a small snapshot of what that cost is, a small element in comparing one element against another element, and that's not always the most accurate way of making the price comparison.

The speed and control of a decentralised model

Modulous operates on a decentralised model, which means it doesn't have its own factory. By working with supply partners, they have achieved a large core supplier partner network. This enables them to manufacture and deliver the key sub-assemblies that make up their modules. It means that they can have a product delivered ready for assembly that doesn't require touching, adapting, building, or amending when it reaches the assembly facility. The sub-assemblies are assembled and go through numerous QC checks and testing before they arrive at the assembly facility. So any issues can be addressed a lot earlier on in the process. That gives confidence that they can deliver a speedier assembly process and, ultimately, a speedy deployment to the site. By testing and observing, and checking the specification earlier in the process and working with supplier partners results in greater confidence downstream or upstream within the project delivery. So, they can demonstrate quality and achieve confidence by working with supply partners in collaboration.

The suitability of products for MMC

What type of products benefit from MMC and which are unsuitable?

There are so many types of MMC with a solution for every problem. So, for example, residential, hospitals, care homes, hotels, there's a whole range of markets. So it's important to look at what is the driver for the project and what type of offsite manufacturing will suit it best. You might end up with one or two options. It's not always what you think. Sometimes it's cost; other times, the program or logistics. You need to find what suits best for the project that you want to deliver. Hence, those early discussions and understanding the full brief and not coming straight back to price. There are all of the other things that have a knock-on effect on price and to find the most appropriate form. For example, it could be the case where the program is too long for offsite. If you're not going to be able to deliver it fast enough and return on the investment isn't a driving point, then it's probably not the most suitable type of construction. So, there's

a fit for every project. Look at what type of construction is involved, if it's bathroom pods, an offsite element, a roof truss or something else. It's the safety, the predictability, and any element that you can move from a variable site environment into a controlled offsite environment that is going to benefit the project.

Does offsite construction preclude some traditional materials such as bricks and roof tiles?

No, it doesn't. It's completely dependent on what the client wants to use. For example, you might not be doing the modular aspect with bricks, but you can install brick slips, or on-site, a brick skin can be built around it. Obviously, that will increase costs. Where cost is tight, you might try to avoid doing a whole new brick skin or brick slips. But yes, it can be done. Then with traditional roof tiles, there's no issue. They can be installed within the factory, or they can be installed on-site.

You have got to remember that offsite isn't just modular. There is a whole load of offsite solutions out there that will apply to different projects. You just have to select the right one for what you need. Offsite is not new, timber frame has been going up for years since the 70s. In addition, there are steel frame systems that have been going since the 80s in panelised offsite construction. It's just about different methods and adapting some things that are new and some things that are old.

With regards to the use of construction membranes, are there any common issues you've come across within offsite manufacturing?

The general performance of offsite manufacturing is quite high. You can achieve good airtightness and condensation control. The main concern is trying to get a continuation of the membrane within the detailing where you have, say, two panels adjoining on site or where you are bolting two modules together. There are also hard-to-treat areas, for example, sky hooks for lifting modules up, potentially penetrating out from the roof or the wall and potentially penetrating your external line. In that instance, what we want to create is a continuation for both the vapour control layer and the breathable membrane. Depending on where the air tightness is as well, that will need to be taken into account. So detailing is a massive thing; so there needs to be emphasis put on that ideally at the design stage and how that will be achieved within the factory, plus how you need to do any remediations on site if it can't be done in the factory and the use of training on that.

Another thing is exposure. If the membrane is being used to potentially wrap a panel or a module, and it's being left outside. Maybe there have been some unavoidable circumstances. It has been the case that modules or panels are left outside exposed to rain for long periods of time. So we must consider moisture ingress, UV protection, and making sure that the hard-to-treat areas such as the details don't become compromised. If they haven't been detailed correctly, you can have issues with the likes of moisture if it's exposed to inclement weather. So, it's about making sure that the products being used are suitable, about the detailing and the design of the building, and how that product will be stored.

Unfortunately, sometimes membranes get left outside for long periods and degrade because they've not been designed with that in mind. One last area is transportation. So, if the membrane is going to be exposed on a module, or if a panel is being transported down the motorway, it will be exposed to strong winds that can damage the membrane, tear or rip it. So, then you're going to have to look to replace or repair any damage before any on-site work commences. The idea is to try and get as much as you can to be done offsite and not have to worry about some of the detailing that you don't want to be done on-site so we can crack on with getting the product finished.

Should ground gas protection be a consideration at the manufacturing stage?

