CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

1. Category - Check one and indicate New, Existing, or Existing Building Commissioning (EBCx)

☐ Commercial Buildings	☐ New	☐ Existing or	☐ EBCx	
Institutional Buildings:				
■ Educational Facilities	■ New	☐ Existing or	☐ EBCx	
☐ Other Institutional	☐ New	☐ Existing or	☐ EBCx	
☐ Health Care Facilities	☐ New	☐ Existing or	☐ EBCx	
☐ Industrial Facilities or Processes	☐ New	☐ Existing or	☐ EBCx	
☐ Public Assembly	☐ New	☐ Existing or	☐ EBCx	
☐ Residential (Single and Multi-Family)				

2. Name of building or project: David Rubenstein Forum

City/State: Chicago, Illinois

3. Project Description: New 97,000-square-foot, 10-story academic meeting and event venue.

Project Study/Design Period: 06/2015 (Begin date (mm/yyyy)) to 07/2020 (End date (mm/yyyy))

Percent Occupancy at time of submission: Partial (not full capacity due to COVID)

4. Entrant (ASHRAE member with significant role in project):

a. Name: Vidri (Last) Rina (First) (Middle)

Membership Number: 8276816

Chapter: Illinois

Region: VI

b. Address (including country): Primera Engineers, 550 W. Jackson Blvd., Suite 600

Chicago (City) IL (State) 60661 (Zip) USA (Country)

c. Telephone: (O) 312-242-6336 d. Email: rvidri@primeraeng.com

e. Member's Role in Project: Lead Mechanical Engineer

f. Member's Signature: Rina Vidri Digitally signed by Rina Vidri Date: 2021.09.14 11:30:07 -05'00'

5. Engineer of Record: Primera Engineers

By affixing my signature above, I certify that the information contained in this application is accurate to the best of my knowledge. In addition, I certify that I have discussed this entry with the owner and have received permission from the owner to submit this project to the ASHRAE Technology Awards Competition.

Project Summary

The David Rubenstein Forum at the University of Chicago, which opened in Fall 2020, is a 97,000-square-foot, ten-story convening hub located on the University's Hyde Park campus. The Rubenstein Forum responds to the University's need for a multi-purpose venue to host meetings and conferences that were previously held at venues off-campus. As a space on intellectual exchange, it includes highly-collaborative, well-appointed meeting and event spaces commensurate with the types of conferences, special events, workshops, and symposia that University faculty and academic departments frequently host.

The Rubenstein Forum is LEED Gold certified. The HVAC design includes a dedicated outdoor air system with energy recovery and chilled beams, using campus chilled water for cooling and condensing boilers for heating. A computational fluid dynamics (CFD) analysis was performed to demonstrate rapid temperature adjustment capabilities for the meeting rooms. CFD analysis was also performed to optimize the quantity and placement of perimeter fin tube equipment and chilled beams. The electrical design included the necessary power distribution for building systems and operations and for audio-visual needs. Energy services included development of the whole building energy model, including façade analysis optimization and life cycle cost analyses of various system options.

Energy Efficiency

The engineering team identified approximately 5,500 MMBtu, or around 40%, overall energy savings from the baseline to proposed models of the Rubenstein Forum. On a more specific basis, there were approximately 361,000 kWh (or 20%) of annual electricity savings, 3,800 MMBTu (or 59%) of annual natural gas savings, and 43,000 Ton-Hr (or 40%) of annual chilled water savings. In terms of energy cost, this totaled an approximate savings of 29% annually, propelling the project to LEED Gold status. Table 1 shows the predicted annual energy performance of the baseline and proposed models. Figures 1-3 display the monthly distribution of electricity, natural gas, and chilled water use, respectively.

	Electricity (kWh)	Natural Gas (MMBtu)	Chilled Water (Ton-Hr)
Baseline Model	1,801,500	6,530	108,591
Proposed Model	1,440,200	2,689	65,512
Savings	**361,300**	**3,841**	**43,079**

Table 1: Predicted energy use of Baseline and Proposed models

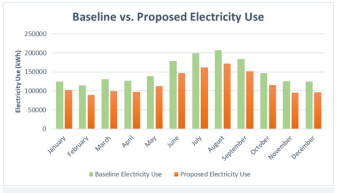


Figure 1: Monthly electricity use

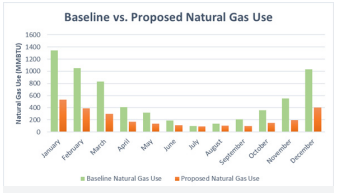


Figure 2: Monthly natural gas use

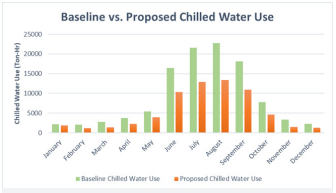


Figure 3: Monthly chilled water use

This energy savings is derived from several factors. Most of the AHUs that serve the building have energy recovery via an enthalpy wheel (both single and series arrangements). Chilled beams provide higher efficiency cooling in many spaces. Most of the spaces contain daylighting and occupancy controls which, combined with higher efficiency fixtures, provide a great deal of savings over the baseline. High efficiency boilers were used to provide heat to the hot water coils, allowing the proposed design to save energy.

