Retrofitting a Live and Learn Center

Owner's Project Requirements – 2027 ASHRAE Design Competition

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1. Introduction

A university in Taipei, Taiwan is looking to retrofit a hotel into a live and learn community. The goal of this project is to transform an existing facility into a center that provides spaces for students to dorm, network, study, and learn. This phase of the project will focus on the 7th- roof levels only.

2. The Project

The existing building spans 300,000 square feet (~28,000 square meters) and has 28 stories. Levels 1-6 are not a part of this scope, original construction occurred in 2010, under ASHRAE 90.1 2007 energy codes. The scope of this project will focus on levels 7-28 (approximately 165,000 square feet/ 15,300 square meters). Level 7, originally consisting of offices and work stations, has been redesigned for computer stations, a student lounge, and fitness rooms. Level 8 has also been reconfigured to expand the laundry area, adding electric washer and dryers for student use. The owner intends to reuse the existing gas dryers unless there is significant savings in replacing them. The other rooms on level 8 have been converted to classrooms and a multipurpose room where students will have access to some kitchen equipment. Levels 10-27 consisted of hotel guestrooms, and will be converted into dormitories to accommodate up to 330 students. Levels 9 and 28 are available for mechanical systems. The owner wants to install all new HVAC systems for the levels in this scope.

In addition to designing the HVAC system, the engineer has been asked to provide recommendations for new windows in accordance with ASHRAE 90.1 or other design team recommendations. Since this is a retrofit design, cost and feasibility of these recommendations should be considered. Please refer to the drawings of the new layouts and additional requirements in the OPR.

*Note: The building is not affiliated with any known universities.

3. Owner's Requirements

The design team shall make every effort to provide a safe and sustainable design, taking into account: energy efficiency, occupant health and safety, occupant comfort, functionality, future flexibility as well as maintainability and a 50-year service life.

The Owner wants a building that is comfortable, energy efficient, and easy to operate and maintain. Building systems should allow staff to monitor and trend equipment performance, adjust schedules, receive alarms, and track energy use to help the building run efficiently.

Space Temperature and Space humidity requirements are defined below, if a space is not listed a general assumption of the space conditions should be made based off of ASHRAE standards by the design team:

Functional Use	**Temperature and Relative Humidity Requirements:**
Offices and Workstations, Student Lounges, Dormitories, Circulation	Summer: 75 F (24 C) DB/ Winter: 72 F (22 C) DB RH: 50%
Laundry	Summer: 80 F (26.5 C)/ Winter: 65 F (18 C) RH max: 60%
Fitness	Summer/ Winter: 68 F (20 C) RH max: 50%
Mechanical/Electrical Rooms	55 F DB (13 C) to 85 F DB (30 C) No RH requirement

Expected Hours of Operations

1. Estimated hours of operation for day use public areas (Offices, workstations):
    a. 7am- 7pm Monday through Friday, 7am-12pm Saturday, Closed Sunday.
2. Estimated hours of operation for day/night use public areas (Laundry, Lounges, Fitness):
    a. 5am- 10pm Sunday through Saturday.
3. Residential operation, 24/7.

The design team shall select systems based on the lowest life cycle cost as well as the below goals of the Owner.

1. Design the system to meet ASHRAE standards as listed in the Codes and Standards section.
2. The Owner has a desire to follow the ASHRAE Advanced Energy Design Guide for Multi Family Buildings.
3. Strive to achieve reduced energy consumption and carbon footprint for a high-performance space that approaches a Net Zero Energy Building and/or Carbon Neutral Building.
4. Provide excellent indoor environmental quality that provides a comfortable and safe environment for all occupants.
5. Incorporate design attributes related to improved HVAC system performance, space utilization, acoustical qualities, interior style, and durability of finishes.

6. Meet the operation and maintenance needs for an easily serviceable, maintainable, and secure facility that has low utility and maintenance costs.
7. Design that meets the Owner's project budget.
8. Maintain thermal comfort in each space per ASHRAE Standard 55.
9. Provide ventilation to each space per ASHRAE Standard 62.1.
10. Provide acoustical controls per ASHRAE Handbooks (i.e. the Chapters on Noise and Vibration Control in HVAC Application, and Sound and Vibration in Fundamentals).
11. Operate the building at positive pressure to prevent unwanted infiltration.
12. HVAC and building systems should be capable of communicating through BACnet to allow for future system integration and centralized monitoring. These features should also be accessible remotely through multiple devices, including laptops, tablets, and mobile phones.

4. Budget Considerations and Limitations

The approach to allocating resources for the HVAC systems is to examine life cycle costs, including capital investments, operating costs, and maintenance costs. The key values are

1. Assume the owner's mechanical budget is 471,690,000 NTD or $15,000,000 US.
2. Assume the systems and equipment serving these floors are completely independent of the lower levels.
3. Life of the HVAC system: 30 years minimum
4. General inflation rate and rate of return as defined in the Utility and Service Life Overview.
5. Utility escalation rate as defined in the Utility and Service Life Overview.

5. Utility and Service Life Overview

General

The purpose of this document is to setup the utility rate structures and elements of the energy economy used in the system selection competition for life cycle costing. It should be noted that the stated situation and numbers may not reflect the reality of the actual energy situation or rates in this region. Regardless, teams should use the values below for the 2027 Design Competition.

General

The purpose of this document is to setup the utility rate structures and elements of the energy economy used in the system selection competition for life cycle costing. It should be noted that the stated situation and numbers may not reflect the reality of the actual energy situation or rates in this region. Regardless, teams should use the values below for the 2027 Design Competition.