Normally you will find that ground gas is dealt with by whoever is responsible for the groundworks package. What's important is to have a continuous homogenous membrane that can fully protect the building and its inhabitants. The main issue, if we take the example of a floor cassette, is that you're going to have junction details when they are put together on site. If you're trying to apply the ground gas membrane to a floor cassette in the factory and then deliver that to a site, you've then got a junction detail to worry about on a very important health and safety product. So, yes, it should always be considered at the design stage, it should always be considered at manufacture, but you need to make sure that whatever is going to be delivered to the site and finished on site is going to be able to function for its main purpose. It makes sense to look at radon barriers and ground gas barriers on every single project. It's a little strange how we select where these are installed. It is difficult to say how much control we will have over the movement of ground gas in hundreds of year's time, but it probably isn't considered enough. We should certainly consider and make sure whatever is going to be delivered to the site is suitable and you want that continuous membrane with the likes of floor cassette modules.

Offsite manufacture for public sector projects

Community Land Trusts CLTs would like to gain benefits of offsite manufacture by leasing the space over council car parks. Are the benefits of offsite manufacture applicable in unusual areas that are council owned?

A good example of this is that there might be a space of land on a car park that we could utilise for three to four years and then after that, you can actually move the modules somewhere else where the need is. So there is definitely a benefit to it. Beattie Passive recently undertook a project involving 150 apartments at an old gasworks in Cardiff and the apartments will probably stay there, but they're designed so that they can be completely dismantled and taken down and then moved on to where the housing need is. So, sort of reimagining how standard houses are, that have more than one life and can be moved on to different areas.

How do you make the structure moveable? On this particular site, spreader beams were laid on top of the existing ground. Basically laying it on a DPM and put hooking eyes in so that once all of the modules are moved out again cranes can have access to lift it up. Thereby, lifting up the spreader beams, and the foundation. There are certain things that you can't move, but in the majority, you're trying to use everything that you've used on a previous site.

Insurance and mortgages for MMC

On the topic of insurance and mortgages for MMC, the views from the panel are provided below:

Clare Fenton from Fenton Partners Limited
"This insurance within our industry is a problem. I remember just post Grenfell sitting around a table with an insurance company and asking them how we can deal with this. They raised the issue of offsite construction at that time, and they said that insurers weren't that keen to insure offsite in our country, although overseas, it was common. This was probably five years ago. Because I've been part of the Construction Innovation Hub, it's a question that I keep asking, and I still haven't had a clear and concise answer. But to be honest, in our industry, nobody wants to give us a clear and concise answer anyway. But yes, I understand where the questions come from because I still feel that we need to be engaging in conversations with the insurance companies and the mortgage societies."

Nathan Beattie from Beattie Passive
"I think it is an issue for self-builders or that kind of smaller entity. We have found issues when some of our partners have tried to get mortgages and have gone to a smaller company. We've got about 450 homes now, and about 300 to 400 of them are all mortgageable or have been mortgaged, so we haven't found an issue. I think the industry is hesitant, and that there is work to be done around offsite construction is not new. It's a greater way of delivering houses to a better standard, and I think that just needs to be relayed correctly to the insurers. But insurers are very risk averse, as we all know, and they don't like change. So I think it will take time to get them on board."

Driving the uptake of offsite construction

Given the positivity from the power of offsite construction, why do we think that uptake from the construction sector is so relatively small and critically, what can we do about it?

Some of the reasons are linked to visibility. If we're talking about modules, talking about offsite, we have seen student accommodation and hotels in offsite systems for a long time, timber frame has been around forever, and roof trusses are offsite. There's a whole load of elements that have been around for ages, and some of it's just understanding what's visible in the market. Sometimes it's time, and the cost is always a big driver. People are worried about cost, and you can engage in a project, or a new element or a new component, and people may go down this road thinking they have lots of time to do it. Then when it comes to placing an order, which is always late, they run out of time, and there isn't time to get in what they want, or they still haven't understood offsite enough, so they fall back on what they know. So, it's all about understanding the options that are out there and planning as early as possible, taking into account all the aspects that need to be considered for a project and then moving it forward. Education has an important role in the market understanding what's available.

Another of the drivers is the Construction Innovation Hub. They've done a whole feasibility study on this with the government. They've spoken to all departements in the government, and they've said there's a 40 billion pound pipeline of requirement coming through. There will be a directive, part of that will need to be apportioned to offsite. The government is seeing this as an opportunity. Seeing the benefits of offsite, again that word quality. We need to mention the Hackett Review, she's identified, quality is an issue with building on site, and how it reduces ability to bring an element of quality control. Like always, not unlike BIM, the government need to intervene to get that momentum and the carrot for the industry to step up to the mark.

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