

Steam Systems Balancing and Tuning

Larry Brand
Gas Technology Institute
Jayne Choi, Peter Ludwig
CNT Energy



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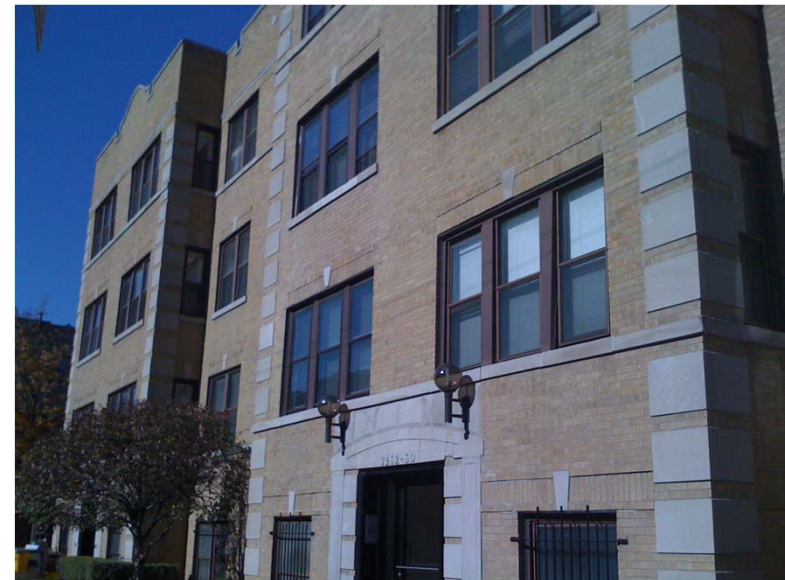


Test Plan

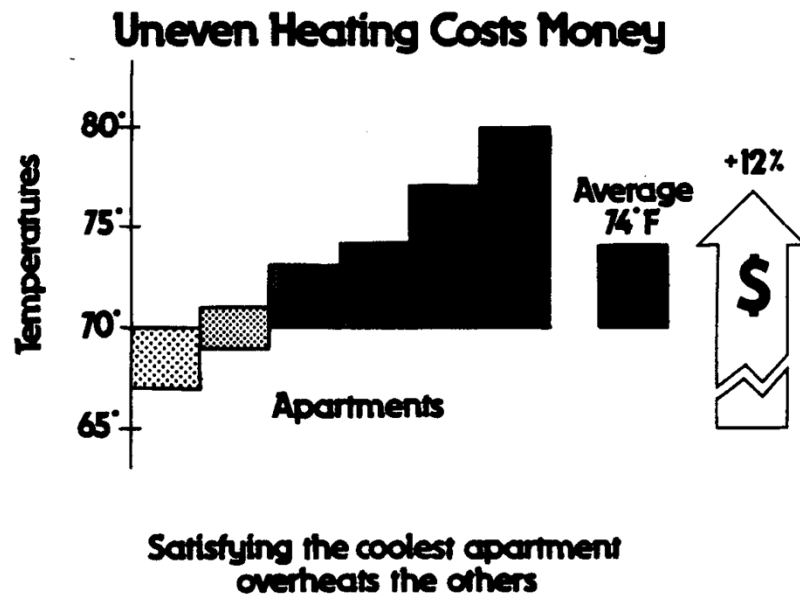
- **Problem Statement**
 - Background
 - Cost-effectiveness
 - Objectives
- **Experiment**
 - Research questions
 - Scope
 - Measurements and data
- **Analysis**
- **Expected Results**
- **Conclusions**

Background

- Chicago's older multifamily housing stock
 - Predominantly heated by centrally metered steam systems
- Old steam systems invariably suffer from imbalance
- Contractors currently not selling system balancing as a service or recommending it as a measure



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(Peterson, G., 1985)

Cost-effectiveness

- Improving the balance of buildings provides
 - Opportunity for cost savings
 - Increased resident comfort
 - Katrakis, J. et al (2010): 5-15% energy savings, 2-5 year payback
 - Documented savings of up to 10% of heating load