Over the last year of operation, the Rubenstein Forum has seen some additional energy improvements compared to the baseline model; in one area, it has realized some savings compared to the proposed model. In terms of overall energy use compared to the baseline, the Rubenstein Forum improved in all areas except for chilled water use, as shown in figures 4, 5, and 6.

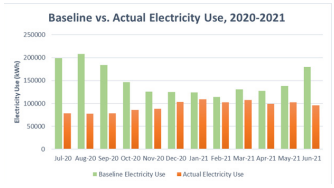


Figure 4: Baseline vs. Actual electricity use

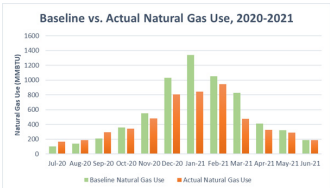


Figure 5: Baseline vs. Actual natural gas use

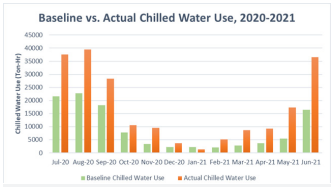


Figure 6: Baseline vs. Actual chilled water use

The building has seen a 37% improvement in electricity use, an 18% improvement in natural gas use, and a 48% increase in chilled water use compared to the baseline model. In addition, the Rubenstein Forum has seen 22% savings in electricity use, compared to the proposed design, as shown in Figure 7 and Table 2.

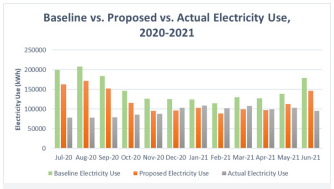


Figure 7: Monthly electricity use of models vs. actual

	Annual Electricity Use (kWh)
Baseline Model	1,801,500
Proposed Model	1,440,200
Rubenstein Forum	**1,129,043**

Table 2: Electricity savings of the Rubenstein Forum compared to simulated energy models

These realized energy savings likely stem from many things. For electricity, it is likely due to more accurate occupancy schedules such that mechanical equipment running on electricity is only used when needed, more accurate lighting schedules to reflect occupancy, and better control of plug loads. For natural gas use, the improvement is likely due to the weather being warmer than the simulations projected over this time, leading to a lower

heating load. Conversely, the warmer weather is likely one reason why the chilled water use was greater than the simulations predicted. Another possible reason for the chilled water increase is that the system likely needed to operate more often and under more stringent conditions than the models predicted due to more strict temperature/humidity requirements needed to condition spaces containing artwork.

The Rubenstein Forum energy models have not been calibrated to the actual energy use of the building, which is another factor that can lead to discrepancies between projected energy use and actual energy use. Most importantly, the proposed model beat the baseline model, which illustrates that the Rubenstein Forum does improve over the energy use of a typical building of this type and exceeds energy code.

Indoor Air Quality

The Rubenstein Forum has a make-up air handling unit, two dedicated outside air handlers (DOAS) and two variable air volume (VAV) air handling units with energy recovery to provide conditioned air to the spaces during all occupied hours. These units are heated by a hot water system served by three high efficiency gas boilers and cooled by a chilled water system served by two heat exchangers, which draw from the existing campus chilled water loop. Most of the net square footage of the Rubenstein Forum utilizes demand-controlled ventilation through carbon dioxide sensors and occupancy sensors; these sensors can also override the BAS controls, if needed. Variable air volume boxes are implemented throughout the building to ensure enough conditioned and ventilation air reaches each space based on desired temperature and humidity.