Utilities

The following utility rate structure will apply (prices given in NT$):

Utility	Summer (May 16 – Oct 15)		Winter (Oct 16 – May 15)	
	Peak (M-F 09:00-24:00)	Non-Peak	Peak (M-F 06:00-11:00 & 14:00-24:00)	Non-Peak
Electricity	$ 6.75/kWh	$ 2.71/kWh	$ 6.37/kWh	$ 2.46/kWh

Electric Demand	$ 223.60/kW/month	$ 166.90/kW/month
Natural Gas	$ 8.29/m^3	
Water	$ 10.00/m^3	
Sewer	$ 5.00/m^3	

Monthly electric demand charges are assessed based on the maximum 15-minute electric demand. Weekends and holidays are off-peak all day.

Utility rate structures shall use the following rates of escalation:

- Electrical costs are estimated to rise at an annual rate of 3.5%
- Natural Gas costs are estimated to rise at an annual rate of 7%
- Water and Sewer costs are estimated to rise at an annual rate of 3%

Building Service Life

The building is considered a "Long Life" service building and therefore is defined by ASHRAE Standard 189.1 (latest addition) to have an expected minimum service life of 50 years. All building decisions related to the building systems, and operations shall include a 50-year life cycle study. This will support of a sustainable approach to all building design, construction, and operational elements. Student teams shall include this basis with all building analysis. To complete the life cycle study, the building owner expects the following elements to be included with any analysis.

- General Inflation rate for future cost items (replacement items, maintenance and anticipated future costs) will be 3%
- Owner's Rate of Return for monetary decisions (this is to be used for bringing future costs back to present net worth dollars) will be 4%.
- System selections shall account for an equipment installation cost, annual maintenance cost, major maintenance cost, and replacement cost at the end of their life cycle.
- Consider the following examples for two systems within a 50-year life cycle analysis. Option 1 is a system with a 25-year service life and major maintenance every 5 years. Option 2 is a system with a 15-year service life and major maintenance every 5 years.
    - Option 1 (25 Year Service Life):
        - Equipment Installation: Years 1, 25:
        - Annual Maintenance: Years 1-50
        - Major Service: Years 5, 10, 15, 20, 30, 35, 40, 45
    - Option 2 (15 Year Service Life):
        - Years 1, 15, 30, 45: Equipment Installation
        - Years 1-50: Annual maintenance
        - Years 5, 10, 20, 25, 35, 40, 50: Major Service
- The following assumptions may be used for equipment service life / replacement cycle:

Assumed Service Life & Maintenance Costs for Common HVAC Systems:				
System Type	Service Life	Annual Maintenance Cost (% of First Cost)	Major Service Interval	Major Service Cost (% of First Cost)
Boiler (Gas-Fired)	25	1	5	5
Boiler (Electric)	20	1	5	5
Air-Cooled Chiller	20	1	5	5
Water-Cooled Chiller	25	1	5	5
Cooling Tower	25	2	5	5
Hydronic Piping	50	1	20	5
Hydronic Pumps	25	1	5	5
VRF System	15	1	5	3
Air Source Heat Pump	15	1	5	3
AHU	15	1	5	3
Packaged RTU	15	1	5	3
Custom RTU	20	1	5	3
VAV Box	15	1	5	3
Fans	25	1	5	5
Ductwork & Diffusers	50	1	10	5
BAS/Controls	15	5	5	5

Note: Use the most similar system type if an exact match is not listed

The Life Cycle Analysis shall illustrate a 50-year study and bring all costs back to a total present value sum for each alternative, so the building owner understands in present dollars which alternatives represent the best life cycle value.
Suggestion: Use a spreadsheet to track the annual costs for each year and apply the relevant inflation.

6. Building Assumptions

It is assumed that the new building envelope construction and other building systems (e.g. lighting and plumbing) meet ASHRAE 90.1 requirements, while incorporating the owner's project requirements.

1. Superior acoustic criteria in all spaces with minimal sound transmission from the adjacent spaces and low noise production from the HVAC systems.
2. Assume the building is standalone, and therefore the HVAC systems are not tied to any central or district energy systems.
3. Assume all the utilities are available to the site (e.g. electricity, natural gas, water and sewer).
4. Document Envelope Recommendations and Electrical Assumptions
5. Not much information is provided for all teaching labs, design teams must make and document assumptions in order to communicate back to the owner expected operational parameters and limitations.

7. Codes and Standards

Codes as determined by the local Authority Having Jurisdiction (AHJ). Design teams should also utilize the following ASHRAE Standards in the project:

1. ASHRAE Standard 15 and 34
2. ASHRAE Standard 55
3. ASHRAE Standard 62.1
4. ASHRAE Standard 90.1
5. ASHRAE Standard 189.1
6. ASHRAE Standard 154
7. ASHRAE Standard 241
8. ASHRAE Advanced Energy Design Guide for Achieving Zero Energy in Small to Medium Office Buildings
9. ASHRAE Standard 202

As this project is a major renovation and change-of-use, the design team shall reassess ventilation and energy performance for all affected spaces based on the new room functions and occupancies. Ventilation and exhaust shall be updated as required by ASHRAE 62.1, and all new or modified HVAC systems, controls, and replaced envelope elements within the project scope shall comply with ASHRAE 90.1 renovation/alteration requirements, with window upgrades evaluated for cost, feasibility, and life-cycle benefit.

Use the latest available versions of all ASHRAE Standards and Handbooks.

8. Competition Requirements

-Please reference the website, https://www.ashrae.org/communities/student-zone/competitions , for each competition requirements and timeline.

-Net Zero participants: This project's building is not affiliated with any real universities nor specific location other than the city.

9. References

Standards and Guidelines: https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards

FAQs:
https://www.ashrae.org/file%20library/communities/student%20zone/design%20competition/2026-design-comp-questions.pdf