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Rethinking residence halls, the passive way

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In today's world, where every dollar spent on energy represents a loss due to inefficiency, the need for smarter, more resilient buildings has never been clearer. Passive house design employs passive strategies, such as robust insulation, airtight enclosures, and reduction of thermal bridges, paired with highly efficient mechanical systems, to deliver substantial energy savings. While the term might suggest it is only suited for homes, there is strong potential for passive building strategies in many project types, particularly residence halls.

Across the country, universities are investing in essential upgrades to their campus buildings. As heating and cooling account for a large share of total energy use, residence halls have significant load reduction potential via passive building strategies. Passive building strategies—such as airtight construction, efficient ventilation, and a well-insulated enclosure—target heating/cooling demand reduction and improve thermal comfort.

Page, now Stantec, recently completed the design for Catawba College's new residence hall and has been officially recognized as a Design Certified Phius CORE 2024 project, the leading passive house certification system in the United States. This residence hall is the first in North Carolina to achieve this distinction. With the first of two steps completed for the Phius certification process, the final certification is expected to be finalized in the next few years, once the residence hall is fully operational.[1] The building is projected to achieve an Energy Use Intensity (EUI) of 29.7 kBtu/ft^{2}yr, nearly a 50% reduction from typical residence halls across the US. With 40% energy cost savings, compared to the North Carolina energy code, the project is expected to receive a $92k incentive and $19k annual energy cost savings. The design team employed a data-driven, climate-responsive approach to minimizing cooling demand in the warm, humid conditions of climate zone 3A.

Constructing residence halls to meet the rigorous Phius standard can be challenging, but the benefits make the effort truly worthwhile. Some of the hurdles the project team worked through are listed below:

1. **Higher occupant density**: Residence halls have more people per square foot than a typical single-family home or apartment building. This results in increased plug loads and mechanical demand, intensifying building energy consumption. At Catawba, lighting and plug loads account for 59% of total energy consumption, considerably higher than in a typical multifamily or single-family building.
2. **Complex zoning**: Due to a residence hall's density, it's common design practice to zone multiple rooms to a single HVAC unit. At Catawba, each heat pump serves at least two rooms,

requiring careful load balancing to ensure everyone receives the same level of comfort. In buildings with poor envelopes and a single HVAC unit serving multiple rooms, one occupant might feel uncomfortably cold while another feels fine, simply because their temperature preferences differ. At Catawba, the high-performance envelope helps balance those conditions by stabilizing heating and cooling loads. This reduces the reliance on HVAC systems and minimizes the need for extreme temperature adjustments to maintain comfort across zones.

3. **Compartmentalization requirements**: Under EPA Energy Star standards (required for Phius), every one or two-bed student room opening into a corridor is considered a “dwelling unit” and must meet strict airtightness rules, eliminating the common practice of undercut doors as a return-air strategy.

There are significant advantages to investing in energy-saving building practices through passive building strategies. These benefits enhance the building’s resilience, operational efficiency, and long-term savings.

1. **Durability:** Academic institutions want their buildings to last. Passive buildings are highly durable as they prevent moisture infiltration, air leakage, and mold; extend the lifespan of mechanical systems, which operate less often and at lower capacity, and maintain an energy efficiency that will meet energy codes for decades.
2. **Energy savings**: Residence halls consume large amounts of energy due to occupancy density and 24/7 operation throughout the academic year. At Catawba, passive building strategies

deliver ~50% energy savings compared to a typical residence hall.

3. **Indoor air quality**: Indoor air quality in living spaces has become a growing priority in recent years. In residence halls where students live in close quarters and illnesses spread easily, maintaining clean, healthy air is more important than ever. Catawba's new residence hall leverages dedicated outside air systems that lead to improved ventilation effectiveness, moisture control, and higher filtration that improve air quality and reduce mold risk.
4. **Thermal comfort**: Thermal comfort is among the top criteria that impact students' satisfaction with their residence hall. A comfortable living environment in a student's home away from home is key to student academic performance and overall well-being. Passive buildings' airtightness and thermal performance requirements eliminate drafts and cold spots, resulting in exceptionally comfortable indoor conditions.
5. **Efficient form factor**: An efficient form factor reduces exterior surface area and difficult geometry issues, allowing the enclosure to be easily air sealed and reducing heat transfer.
6. **Decreased demand on HVAC**: In most buildings, heating and cooling are the dominant use of energy. Using passive building strategies to decrease heating and cooling loads, less than 10% of Catawba's new residence hall's energy use is dedicated to heating and cooling combined, quantifying the savings passive buildings provide.
7. **Resiliency:** With the ever-increasing frequency of natural disasters, resiliency plays a key role in maintaining operations and safety. Studies show Phius-certified buildings remain within comfortable temperatures far longer after power outages than other energy code buildings.[2] Catawba students can feel at ease knowing their building will remain safe and comfortable for an extended period of time during outages or extreme weather.

Passive building offers a proven path to durable, efficient, and healthy residence halls. As the next generation of students move into these resilient buildings, it becomes clear that performance and comfort are not mutually exclusive but mutually reinforcing. This design approach enables universities to future-proof their investments and leave a lasting legacy. Institutions are encouraged to consider passive building for their next project and join the growing movement toward high-performance campus living.

References:

1.

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