



Introduction

Future Energy Dynamics was contacted by Energy Panel Structures, Inc. to conduct an independent energy analysis of the garage built by Building Green Structures. Using standard energy rating methods, data was collected and entered in eQuest V3.65, a DOE approved energy modeling software for non-residential structures.

eQUEST (Quick Energy Simulation Tool) is a sophisticated, user-friendly building energy modeling software. It integrates the DOE-2.2 simulation engine with intuitive wizards and graphical interfaces, enabling users to perform detailed energy analysis of building designs. Its freeware status and robust capabilities make it a valuable tool for architects, engineers, and energy consultants aiming to optimize building performance.

As there are no specific energy codes regulating a building to be used as a garage, basic default values were used in developing a reasonable comparison model. This energy model was used to demonstrate how the use of **EPS SIPs (Structural Insulated Panels)** allowed for this building to achieve, among other exemplary results, 38% of an overall energy savings when compared to an identical model built with standard 2x6, 24in on-center with no insulation in the exterior walls.



The focus of this report addresses the energy efficiency of the building structure and highlights the R-33 SIP's walls used that set it apart from standard construction practices.

Details on the reduced energy use of the structure are included at the end of this report.

Scope

Work performed and data gathered to complete this report include:

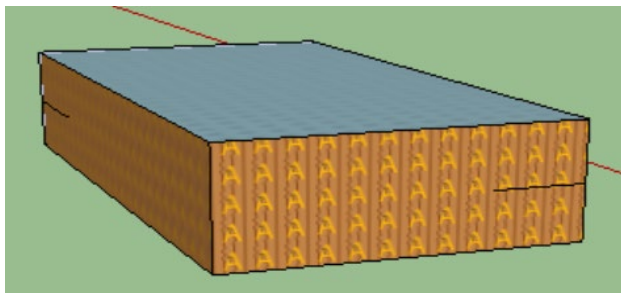
- Blower door and duct leakage testing.
- Standard photographs of the structure.
- HVAC equipment efficiency statistics sourced from AHRI.
- Number and wattage of lighting equipment sourced from building plans.
- Addition detailed information collected include:
 - Window U and SHGC values.
 - Typical HVAC temperatures and run time settings.

These data points were included to complete an eQuest V3.65 energy model constructed with standard building materials for basic framed walls and then a second model was created with the only change being the use of **EPS SIP** walls.

Blower Door Testing

A Minneapolis blower door system was set up and used to depressurize the building to determine air infiltration in cubic feet per minute at 50 pascals of pressure. This method was chosen due to the size of this building being below 10,000 sq ft.

The test results, when paired with square footage and volume details of the structure, provide the Air Changes Per Hour (ACH) calculation. A three-dimensional drawing, shown below, was created to establish an accurate calculation of the volume. When conducting the test, careful inspection of the structure also gives insight into areas where air infiltration from the outside may be taking place.

