Shifting Gears: A Passive House Car Dealership in the Making

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The world's first Passive House car dealership is nearing completion in Red Deer, Alberta. Designed by Cover Architectural Collaborative and Sublime Design, with Passive House consulting provided by Peel Passive House Consulting, the 1,540 m^2 (16,600 ft^2) facility will house the new Scott Subaru dealership. This legacy project dovetails nicely with the 50th anniversary of the company developing the project, The Scottsville Auto Group.

Motivations

Garrett Scott, Owner and Chief Operating Officer, sought a low impact building that would support his growing business. He readily admits that he's not an avid environmentalist but recognizes the myriad benefits of constructing to the Passive House Building Standard. "I think building smarter and showing that these retail facilities can be structured in a way that they're still functional for a retail presence and also able to accommodate a nicer work environment for the teams that are inside of them and not to mention the customers as well. We hope the long-term benefits will help inspire others to possibly build similar type structures."

This isn't the first environmental building initiative Subaru has undertaken. Its Indiana automotive assembly plant is the first zero-landfill factory in the US. Scott was inspired by this project in deciding to pursue Passive House certification on his building.

Setting the Standard

Most, if not all, large car manufacturers have strict corporate standards regarding aesthetics, layout, and service requirements. Subaru is no exception to these. Adding to these baseline requirements were specific client requirements. Chief among these was that any decisions made in pursuit of Passive House certification were not permitted to compromise customer or vehicle service at all. An additional major factor impacting the design was the local winter design temperature of -20°F (-29°C). Navigating these requirements proved challenging and demanded the best of the whole design and construction teams.

Base Design

The building is divided into three zones: a showroom, a repair shop, and a car drop-off zone. The showroom includes a car display area, customer reception and lounge and sales offices on the first floor, and back offices, meeting rooms, and staff kitchen on the second floor. The repair shop comprises a ground floor with 6 service bays and parts storage, and a second floor with mezzanine, storage, and cat walk. The drop-off zone is a single storey area used to collect customers' cars for repair and show off new cars housed in the parking lot to customers at night and during periods of inclement weather.

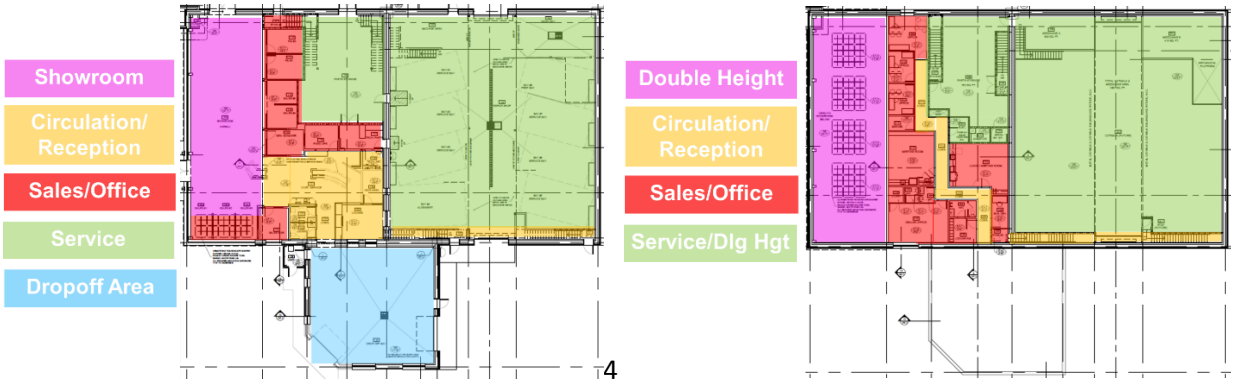


Figure 1: Building utilization by zone © Cover Architecture, modified by Peel Passive House Consulting

Envelope

The base design of a typical car dealership is ideal for Passive House: a nice big box. This allows a relatively simple opaque envelope. The structure is wood frame using 2x12 LVL studs, with a 2x6 interior service cavity, with an effective R value of R60. One key challenge that emerged was mitigating the impact of the west facing storefront, whose 65% glazing percentage was dictated by corporate design guidelines. Red Deer is nestled between two of the country's sunniest cities, Calgary and Edmonton. Various measures were explored to mitigate the solar gains but the only ones deemed feasible were insulated spandrel panels in the top row of glazing and automated operable internal blinds with manual override. Unfortunately, these measures were insufficient to mitigate the high cooling load.

