

Super-Efficient and Cost-Effective Residential Buildings - the 125 Haus in Utah

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Project Description - Located at an elevation of 7,000', 125 Haus is a moderate-sized, 2,400sq. ft. Mountain-Modern residence in Park City, Utah. It is an interdisciplinary high performance design and research case study. Priced at market rate for the Northern Utah and Intermountain West Cold Climate Zone, 125 Haus became Utah's most energy-efficient and cost-effective house. The main goal – 80%+ energy-efficiency over the built-to-code IECC 2006 standard building at market rate cost – was achieved through an architect-lead integrated design process that included general contractor, engineers, and the University of Utah's Integrated Technology in Architecture Center; furthermore through focusing on standard materials, components and products of high quality, common construction methods and the use of local work forces. 125 Haus was designed to the German Passive House Standard; its construction, energy saving potential, cost efficiency, and return on investment was documented, evaluated, and analyzed throughout a 2-year post-occupancy monitoring period that concluded in December 2013. The results show that 125 Haus, compared to an identical, but code-minimum standard building in the same location, is about 80% energy efficient at no additional direct construction cost.

As an integral part of the design process, more than 35 EnergyPlus and Passive House Planning Package PHPP energy simulations were conducted during the design phase. The findings showed that 125 Haus will be about 75-90% energy-efficient over the built-to-code IECC 2006 benchmark building, which is the Utah applicable standard as of 2012. Results were used to adapt the building to its specific site conditions, to test different design configurations, wall systems, and components, and to optimize performance with regard to efficiency and costs. As a result of this approach, the team was able to develop a new wall system that is based on standard framing coupled with an exterior insulation façade system; it can be applied in ratings from R40 to R70 for other buildings at various locations and climate zones.

125 Haus is heated with a lean, minimized HVAC system, which keeps construction as well as maintenance cost low: a heat recovery system coupled with an on-demand gas hot water heater and a direct-vented gas fireplace as a backup system for extremely cold nights. External sunshades and passive night air-cooling through operable windows provide the required cooling during the warm-to-hot summer months. By focusing on standard products and materials of high quality, coupled with common construction methods and the integration of builder and engineers in the team, the applied strategies towards energy efficiency and cost-effectiveness will be fully market transferable; the results are expected to be broadly applied to the housing market in Northern Utah and beyond. Through its cost-effective passive energy saving and sustainable strategy, 125 Haus will contribute to pioneer the US residential building sector by making such structures affordable and attractive to a broad clientele.



South East Entrance Elevation

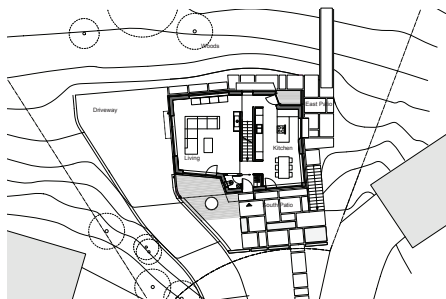


Direct Vent Gas Fireplace as Heating Source

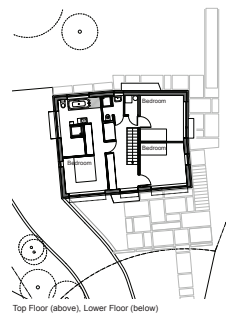


South Patio

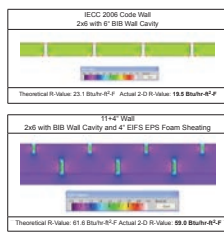
125 Haus in Park City, Utah



Site Plan and Main Floor



Top Floor (above), Lower Floor (below)



Thermal Bridging Analysis and FEA Heat Flux Results as Decision Making Tool



Thermal Imaging and Testing of Installed Components

Project Location	Park City, Utah Latitude: 40°44'36.74" Longitude: 111°56'38.92" Elevation: 6,982 ft	Roof Construction	10" TGI, 3" on center
Typology	Single family detached residence with build-in garage	Roof Insulation	R-30 10" BIB blown-in fiberglass between TGI plus 4" EPS on top of sheathing
Finished Floor Area	1,895 SF (without garage)	Windows	Serious Windows 725 Series U-factor values range from 0.14 to 0.19 Bluhw-ft ² -F Casualty triple-pane Windows U-factor values range from 0.18 to 0.20 Bluhw-ft ² -F
Gross Area	2,444 SF (without garage) 2,943 SF (with garage)		SHGC: 0.48 for south facing windows, 0.27 with low-e coating for all other elevations
Climate	Cold climate zone	HVAC System	Ventilation: Venmar HE 1.8 88 - 95% efficient HRV Heating: 170 kWh/yr Navien Cooling: 96% Tankless Water Heater (natural gas) with heat coil in morning HRV air source, 300 SF radiant concrete floor heating in basement (also used for DRW) 25 kWh/yr Montigo direct-vent linear gas fireplace as backup Cooling: Nighttime natural air ventilation through operable windows and thermal chimney DRW: see heating above
Heating degree days	8,190		
Cooling degree days	162		
Design and Construction	Planning: 05/2009 - 05/2012 Construction: 05/2011 - 10/2011 (5 months) Completion: 10/2011 Post-occupancy monitoring: 10/2011 - 12/2013		
Foundation	Poured-in-place concrete		
Foundation Perimeter Insulation	4" EPS		
Under-Slab Insulation	10" EPS-Geofloam		
Wall Construction	R-30 Double-stud offset stud wall, with 2x6 structural and 2x4 interior framing, creating 11" cavity		
Air tightness control layer	OSB sheathing on outside of 2x6 framing	Annual Space Heating and Cooling Demand	Natural Gas: 217 DTH Electricity: 832.0 kWh
Air infiltration rate	212 CFM50 / 0.8 ACH50	Annual Heating and Cooling Cost	265.02/year or \$22.09/month
Wall Insulation	11" BIB blown-in fiberglass		
EIFS	4" rigid EPS with exterior stucco		

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Living Room



Kitchen

Housing