Objectives

- Increased visibility of steam balancing as energy efficiency measure
- Streamline steam balancing to make it cost-effective and transparent
- Provide building owners with increased understanding of their heating systems thereby reducing energy costs

Research questions

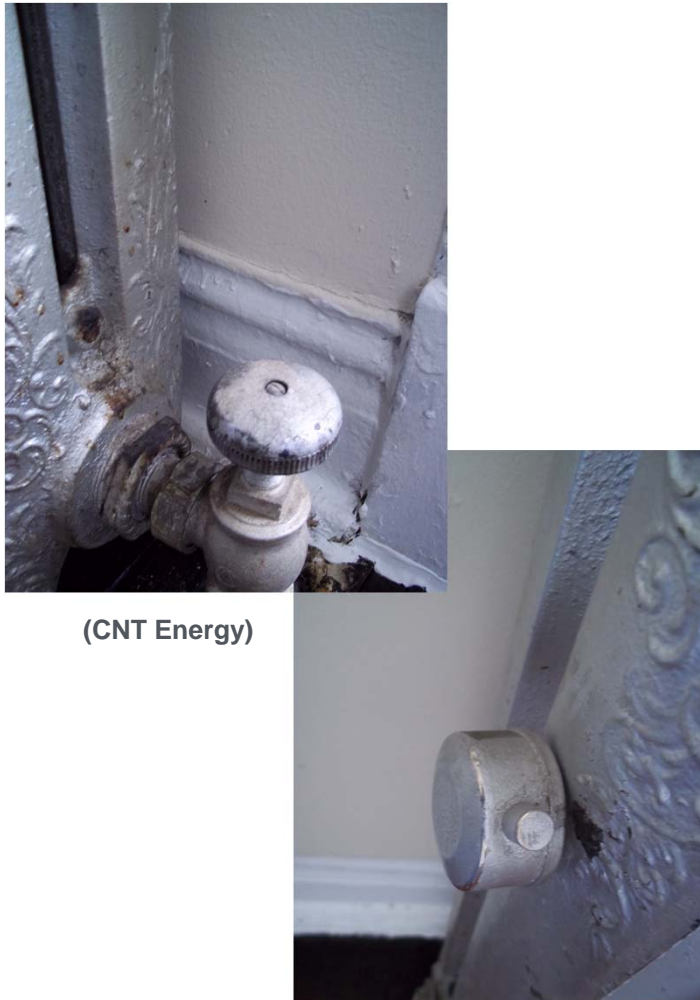
- How do steam balancing measures affect the temperature dynamics within units?
- Which individual steam balancing measures are most cost-effective?
- Which measures should be further promoted to increase awareness about their contribution to system balancing?
- Are certain steam balancing measures more effective on certain building types?

Scope

- ~10 test buildings, all with 1-
pipe steam systems
- 1. Retrieve pre-upgrade
measurements and data for
monitoring
 - Structural data
 - Boiler information/pipe
structure/condition of vents
 - Temperature data
- 2. Develop detailed scopes of
work



(<http://www.onsetcomp.com/products/data-loggers/u10-003>)



Scope (cont.)

3. Oversee general contracting
 - RFPs from 3 contractors for each measure
 - Inspection of work/quality control
4. Collect post-upgrade temperature data
5. Utility bill analysis comparing pre-upgrade and post-upgrade energy use

Measurements and data

- Temperature (indoor/outdoor)
- Radiators (EDR, vents)
- Main line piping (length of loops, main line vents)
- Boiler (capacity, size, burner condition)



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Measurements and data (cont.)

