Building America Case Study

Balancing Hydronic Systems in Multifamily Buildings

Chicago, Illinois

PROJECT INFORMATION

Location: Chicago, IL area

Partners:

Elevate Energy
elevateenergy.org/

Partnership for Advanced Residential Retrofit
gastechnology.org/PARR

Building Component: HVAC

Application: Multifamily

Year Tested: 2014

Applicable Climate Zones: 1, 2, 3

PERFORMANCE DATA

Retrofit: Booster pump to increase flow in an underheated zone

Cost of energy efficiency measure (including labor): $6,330

Temperature spread decrease: 6.6°F

Most older multifamily buildings in Chicago are heated by centrally metered steam or hot water systems. These buildings cannot operate efficiently when these systems become imbalanced because of undersized piping, improperly configured flow rates and water temperature, and owner and occupant interactions with the system and controls. The buildings become under- and overheated, which causes tenant discomfort and higher energy use intensity.

In this project, the U.S. Department of Energy Building America team Partnership for Advanced Residential Retrofit (PARR) worked with Elevate Energy to conduct a literature review and field research on cost-effective balancing hydronic systems in a multifamily hydronic system at two Chicago area multifamily buildings with known balancing problems. They collected high resolution temperature data at the buildings to quantify the possible extent, extremity, and duration of imbalance in a hydronically heated building. One building was retrofitted with a booster pump on an underheated wing; the other was used as a control.

The research revealed that the temperature in a unit in such a building can vary as much as 61°F, particularly if windows are open or tenants use intermittent supplemental heating sources such as ovens. Temperature-averaging controls cannot be used to increase system efficiency when these types of interactions take place. The team added a booster pump at the test building, which lowered the average temperature spread from 22.1°F to 15.5°F, probably reduced the use of ovens for heating, and decreased the extent of underheating to the units furthest from the boiler.

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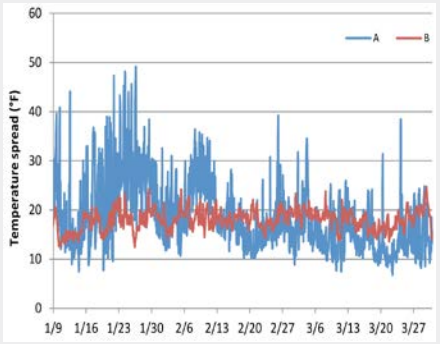
Temperature Imbalance

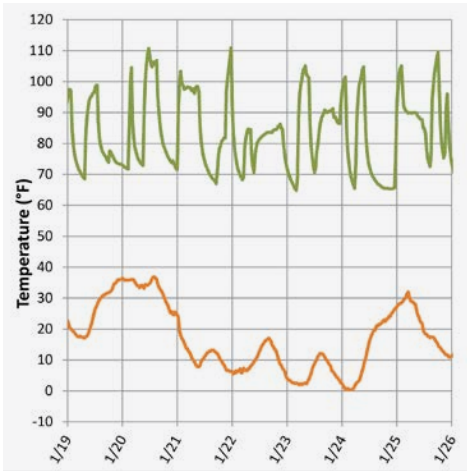
Temperature imbalance can be an extreme and serious issue in multifamily hydronic buildings. Type and age of construction, piping configuration, heater emitter type, zoning, and even tenant behavior can affect how evenly the building is heated. In an imbalanced building, temperature can fluctuate in a single unit by more than 50°F.

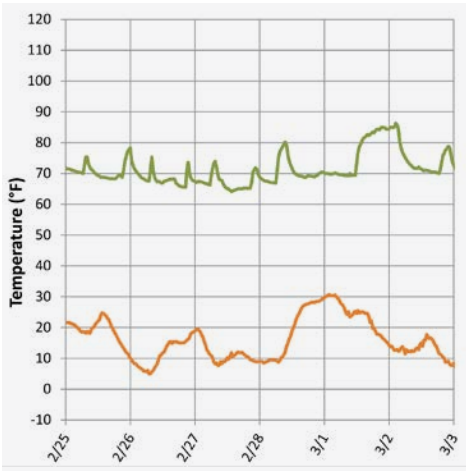


High resolution temperature data were collected at two test buildings. The graph shows a wide range of temperatures and spreads among units and over time.

For more information, see the Building America report, *Balancing Hydronic Systems in Multifamily Buildings,* at: *buildingamerica.gov*

Image credit: All images were created by the PARR team.





Left: pre-retrofit. Right: post-retrofit. The extreme temperature peaks in the test building decreased significantly, which probably indicates that ovens were used much less for heating. (Green lines indicate unit temperature. Orange lines indicate outside temperature.)

Lessons Learned

- Unit temperature in a multifamily hydronic building can vary by as much as 61°F, particularly if windows are open or tenants use intermittent supplemental heating sources such as ovens.
- Temperature averaging controls can be rendered ineffective when tenants are uncomfortable and try to control the heating in their units.
- The average temperature spread in the test building decreased from 22.1°F to 15.5°F after a booster pump was installed on one of the building's two main line loops.
- Multifamily hydronic systems involve a wider range of components than steam-heated buildings and can become imbalanced for more reasons; thus, hydronic balancing can be a more complex process.
- Tenant discomfort, heating fuel waste, threats to health and safety, and moisture damage from improper moisture levels can all be alleviated by proper balancing.

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For more information, visit:
buildingamerica.gov

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