

Bosch Rexroth Lean Manufacturing Audio Series

“Cellophane House Part I”

Welcome to the Bosch Rexroth Lean Manufacturing Audio Series, where you can hear about new approaches in using lean techniques and principles. We'll discuss how to apply lean concepts in some fresh and perhaps unexpected ways to help you transform the performance of your company.

Today, our lean story falls outside our ordinary manufacturing topics. We want to share with you a unique design project that incorporated innovative thinking, waste reduction and design for reuse principles into a very commonplace creation: the family home.

Our guest today is James Timberlake, Partner at the Philadelphia-based architecture firm KieranTimberlake. In the summer of 2008, The Museum of Modern Art in New York City launched a special exhibition entitled “Home Delivery: Fabricating the Modern Dwelling.” As part of the exhibit, five full-scale prefabricated homes were erected on a vacant lot to the west of the Museum, to demonstrate new directions and solutions to contemporary issues in housing. KieranTimberlake's concept, the Cellophane House, was one of the five erected, and James joins us today to tell us more about the project, and how Bosch Rexroth's aluminum structural framing product helped fulfill KieranTimberlake's goals for the project.

James, thanks for joining us today.

James: Thank you very much. It's nice to be here with you.

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(1:28) QUESTION 1:

James, let's begin by having you tell us a little bit about Kieran Timberlake, and the kinds of projects your practice focuses on.

James: Kieran Timberlake designs for a broad range of clients, from private residences to cultural and educational institutions. We're a generalist practice, but we're a research-based firm.

Design research is a central driver for all of our work – it permeates our projects and the culture of our firm. We've been fortunate to have clients who seek innovative solutions, like Sidwell Friends School, where we built the first LEED Platinum Middle School, and Yale Sculpture Building in New Haven, CT, another LEED Platinum project, and the Melvin J. and Claire Levine Hall at the University of Pennsylvania, which uses the first actively ventilated curtain wall in North America.

(2:23) QUESTION 2:

Can you tell us exactly what LEED means, and what a LEED Platinum project is?

James: Certainly, LEED stands for Leadership in Energy and Environmental Design, and is a certification process designed to encourage adoption of sustainable green building and development practices. LEED Platinum is the highest certification one can achieve. They have different levels, and LEED Platinum is certainly the highest.

(2:52) QUESTION 3:

Okay, so environmental design and sustainable development is something you've definitely invested time and resources in, when pursuing new solutions. Tell us about the Cellophane House and your core design objectives. What were you trying to demonstrate?

James: Well I think first we were trying to advance the arguments that we made in our book, *Refabricating Architecture*, which was published in 2003 by McGraw-Hill, which discusses strategies for how architects can improve the quality and productivity of architecture, design and construction.

Cellophane House is a continuation of our investigation of off site fabrication, and integrated component assembly, like we used at Loblolly House in 2006, which used a Bosch Rexroth framing, to reduce time, labor and waste associated with stick-built construction.

Cellophane House is also a stair-step for our next generation of SmartWrap, a high-performance building material that we began developing in 2001. At this time, we created a multi-layered, high performance wall that controls the interior climate of the house, and it also offers the potential for the house to exist off-grid by harnessing solar energy, so all of these components are coming together.

I think the last couple of provocations about this particular house, one was in building off-site, we wanted to look at ways of building more than one or two stories, so the frame that we'll talk about enables us to consider building higher than one or two stories. Lastly, Cellophane House is translucent and transparent. The components and materials that make it up, principally beyond the Bosch Rexroth frame are translucent and transparent. This was a provocation about how one might live in the 21st century more transparently, rather than within a typically opaque home that has windows punched in the walls.

(5:11) QUESTION 4:

So with these projects, such as Loblolly House and the SmartWrap building material, how else were you trying to change the way we think about the “stick-built” home construction process, and the materials used in it?

James: I think that's a great question. We aimed to create a mass customizable system of building that can be tailored to site, program and personal requirements, not just a one-off. In other words, like an automobile on-line, we imagine every individual is going to have a different opinion about what their house might look like, and so we're going to offer those choices through the different kinds of components that we can bring to the product.

Every other industry is subject to rigorous cost-cutting and process optimization. We thought we could show how an almost industrial approach could bring some of those benefits to the home building process. It's almost like "lean" home building, so to speak.

Cellophane House is not only designed for assembly, it's also designed for disassembly, meaning that it can be taken apart and the materials retain their integrity. The house has no permanent connections, so it can be easily assembled, modified, disassembled, and therefore reassembled

(6:33) QUESTION 5:

So instead of filling up dumpsters and landfills with old brick and metal and wood, when we do our renovations or we want to put in a new building in a site with out-dated or unusable structures, it's better if we disassemble and re-use. It sounds like you're saying that if we design the building and select the right materials right from the start, we can eliminate waste. So what other ideas did you want to showcase with the Cellophane House?

