

## Bosch Rexroth Lean Manufacturing Audio Series

### “Cellophane House Part II”

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.

This is the second part of our discussion with James.

#### **(0:25) QUESTION 1:**

**Now James, in the first podcast, we talked about one of the most important design concepts for the Cellophane House, which is off-site fabrication. Rexroth's aluminum structural framing is bolt together, requiring simple tools and really, little specialized expertise. Did this capability match your requirements for offsite fabrication?**

**James:** Oh, absolutely. I think we have a diagram some place, in some of the presentations that we commonly show with this particular house, that shows this all coming together with an allen wrench. Aside from the ability to reuse or recycle the parts, the system fits well into our theory of productivity. In *“Refabricating ARCHITECTURE”*, that I mentioned earlier, we talk about how the automotive industry is advanced by dividing a car into what are known as subassemblies or modules, which are composed of many preassembled parts manufactured off the main assembly line. Once each of these modules or component assemblies is finished, it is delivered to a main assembly plant and attached to other component assemblies. This process reduces the overall time it takes for a car to go from the factory to the market, and the time and total cost required to assemble the vehicle to the point of final assembly is dramatically reduced, as well as the quantity and cost for the raw materials.

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Cellophane House we conceived of to be assembled in exactly the same way. All of the components of the house including the wall partitions, stairs, bathrooms, NextGen SmartWrap™ facade, and the walkways are fabricated independently and simultaneously, so the assembly of individual housing components is not dependent on the completion of the others.

For example, the louvers on the roof and its adjoining stud wall up on the terrace level are assembled at the same time, which is not possible with most typical construction. A traditional stud wall can take weeks to construct if it is built in succession, but the partitions and panels in Cellophane House just take a few days to assemble.

I think this is true of elements in factory assemblies as well for manufacturing, where the Bosch Rexroth framing system is utilized. This allows for simultaneous construction in a wide variety of applications.

### **(3:08) QUESTION 2:**

**So you applied an elemental manufacturing concept – modules – to eliminate wasted time in assembling a home. And that’s a key topic we focus on in these Lean Manufacturing podcasts: reducing waste through innovative use of processes, systems and materials. So how does the design of the Cellophane House, and the use of aluminum structural framing in its design, help reduce waste and make home construction “more lean”?**

**James:** Well this is really critical, and I think this gets to one of the critical components of why we selected Bosch Rexroth. Rather than force the materials to conform to our design, we let the standard measurements that the materials come in dictate the dimensions of the house. This eliminates the time and the labor required to cut the material to size.

Combine that with the ability to generate a parts list from our digital model, we were enabled to order the exact amount of material that we needed, and we were left with virtually no waste. After all of the chunks were assembled, only six spare pieces of aluminum framing remained. That was just incredible to us.

#### **(4:23) QUESTION 3:**

**It really does sound as though you've minimized waste with this digital approach. James, you emphasize that one of the innovative aspects of the Cellophane House is that it was digitally modeled and fabricated virtually, using Building Information Modeling, or BIM. Could you describe BIM briefly, and the way Rexroth's Aluminum Structural Framing helped you use this virtual design and fabrication process?**

**James:** Certainly, unlike a CAD, or computer aided design drawing, a Building Information Model encompasses all of the information for a building, including geometry, spatial relationships, geographic information, quantities and properties of building components.

BIM is what makes simultaneous off-site fabrication possible. Without the geometric and dimensional certainty afforded by the closure of the parametric model – each dimension is accurate within 1/32 of an inch – parts could not be assembled in advance to the required tolerances, in other words. Dimensional discrepancies, as I mentioned earlier, are reconciled in a model, instead of on the construction site. Therefore, the higher level of tolerance. Therefore, the whole idea that you can't slip a business card in between the frame and the material – it's that precise.

We were able to import the Bosch profiles directly into our model, generating lists for ordering parts, and track data such as cost, weight, and quantity, and it was very easy to do this. The

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parametric model enabled us to design the off-site fabricated elements for ease of shipping, rigging, and attachment.

**(6:06) QUESTION 4:**

**That is fascinating. Now, you worked with distributor Airline Hydraulics to source and specify the structural framing used in Cellophane House. So what was it like working with them and what contribution did they make to the success of the project?**

**James:** We've worked with them on many, many projects at this particular point. John Sellman at Airline Hydraulics was terrific to work with—he was very engaged in the project and generous with useful advice. He also arranged for the machining of all the Bosch members after a subcontractor backed out at the last minute, which really was a great lifesaver, if you can imagine, in the amount of time that we had to get this particular house ready for delivery to New York, and with the limited amount of time we had to assemble it in New York.

John is also dedicated to expanding the demand and uses for Bosch Rexroth beyond its current markets, and when he was in here a few weeks ago, in our office, he talked with us about the lessons learned from this particular assembly method and their manufacturing and supply side demands. It's a great help to have a partner in developing a product such as Cellophane House, that understands this side of the equation.

Lastly, I think we just want to mention Kevin Gingerich, who we were first introduced to five years ago at Bosch USA. Kevin has been enormously helpful in getting us to the resources of Bosch Rexroth and Bosch worldwide, and we're immensely grateful for that.

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**(8:02) QUESTION 5:**

**Very nice comments on both John and Kevin. Now while working through the design and fabrication of Cellophane House, did you discover anything new about Rexroth's aluminum structural framing system, anything that helped you improve what you were trying to accomplish here?**

**James:** Well we think we pushed the limits of the Bosch system in several aspects of the design: such as developing composite beams for long spans, and design and fabrication of custom connectors for long beam and diagonal brace connections. I think our structural engineer really found this to be highly flexible in terms of adaptation. With the addition of a few custom parts that we worked with Bosch to help develop and also our structural engineer, this expands the opportunities even greatly beyond what's in the catalog.

The t-slots of the extruded members also made excellent channels for concealing low voltage wiring to LED, or light emitting display light fixtures throughout the building

**(9:12) QUESTION 6:**

**Some extra bonuses, that's great. The Home Delivery Exhibition and the Cellophane House were on display between July and October of 2008. How did the exhibition go, and what are your future plans for the Cellophane House?**

**James:** Well the exhibit was terrific, and the Home Delivery Show, I think, was one of the best the Museum of Modern Art has ever done, curated by Barry Bergdoll. The house itself I think was the hit of the show, if I do say so myself. The blogs and the critiques that have been published worldwide, and are available through the internet, have been overwhelmingly positive, and I think the Bosch Rexroth system has certainly been the great part of the acceptance of this particular project, but also part of the critical analysis of the

project as well, in terms of its overall beauty. I think people remark about the aluminum frame and just how beautiful it is.

The house in late October was disassembled and it has been stored, but we are using parts of it at this particular point for continuing conceptual research. We trust that in the very near future, we will be reassembling the house, and continuing that research in real time.

**(10:53) QUESTION 7:**

**Well congratulations on a very exciting and successful project, and thanks so much for taking the time to share this story with us today, James. It's really inspiring to hear how innovative thinking that's not tied down by the past, combined with the untapped potential of today's technologies, can re-invent a very traditional process – like building a house – and make it more efficient, more sustainable and environmentally responsible.**

**Wrap-Up:** You've been listening to another Bosch Rexroth lean manufacturing podcast. We post new podcasts on a regular basis, so please bookmark our site and check back frequently for the latest lean manufacturing insight and advice. For Bosch Rexroth, I'm Liz Cohen. Thanks for listening and best wishes for success in your next lean project.

Visit the Bosch Rexroth Lean Manufacturing Center on the web at [www.boschrexroth-us.com/lean](http://www.boschrexroth-us.com/lean).

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