- Near boiler piping (height of header piping, width of risers, wet/dry return)
- Boiler controls (pressure control settings, number of sensors, usage by maintenance staff)
- Water usage (pre/post water usage by heating system)

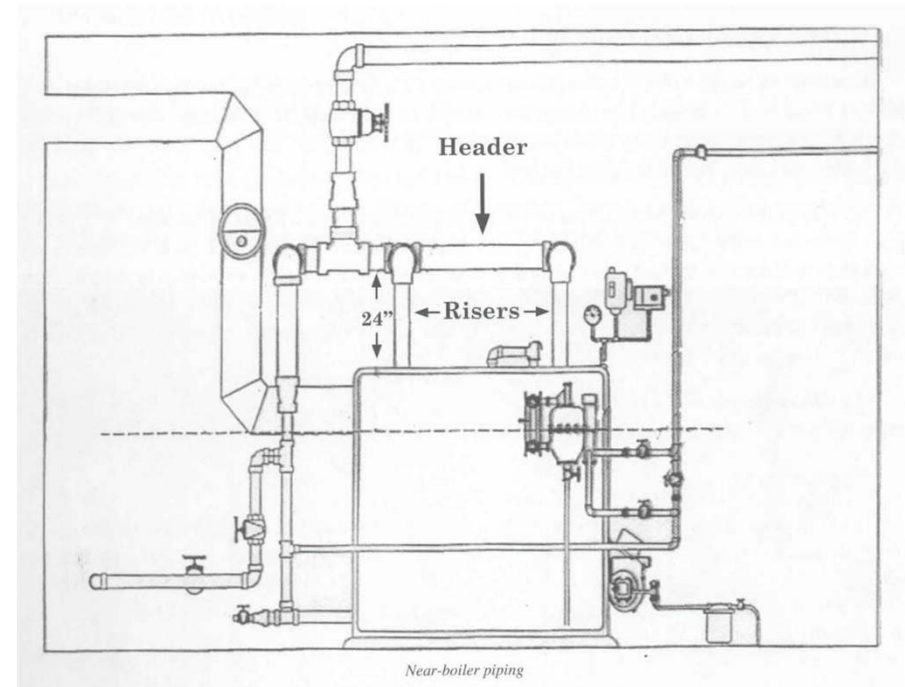


Diagram of near boiler piping (Holohan, D., 2010)

Data logger inventory

Data Collected	Sample Model	#/Building	Total #
Indoor Air Temperature	HOBO U10 Temperature Data Logger	6	60
Outdoor Air Temperature	HOBO U23 Pro v2 Temperature/Relative Humidity Data Logger	1	10
Boiler Firing Pattern	HOBO U12 4-Channel External Data Logger	1	10

Cost-effectiveness

- Natural gas savings
 - Utility bill analysis
- Natural gas savings converted to financial savings
- Calculation of simple paybacks from yearly financial savings and measure costs
- Will need to be aware of behavioral changes



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Temperature control and steam system behavior

- Coordination of temperature and boiler-firing data to determine:
 - Calculation of times taken for units to heat up
 - Rate of heat gain/loss across units



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Expected results

- Confirmation of 5-15% mean energy savings in test buildings
- Comprehensive analysis of measured savings and cost-effectiveness of steam balancing
- Information on the most effective steam balancing measure packages
- Guidelines for successful coordination with building owners and maintenance staff

Conclusions

- There exists a need to develop steam balancing as a viable energy efficiency measure
- Research is needed to further and encourage market penetration of this measure
- Coordinating with building owners and educating maintenance staff on boiler controls is a crucial factor in keeping heating costs down
- This project will further develop the methodology for and investigate the costs and energy savings associated with steam system balancing

Jayne Choi

Energy Analyst

CNT Energy

jchoi@cntenergy.org

Peter Ludwig

Energy Efficiency Programs Manager

CNT Energy

peter@cntenergy.org

Holohan, D., 2010. *Greening Steam: How to Bring 19th-Century Heating Systems into the 21st Century (and save lots of green!).*

Katrakis, J., Lobenstein, M., & Hewett, M., 2010. *Cost-effective boiler system retrofits.* Consulting-Specifying Engineer.
[http://m.csemag.com/index.php?id=2832&tx_ttnews\[tt_news\]=22127&cHash=3b07e71e00](http://m.csemag.com/index.php?id=2832&tx_ttnews[tt_news]=22127&cHash=3b07e71e00)

Peterson, G., 1985. *Achieving Even Space Heating in Single Pipe Steam Buildings.* CEE TR85-8-MF. Minneapolis: Center for Energy and Environment. www.mncee.org/