Figure 2: Insulated Footing. A tent is erected around the foundation walls and heated to allow the project to continue construction during winter. © Cover Architecture

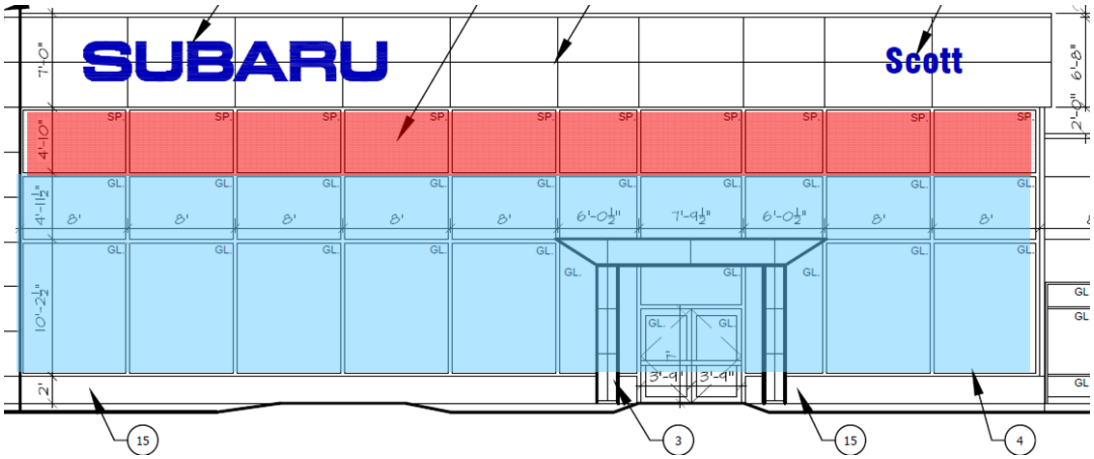
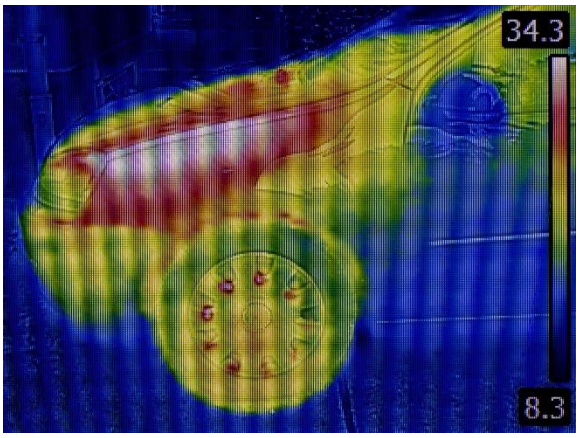


Figure 3: South elevation showing insulated spandrel panel (red) and standard curtain wall glazing (blue). © Cover Architecture

Overhead doors were another envelope challenge. Conventional North American doors are not rated for their airtightness, so could not be relied on. The team had to look to Europe for doors with sufficient airtightness. Careful detailing ensured a durable seal between the door frame and the wall.



The unique uses in the building required a detailed investigation of Internal heat gains ("IHGs"). One element that was initially overlooked was the heat gain/loss from incoming cars. Cars may be dropped off warm or left overnight and effectively turn into large ice blocks. Another element was the heat generated by the engines operated during repairs. The exhaust can reach 340°C (650°F) and its contribution to the IHGs varies substantially based on the run time of the engine.

Ventilation

The car exhaust also contains harmful pollutants that must be directly exhausted outdoors. To meet code requirements, each of the 6 service bays requires 400 CFM of exhaust. Normally, all bays are connected to the same exhaust fan, leading to all bays being exhausted, even when only one bay is in use. For this project, each bay was instead separately vented, cutting the exhaust rate by 83%. To further reduce losses, the team explored heat recovery options on the exhaust, including HRV, coaxial tubes, wrap-around coils, and heat pipes. None

Figure 4: Car Exhaust Hose.

of the manufacturers would warranty their equipment for use in car exhaust systems, rendering these measures infeasible.

Heating and Cooling

Heating and cooling are provided by a ducted VRF system. Electric resistance coils were installed in the supply air of each indoor unit to provide heat during peak heating conditions, when the heat pumps are expected to stop operating, due to the very low temperatures. Despite the low nighttime summer temperatures and humidity levels in Red Deer, active cooling could not be avoided due to the solar and internal heat gains.

DHW

The main DHW load in the building is for washing each car entering the repair shop, per the client's service requirements. The daily load of 2020 L is heated by a portable, on-demand, gas-fired water heater, the only service in the building fueled by natural gas. To reduce the demand, the team installed a Drain Water Heat Recovery device, which is normally used to recapture waste heat from showers.

Summary

Challenges that cold climates present to Passive House design is nothing new. But the combination of climate, project requirements and operational realities forced the design team members to continually re-evaluate proposed solutions in order to optimize the design and ensure certifiability. A team committed to the project goals and willing to seriously explore alternative solutions is essential for success.