Innovation

In addition to the energy recovery (both single wheel and series wheel arrangements) on the air handling units, staggered startup of equipment to minimize peak in rush current and campus global zone temperature resetting allows the University to better manage peak energy use. The Rubenstein Forum uses chilled beams in an innovative way for perimeter cooling. It draws its cold water from an existing chilled water loop while using heat exchangers to serve as a pressure break between the campus and building cooling systems. In addition, it uses multiple secondary loops to allow for higher temperature differentials. Variable air volume boxes are also implemented in a creative way so that every space is properly ventilated while continuously adjusting outside air rates to zones, along with zone temperature setpoints. Because of the environment created by COVID-19, occupancy in building often shifts between extremes. The Rubenstein Forum air handling systems utilize fan arrays—with individual fan control within the array—allowing for a large, stable operating range. Multiple fans within each array can shut down—not just modulate—to provide greater flexibility and fan energy savings. The Rubenstein Forum contains a dedicated make-up air system serving only the kitchen and includes high efficiency kitchen exhaust fume hoods, which regulate exhaust and make-up airflow (energy) based on cooking intensity and occupancy to provide some additional energy savings.

Operation & Maintenance

The key energy-using systems were fully reviewed and verified via the ASHRAE Commissioning Process Guidelines. This included development of pre-functional checklists for the installing contractor to use as a guideline to ensure access for maintenance, inspection, cleaning, and replacement is available for each component. Access was further verified during field observations. Special consideration was placed on locating most above ceiling equipment at a location that can be accessed by a 10-foot ladder. It was also verified that small lifts would fit in the service elevator to allow for further access.

The commissioning process was very successful for this project and was a total team effort. The functional testing and full system testing verified the design intent. Most control devices, including the devices operating the energy recovery wheels, fan arrays, boiler plant and kitchen hood systems are controlled by the BAS to ensure consistent operation with known performance. The contractor team provided complete O&M manuals, spare parts lists, and owner training as part of the building turnover.

Cost Effectiveness

As shown in Table 3, the proposed model is saving approximately 29% in energy cost per year over the baseline.

	Annual Energy Cost ($)
Baseline Model	$186,257
Proposed Model	$132,136
Savings	**$54,121**

Table 3: Energy cost savings of Proposed model

While a concrete payback period is unknown, 29% annual energy cost savings compared to an average building of this type is substantial and will provide a return on investment every year. A 40% reduction of energy use will have a positive effect on the

