



Center for Energy and Environment

Carleton College Builds Phius- certified Student Housing

Carleton College in Northfield, Minnesota, is known for its commitment to sustainability and climate leadership. In alignment with their Sustainable Future Framework to reduce emissions and improve the quality of campus living spaces, the College set out to build 11 student housing buildings (adding 184 new beds and office spaces) to achieve Passive House Institute U.S. (Phius) CORE 2021 certification. The Phius certification ensures the highest standard of efficiency and performance while dramatically reducing overall energy use on campus. This is the first passive house student housing project in the Midwest, and one of the first student housing projects in the country to become Phius certified.

Project Background

To execute this plan, Carleton College engaged architecture and engineering firm LHB to assemble a team of experts to plan, construct, and certify 11 townhouses on two job sites. Center for Energy and Environment (CEE) provided initial design review, ongoing project consultation, and onsite testing and verification to ensure the buildings met Phius CORE 2021 standards.

Among other project partners, CEE worked closely with sustainability analyst and Certified Passive House Consultant (CPHC) Molly Eagen of Cause Sustainability. Cause performed preliminary WUFI energy modeling, which allowed the project team to assess and choose the energy efficiency features best suited to each site, the campus's existing geothermal district energy system, and Phius requirements.

Testing and Inspection

Jake Selstad, a senior rater at Center for Energy and Environment (CEE), was the Phius Certified Verifier for all 11 buildings on the project. In addition



Certifications and Ratings

- **Phius CORE 2021**
- **DOE Zero Energy Ready Homes** (now DOE Efficient New Homes)
- **EPA Indoor airPLUS**
- **Energy Star New Construction** (version 3.1)
- **RESNET HERS: 27-30 before solar**

Energy Efficiency Features

- **Super air-tight construction:** Average infiltration per building: 0.059 CFM50/ft² (roughly 0.6 ACH50)
- **Increased R-values on building assemblies:** Insulated concrete forms on foundation walls (R-31), floor slab (R-30), above-grade exterior walls w/ continuous exterior rigid insulation panels (R-43), and vented attics (R-70)
- **High performance triple-pane windows** (U-Value: 0.14 fixed and 0.17 casement) with solar heat-gain coefficients tailored to facade orientation
- **Energy Recovery Ventilation** (Adjusted SRE: 77-83%) providing fresh air to living spaces
- **Water loop heat pumps** served by campus-wide geothermal district energy system
- **On-site solar photovoltaic panels**
- **All appliances Energy Star rated**



Partners

- Phius
- Carleton College
- LHB, Inc.
- Cause Sustainability
- Emanuelson-Podas
- Mattson Macdonald
Young Structural
Engineers
- TKDA
- PEGASUS GROUP
- Terra Construction
- Alpen Windows
- Horwitz
- Gephart Electric
- Efficiency
Commissioning LLC



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to early-stage consulting and reviewing design plans to ensure compliance with all pre-requisite certifications (EPA's ENERGY STAR, Indoor airPlus, and DOE's Zero Energy Ready Homes), CEE also provided preliminary energy modeling.

Because airtight and insulated building assemblies are critical to Phius certification, CEE conducted extensive preliminary (slab and foundation wall insulation inspection) and mid-construction blower door testing along with comprehensive reporting and communication with the contractor Terra Construction. Most contractors are not very familiar with passive house building, so this engagement helped increase their fluency and pass Phius's rigorous airtightness standards.

Near the end of construction, CEE performed final testing and verification. This included a blower door and HVAC ductwork testing, and testing and balancing of the Energy Recovery Ventilation (ERV) units in each building.

Results

Based on Cause's final WUFI modeling of the as-built construction, the 11 buildings are projected to achieve a 70% reduction (50% from geothermal and 20% from passive house principles) in energy use compared to similar buildings meeting minimum 2018 IECC energy code.

In total, the New Homes team helped this project achieve HERS scores ranging between 27 and 30 before solar, whereas an average new HERS-rated Minnesota building receives a score of 46. The 11 buildings averaged a final air leakage of .059 cfm50/ft² (approximately 0.6 ACH50). Most new single-family homes built to code are considerably less efficient and range between .20-.30 cfm50/ft² (approximately 3.0 ACH50).

Ventilation is especially crucial in a super airtight envelope, so virtually every register in each building was individually measured and balanced by the tab contractor and re-verified by CEE. The Energy Recovery Ventilation units in each building provide fresh air with high-efficient recovery to ensure healthy indoor air quality.