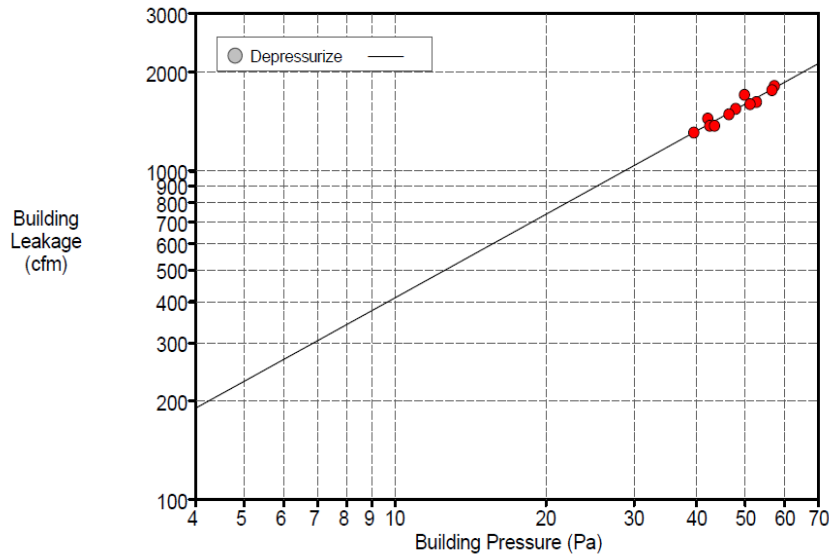


The 2018 IECC recommends ≤ 4 cfm/ft² for commercial buildings and ≤ 3 ACH for any new residential construction. This standard encourages the maximum benefit to the conditioned air distributed in the building before it needs to be replenished.





Blower Door Test Results and Graph



Test Results at 50 Pascals:

cfm50 Airflow	1601 (+/- 2.4 %)
ACH50	1.05
cfm/ft ² (Floor Area)	0.2555

A multipoint test from 40- 60PA (pascals of pressure) was conducted with a DG-1000 digital monometer and Tectite 5.0 Software.

- Square footage and volume calculations were made using a computer model developed from building plans and actual photos taken during the assessment.



- The volume of the structure was calculated to be **91,667 Cubic Feet**.
- The conditioned floor area was calculated to be **6266.6 Square Feet**.
- Infiltration at -50 pascals of pressure was measured at **1601 Cubic Feet Per Minute**.
- The test showed the building has a **1.05 ACH50**.

HVAC Equipment and Duct Leakage Test Results

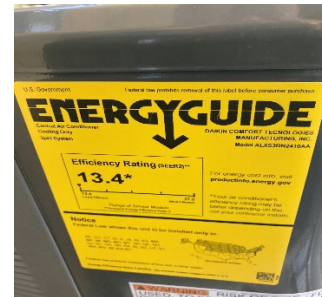
The DAIKIN model HVAC systems for the building include four complete systems. The two primary HVAC systems share a common return plenum with separate supply ducts. The third unit is for the loft area over the kitchen space. And the fourth unit is mini split system servicing the kitchen area.

Equipment data:

Primary Systems 1 & 2 are 97% Efficient Furnaces with 13.4 SEER2 AC Units

Secondary System is a 97% Efficient Furnace with a 13.4 SEER2 AC Unit

Mini-Split Heat Pump has a HSPF2 at 8.1 with and cooling system of SEER 14.6



Duct leakage tests on the HVAC units servicing the building were recorded as follows:

- Combined Systems 1 & 2: Leakage to outside 85 cfm, total system leakage 380 cfm.
- System 3: Leakage to outside 14 cfm, total system leakage 380 cfm.
- System 4: Was not tested due to limited available testing space.

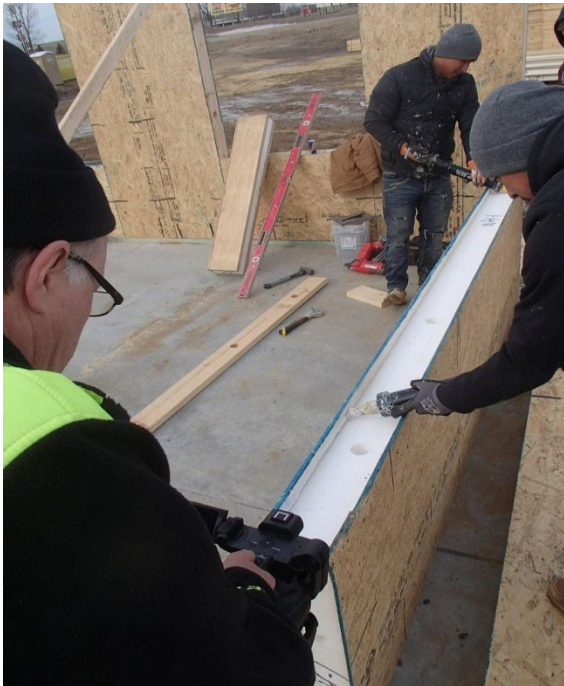
These results are very impressive for a structure of this nature and were necessary for a complete energy model.



