

Project Introduction-Project Summary



University of Missouri – Columbia

Mixed-Use Multifamily

Project Summary

Team SUNsational is collaborating with the Columbia Housing Authority to create a new vision for rent-assisted, low-income residents in downtown Columbia, Missouri. To achieve our goals of sustainability and affordability, we are designing a high-performance, mixed-use multifamily project with a small, neighborhood retail store. Our design includes integration of passive design strategies, low energy heating, cooling, lighting, equipment and appliances; and other design strategies that

promote a comfortable living environment while achieving net-zero energy use. The design will be resilient for fire, floods, drought, high winds, heavy snowfall, tornadoes, and earthquakes, which are possible in this location. The apartments can be easily converted to owner occupied affordable condominiums.



Fig. 1: Exterior View of Park Avenue Apartments

Design Strategy

The building is elongated on an East/West axis to maximize roof area for photovoltaic panels and opportunities for passive design strategies (heating, cooling, daylighting). The East and West wings of the building are connected by an atrium space which serves as a communal space for public and tenant meetings, ancillary space for mail, location of an interior garden, and a refuge from disasters. Adjacent to the communal space is a small retail shop supporting the surrounding neighborhood. The center atrium space also contributes to the passive cooling and daylighting strategies. The South section of the roof includes green vegetation roof blocks, and the North section of the roof has a steel support structure sloped at a 31-degree angle to support the photovoltaic arrays.

Project Data

- Location: Columbia, Missouri. Climate Zone: 4A (Mixed-Humid)
- Building Size: 56,650 sf of twenty-one 1-bedroom units of 600 sf; twenty-seven 2-bedroom units of 725 sf.; and Retail Space of 1600 sf. Lot Size: 1.62 acres (shared with MU AH team)
- Building height: Three story, 32 ft. One-bedroom units: 1 bedroom, 1 bath. Two-bedroom units: 2 bedrooms, 2 baths. Total Building Occupants: 374 (123 – 150 residents)
- Residential: HERS Rating (single apartment): 40 w/o PV; 0 w/PV. EUI: 37.5 – 56 kBtu/sf2/yr.
- Estimated Monthly Energy Costs: \$48 w/o PV; \$0 w/ PV
- Estimated Cost of Project: \$5,525,082 (approximately \$155,000 per net unit)

Technical Specifications

- Insulation Values: Foundation/Floor: R-15; Walls: R-40; Roof: R-50
- Window Performance: U-value: 0.25; SHGC: 0.22 – 0.32; VT: Infiltration: 0.1 @ 50 MPH (cfm/ft²)
- HVAC System: Ground Source (Geothermal) Heat Pump System, 1.5 ton each in 48 units, two 4-ton and one 6-ton units for Commons and Retail Store. 16 - 20 EER COP 3.5 - 3.8
- Primary Structural Systems: Residential and commercial areas: SIPs walls and roofs with ICF added to compartmentalized firewalls (Commons); Wood trusses for floor and roof with lightweight concrete floor topping. Commons (core): structural steel floors and roof (concrete topping)
- Photovoltaic Array: Four 40kW photovoltaic arrays, 160kW total system based on available roof space and 470W per panel).

Project Highlights

Neighborhood Context

The surrounding North-Central Neighborhood includes mostly small to medium, 1-2 story, closely spaced houses on narrow lots. Most of Park Avenue in this location is a complex of City of Columbia owned public housing apartments. The site is one to two blocks East, West, and South, from major North-South, East-West, and neighborhood routes of COMO Connect, the city's bus service. The site is within a 5-10-minute walking distance to elementary and secondary schools of Columbia grocery stores, and green spaces. The site is one block from Downtown Columbia.

Basis of Design (Standards and Programs)

The design of the Park Avenue Apartments project will meet or exceed the requirements of the DOE Solar Decathlon – Design Competition as well as the DOE Zero Energy Ready Home Requirements (Rev. 06); below target of 75 for the source energy use intensity (EUI) (Climate Zone 4A), the Energy Star Qualified Homes (V. 3.1) HERS Index Target Procedure for National Program Requirements; the EPA Indoor airPLUS program, and the EPA WaterSense program. The design of the house will also follow research-based recommendations for Universal Design and HUD guidelines for Resilient Design and Construction. The house design will comply with the 2018 International Building Code, 2018 International Energy Conservation Code, and zoning requirements of the City of Columbia (<https://www.como.gov/community-development/bsd/>).

Building Highlights

The design of the Park Avenue Apartments project includes passive energy design strategies and best practices in ecological design of the site and landscaping. The building features enclosed outdoor balconies, vegetative roofs and walls, and appropriate sunshading at the South fenestration. The North half of the roof includes a steel tube structure that is angled to the optimum angle for a 160kW photovoltaic array. Materials used throughout the interior and exterior maximize regional, available, rapidly renewable, and recycled content products and assemblies. The building design utilizes a hybrid structural system, with compartmentalized areas for building code compliance and natural disaster resiliency. The commons area (core) of the building incorporates insulated concrete form walls (ICF) adjacent to firewalls, with structural steel supporting a mezzanine. These systems for the core area allow for safe refuge in the event of a natural disaster (tornado, fire, earthquake, and high winds). The roofing system consists of a single-ply membrane material with green roof blocks (vegetative roof). Rain water harvesting is used for site irrigation, and water-efficient plumbing fixtures, energy-efficient appliances and lighting add to the overall ecology of the building.