James: Well that's all true, and then further, we built with open-source, off-the-shelf materials, to capitalize on and extend the capacities of existing technologies, and the Bosch Rexroth frame is certainly part of those open-source, off-the-shelf materials.

We as architects prefer to have an ethical responsibility to the environment, and so we want to take responsibility for the full life cycle of our designs, and particularly this house, by selecting recyclable, durable materials that have high re-streaming capabilities.

(7:37) QUESTION 6:

Very admirable. You chose Rexroth's aluminum structural framing to frame the house. Typically, isn't this product is used for factory applications – to frame machine structures, and office and workstation enclosures on a plant floor, and other manufacturing uses? Why did you choose it for this project?

James: Well this is the conversation I think we've been having with Bosch for a long, long time. It's not just for factories anymore. We chose it because it's a pre-existing, readily available system already in production of very high quality that we could enhance with the development of custom connectors, the ability to use it in structures like houses or small buildings.

At the Loblolly House, which we completed in 2006, we adapted this Bosch framing system to meet the requirements of a free-standing residential structure, extending the range of the system while taking advantage of its inherent intelligence. We've done exactly the same at Cellophane House, only this time, I think we were able to rise from two stories up to four plus a roof terrace, almost five stories.

(8:53) QUESTION 7:

So, you've had experience using aluminum framing to create a house already. What specific functional and engineering features appealed to you, and suggested that it would help you demonstrate some of the concepts you wanted to prove here?

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James: Interesting question. The aluminum frame makes a matrix that other off-site fabricated elements like floors and ceilings, stairs, bathrooms, and mechanical rooms can be attached to, and this becomes a universally useable and adaptable product that all of these things can come to.

It can be taken apart as easily as it is erected, I'm sure you've found that in the industrial application, enabling the structure to disappear as quickly and unobtrusively as it appeared. The aluminum frame allows any of the walls, the floors, the structure, or the envelope to be replaced at any time, without invasive modifications to the structure. I think that's probably the most unique and innovative aspect of the use of this particular frame. This is the kind of thing that I think really gets the attention of people coming through the house. You might want a transparent wall one day, but the next day you might want an opaque wall and you can just snap it in and snap it out of these framing members.

Lastly, I think the aluminum is lightweight, it's durable, it's recyclable, it has broad re-streaming possibilities. The wide range of applications allows it to have a useful life far beyond its role in this particular house.

(10:41) QUESTION 8:

So it's obviously easier to use, yet you were certain it could handle all the structural requirements of a full-scale, five story home. Now, you talk about using "offsite fabrication" as a fundamental component of your design for the Cellophane House. Could you explain that concept a little bit, in comparison with other types of pre-fabricated housing designs, and how did Rexroth's aluminum structural framing help you realize this concept?

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James: Well I think the first aspect of answering that probably is really that we have a different definition regarding pre-fabrication. I

think most people, when they hear pre-fabrication think of it not in terms of high quality, but in terms of something that's slapped together. That's certainly not the case in the context of Rexroth's aluminum structural framing.

In the case of how that applies to housing, a common perception or misperception of prefabricated housing is that its originality and its site specificity are all lost in the manufacturing process. Instead, we aimed to design a system of building that has a flexible set of rules that enable multiple outcomes. Cellophane House can be scaled and customized to meet the needs of the individual consumer.

By being off-site fabricated, rather than being totally pre-fabricated, we bring together a whole scale and range of ideas about those elements. Some are framing members, like the Bosch Rexroth system, some are whole panels, and some are whole chunks, like the bathrooms that are being brought to the house. That all serves to increase quality.

Designing in this way presents a unique set of challenges. Since the frame is left exposed, an extremely high level of precision is required, because there is no drywall, moldings or veneers to hide those imperfections. In the case of Cellophane House or Loblolly House, literally the precision of that frame allows us to bring materials to it within the tolerance of the thickness of a business card. So we don't need to hide those imperfections, because it is incredibly precise.

Lastly, throughout the design development of Cellophane House, we needed to consider how the pieces would be assembled in the factory, in other words would a ratchet or a wrench fit in that particular space, and can we get a hand in that particular location? How they would be shipped, how the chunks or parts or component assemblies could be secured in transit, the assembly sequence for all of those, and how the building would resist shear forces, and ultimately how the building is to be taken apart, in other words disassembled.

(13:54) Thanks James, I think you've given us a better understanding of how we can take a new approach to designing and constructing homes in a more sustainable and lean way.

In part two of this podcast, we'll discuss how the Cellophane House was assembled, and how modular manufacturing concepts played a part in its design.

Visit the Bosch Rexroth Lean Manufacturing Center on the web at www.boschrexroth-us.com/lean. You'll find all kinds of downloadable guidebooks, lean kits and other resources. And if you have questions about lean manufacturing, please, use our link and send them in – we'd enjoy hearing from you. Once again, that's www.boschrexroth-us.com/lean

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