Unique Design



The Deichmann family garage building is a one of a kind structure. Their unique building needs have been fully accommodated in a structure built using SIP panels. Not only were SIPs used for the exterior walls, but this building incorporated two large energy efficient garage doors to accommodate oversized vehicles and equipment being brought in to it. The wall construction for these specialized doors validate the versatility of SIPs construction in a traditionally common building.



In



Energy Model Comparison Results

Two models were created in eQuest with the only change being made to the wall. The original model was created using standard building materials for a metal frame, 2x6, 24in on-center structure. This model was then compared to the EPS structure that was completed with R-33 panels. It is important to note that the tested rate of 1.05 ACH was used in both models.

This report recognizes that it would take a considerable amount of time and effort to achieve an identical air sealing performance in a standard steel building. **The analysis does not address the additional air sealing efforts that would be necessary to bring a standard building with metal sheeting up to the same level of performance characteristic of a building constructed with the EPS system components.** This allowed for the total isolation of the SIPs from all other variables used in the total analysis.

Below are the comparative results from the simulations run in eQuest.

Report #1 Annual Energy Use or Demand

Highlights of this simulation include 38% in cumulative savings.

Annual Energy and Demand (pg 1 of 2)		Ann. Source Energy		Annual Site Energy		Lighting	HVAC Energy		Peak		
		Total Mbtu	EUI kBtu/sf/yr	Elect kWh	Nat Gas Therms	Electric kWh	Electric kWh	Nat Gas Therms	Total Mbtu	Elect kW	Cooling Tons
Annual Energy USE or DEMAND											
0	Base Design	442	88.43	19,037	2,472	9,130	7,203	2,378	262	23	18
33	0+R-33	377	75.43	16,154	2,118	9,130	4,320	2,024	217	16	11
Incremental SAVINGS (values are relative to previous measure (% savings are relative to base case use), negative entries indicate increased use)											
33	0+R-33	65	13.00 (15%)	2,883 (15%)	355 (14%)	0 (0%)	2,883 (40%)	354 (15%)	45 (17%)	7 (29%)	7 (38%)
Cumulative SAVINGS (values (and % savings) are relative to the Base Case, negative entries indicate increased use)											
33	0+R-33	65	13.00 (15%)	2,883 (15%)	355 (14%)	0 (0%)	2,883 (40%)	354 (15%)	45 (17%)	7 (29%)	7 (38%)





Report #2 Annual Electrical Energy by Enduse

Highlights 15% cumulative savings in the reduction of the annual electrical energy by end use.

Annual Electric Energy by Enduse (pg 1 of 4)

Annual Energy USE (kWh)	Ambient Lights	Task Lights	Misc Equip	Space Heating	Space Cooling	Heat Reject	Pumps & Aux	Vent Fans	Dom Ht Wtr	Exterior Usage	Total
0 Base Design	9,130	0	2,704	0	4,590	0	220	2,393	0	0	19,037
33 0+R-33	9,130	0	2,704	0	2,567	0	220	1,534	0	0	16,154
Incremental SAVINGS (MWh) (values are relative to previous measure (% savings are relative to base case use), negative entries indicate increased use)											
33 0+R-33	0.00 (0%)	--	0.00 (0%)	--	2.02 (44%)	--	0.00 (0%)	0.86 (36%)	--	--	2.88 (15%)
Cumulative SAVINGS (MWh) (values (and % savings) are relative to the Base Case, negative entries indicate increased use)											
33 0+R-33	0.00 (0%)	--	0.00 (0%)	--	2.02 (44%)	--	0.00 (0%)	0.86 (36%)	--	--	2.88 (15%)