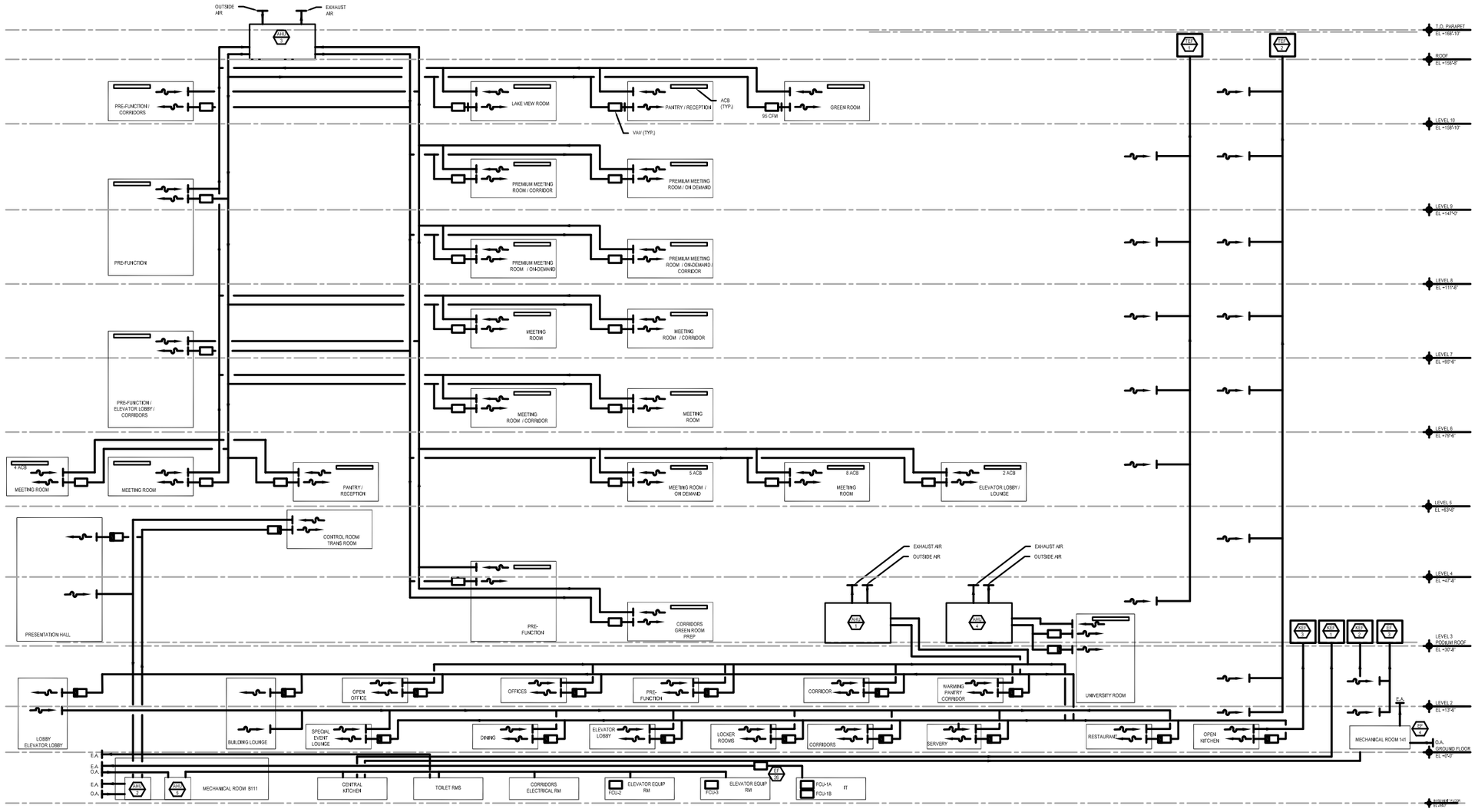
Environmental Impact

environment. In addition, the Rubenstein Forum has a relatively low reliance on natural gas/fossil fuels compared to its use of electricity, which further increases its positive environmental impact. In terms of site EUI, the proposed model improves by 40%, as shown by Table 4.

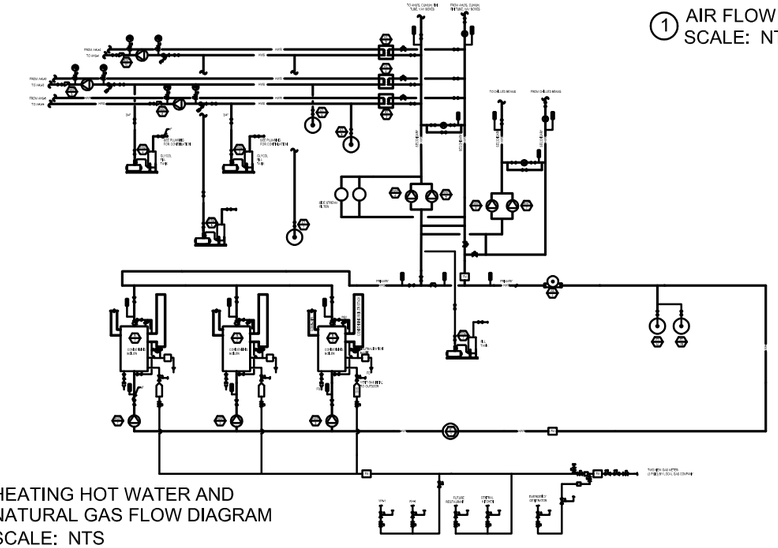
	EUI (kBtu/sf/yr)
Baseline Model	129.8
Proposed Model	77.8
Improvement	**52.0**

Table 4: EUI improvement of Proposed model

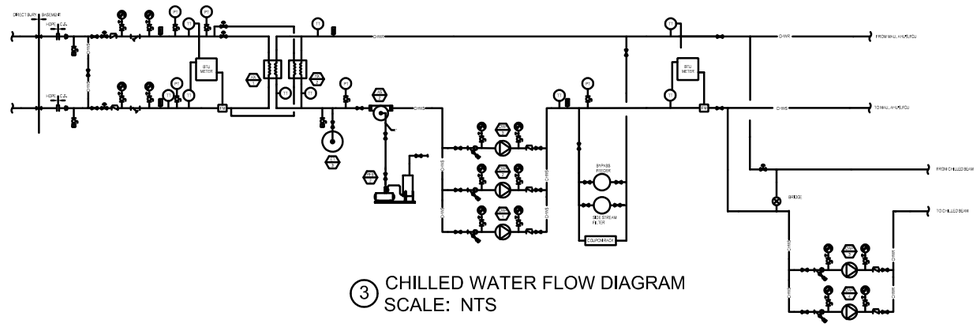
The EUI of the proposed model is below the Energy Star target for a College Education building, which further shows that it has a positive environmental impact.



1 AIR FLOW DIAGRAM
SCALE: NTS



2 HEATING HOT WATER AND NATURAL GAS FLOW DIAGRAM
SCALE: NTS



3 CHILLED WATER FLOW DIAGRAM
SCALE: NTS