nexushaus

rainscreens from concept to reality

Sara Bensalem and M. Anwar Sounny-Slitine

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Sara Bensalem received her Bachelors of Science in Architectural Studies from the University of Texas's School of Architecture. She participated in the Munich study abroad program where she researched the body-building connection in Sustainable Healthcare Architecture. She has also worked as a researcher in environmental impact studies, geological surveys, and sustainable development. To find her papers visit: https://utexas.academia.edu/SaraBensalem/Papers

M. Anwar Sounny-Slitine is a PhD student in Geography and The Environment and has a background in Civil Engineering, Geographic Information Systems (GIS), and Environmental Analysis. He received dual bachelor degrees in Geography and Civil Engineering, a Master's in Geography, participated in the Munich Study abroad program, and has completed the Graduate Portfolio Program in Sustainability from the School of Architecture's Center for Sustainable Development. For the portfolio program he conducted research in the solar energy potential of rooftops on The UT's main campus using solar radiation modeling through LiDAR surveying and GIS. He presented the findings at UT's Sustainability Symposium and can be viewed here: https://youtu.be/wclmkmyuaNc

Fig. 01 Quality control on rainscreen ensuring the proper installation of screws placed trough jig.

Rainscreens are exterior wall systems that consist of a moisture-resistant barrier (MRB) with wall cladding standing slightly off it (Donaldson, 1991). In residential building, rainscreens take the form of a siding installation with an airgap between the cladding and the MRB. The purpose of the rainscreen system is to aid in moisture control of the exterior wall. It limits wicking as they provide a capillary break between the back of the siding and the MRB. In the NexusHaus the rainscreen provides both function and form, with the vertical line breaking the horizontal linear form of the building. The design called for parallel vertical slender pieces of cedar. Cedar is an excellent sustainable wood choice for exterior cladding as it is naturally resistant to microbial deterioration, termites, and decay (Findlay, 1938; Stirling et al. 2014; Racusin & McArleton, 2012; Scheffer, 1996). In addition to the natural properties of cedar, it is an attractive material to use and defines the overall natural look of the building. The experience of constructing the rainscreen proved that design is the first step of making a building and that the challenges of implementation makes the design plan a living model that evolves and changes through construction. Issues arose with varying sizes and color of material pieces, limits in precision of assembly, and the impact of the elements on building materials.

The precision of Computer Aided Drafting (CAD) does not represent the real world well. This concept is often lost in studio design class. For this reason experiences like the solar decathlon is critical for a holistic education in Architecture.

Fig. 02 Final cut of the bottom of the rainscreen insuring the exact length of each individual piece.

While in studio-based learning the review process brings experts to critique building ideas and plans, but even the most well thought out design one can never take into account the challenges that are associated with implementation of the plan. For example the natural variation in building materials as well as variations in fabrication led to varying sizes of pieces. To overcome the variations in sizes we had to modify plans to allow for more tolerance in assembly. The design called for high precision installation that was just not possible. In order to overcome this a few methods were employed, first additional bracing was installed to the interior of the walls that acted as foundation for screws. Additionally a 'jig' was used for the assembly. A jig is a construction tool that was created to make a template for the placement of the rainscreen building materials (Dowd & Curtis, 1922). Once all pieces were assembled in correct locations, the screws were installed to attach them together. When removing the jig it resulted in an impossibly straight and well fabricated panel. The parallel aspect of the rainscreen required the pieces to be installed extremely straight. They needed to display as parallel to each other and perpendicular to the ground. Any slight variation would impact the visual aesthetics of the building. Screws were installed from the back of the rainscreen panels making their installation invisible from the facade. The screws connected each piece in six places to back bracing that was covered in UV resistant black tape. These bases were then installed on top of the moisture resistant barrier screwed through the oriented strand board (OSB) connecting into the framing of the house. The black tape masqued the braces as it was the same color of the moisture resistant barrier. This made it less visible and gave the cedar pieces a floating effect, further adding to the visually appealing facade.

When working with natural materials, color of the material can vary greatly. Each cedar piece had a different hue ranging from lighter to darker pieces depending on the particular tree and location of extraction (Tsoumis, 1969). In order to give the rainscreen a uniform look, pieces were placed in a fashion to give a blended look. Lighter and darker pieces were placed next to each other alternating the hues reducing the distracted

Fig. 03 Team discussing the installation of rainscreen panel on exterior wall.

look of similar colors next to each other. Due to the cedar pieces being on the exterior of the building, they required treatment to make it durable to the external environment. Each piece of wood was treated with a non-toxic eco sealant. The treatment was applied to all surfaces and ends, by immersing the wood in a bath made from a plastic tarp covering wood beams. This process greatly improved the application and efficiency of work.

The fabrication process of the panels resulted in approximately 4′ panels that fit the building exterior walls with precise lengths and seamless installation. Each cedar pieces varied slightly in length, but after the assembly of the panels the bottoms of the panels were cut to insure exact length of each panel. This cut coincided with the meeting of the deck with the building. The top cut coincided with the roofing, but was cut at an angle. This cut was a shallow 15-degree angle which allowed for water to run off the top of the panel preventing pooling and rot of the wood. Panels were designed to allow a seamless look throughout the rainscreen through overlapping bracing. The last piece of cedar in each of the panels covers the break in the bracing. This gives the exterior cladding a look of continuation throughout the paneling and gives the appearance of a single continuous wall of cladding. The corners of the building posed a challenge. A working solution for the corners was developed on the construction site. Many iterations of the corner constantly evolved the corner apparatus. The corner needed to provide a seamless continuation of the cladding across the 90-degree bend, but the installation of the screws from the backing of the panel resulted to clad paneling that required the covering of the joints. Additionally the airspace behind the paneling required it to be installed slightly off the wall and corners needed a design plan that would masque this airspace to preserve the floating aesthetic of the rainscreen. To accomplish this, students worked with professors to design metal braces that bent around the 90-degree corner connecting wood bracing allowing for the continuation of the cedar facade in a seamless fashion. The engineered solution stayed true to the architectural design while introducing strength to the corner assembly.

Once Lawrence Speck, a UT Professor of Architecture, gave a talk about the working relationships required between Architects, Engineers, and Businessmen to a student organization on campus with the purpose of bridging the disciplines. In his talk he communicated the importance of each role and how them working together makes building projects successful. This concept is well represented in the NexusHaus with the diverse team assembled from throughout UT and TUM campus. In the team we have architecture, engineering, and business students. Through this experience we would add here that tradesmen also play a critical role. At TUM's Oskar von Miller Forum (http://www.oskarvonmillerforum.de/en/home.html) tradesmen, architects, and engineers share a learning space in an educational initiative of the Bavarian construction industry. The NexusHaus construction site became a similar learning space, where students were able to work alongside tradesmen and suppliers. Along with the professors these professionals served an advisory role and informally taught students lessons that could never be learned in a studio.

The NexusHaus was a unique learning experience taking a building from concept to reality. Here we wrote about one example of the rainscreen, but throughout the design and construction process there were countless learning experiences for students. Decking, roofing, electrical, plumbing, renewable systems, and countless other systems all required the same dynamic approach to implementation that was unique to a studio experience. Additionally working alongside engineers, businessmen, and construction professionals really cemented the idea that a building is a collective endeavor that results from the collaborative work of many individuals. Making an innovative building only amplified the challenges and highlighted that a successful building project is the result of teamwork.

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