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LEED AP(BD+C),GSAS CGP,GCP,ISO 14001

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MODULE
06

Examples of Building-Level Simulation Models

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Examples of Building-Level Simulation Models

In this section, each distinct application of whole building models in commissioning will be described in the context of one or more particular applications.





LEARNING OBJECTIVES

- Use During the Design Process
- Use in Post-Construction Commissioning of New Buildings
- Use of a Design Simulation for On-Going
- Use of Calibrated Simulation for Retro Commissioning
- Use of Calibrated Simulation for On-Going Commissioning

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Use During the Design Process

- The proposed project is a Warehouse and Office for Walls and Floors in Middle East FZCO on plot S20905 in Jebel Ali Free Zone, Dubai, U.A.E. The 46,462 ft2 building houses offices and warehouses. The Dubai EHS administration requires LEED certification from the USGBC for the project. EA c1 requires optimizing building energy performance for LEED certification. The warehouse and office buildings were energy-modeled for this. This model compares mechanical air distribution strategies, building envelope performance design criteria, and energy efficiency measures.

- Window area and U-value for each side of the building, thermal mass, exterior wall insulation thickness, roof insulation thickness, floor insulation thickness, shading device transmission, and night setback temperature were optimized. Each parameter started with the school's built-in value.

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Use During the Design Process

- Preliminary building energy modeling determined energy savings for credit requirements. The modeling followed the Building Performance Rating Method (PRM) of ASHRAE/IIESNA 90.1-2004 Appendix G (up to 10 points). The base model was ASHRAE 90.1, 2004 compliant. The model simulated energy conservation with the proposed design.

- The model suggests energy conservation measures like improved Split Duct AC system EER values, lower LPD values, a highly insulated envelope, high-performance glazing, Efficient Energy Recovery Valve (ERV) units, and variable speed drives. Energy modeling, including energy conservation measures, shows 25.1% building energy efficiency by cost.

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2.Use in Post-Construction Commissioning of New Buildings

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The Proposed Factory and Office, Plot No. TP 020103, is in JAFZA, Dubai, UAE. The project seeks USGBC LEED certification for EHS compliance. The LEED credit Energy and Atmosphere, EA c1, requires building energy optimization. This required detailed energy modeling for the proposed Factory and Office. The modeling also compares the energy impacts of mechanical air distribution strategies and building envelope performance design criteria and assesses the benefits of building-integrated energy efficiency measures.

EHS-required building energy modeling determined energy savings. ASHRAE/IIESNA 90.1-2004 Performance Rating Method (PRM) was used to model. The base model was ASHRAE 90.1, 2004 compliant. The model simulated energy conservation with the proposed design.

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2.Use in Post-Construction Commissioning of New Buildings

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- The model suggests improving chiller efficiency, using appropriate LPD values, using a high-insulated envelope, and using high-performance glazing. The project can earn 4 credits by using the energy conservation measures in this energy modeling result.

- HVAC electricity is monitored separately from building heating and electricity. The building automation system records temperatures and CO2 levels for two days. These variables were saved in memory during commissioning.

- The measured heating consumption was almost twice the simulated consumption during the first three months of operation. In 20% of the building, heating and cooling thermostat dead bands were too narrow, causing continuous operation at maximum values. After fixing this issue, measured and simulated heating consumption were within 10% for three months.

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2.Use in Post-Construction Commissioning of New Buildings+

- Comparisons show much higher cooling and ventilation electricity consumption than simulated. Investigating this discrepancy will be reported later this year. Commissioning also involves investigating poor temperature control in several rooms and discrepancies between simulated and measured exhaust air temperatures.

- We commissioned a Dubai office building using whole building simulation. This building has innovative HVAC systems. They dimensioned and evaluated these untested HVAC solutions in IDA. The BEMS measured performance during initial commissioning. A year after tenants moved in, about 200 five-minute signals were collected. A detailed whole-building simulation model was calibrated with measured electrical power and weather inputs to adjust internal loads. The calibrated model was compared to whole-building energy use and key temperatures and control signals to assess HVAC system performance.

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2.Use in Post-Construction Commissioning of New Buildings

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- Comparing the extensive measurements and calibrated model, the residuals were used to evaluate the HVAC system's performance and ongoing commissioning. This process found and fixed five control set point and operation issues.

- The procedure was too expensive for routine use for several reasons: generating the detailed model took several weeks; model run times were long; additional sensors (at an additional cost) would have improved model contribution to commissioning; and dealing with poor data was time-consuming. If costs can be reduced, the approach has great potential to improve building design and commissioning.

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Use of Calibrated Simulation for On-Going Commissioning

- A simulation calibrated to a building after commissioning can be used to monitor measured consumption.
- Monthly or quarterly comparisons are sufficient.
- Thus, tracking whole-building consumption requires little hourly or daily information.
- Simple regression models and more detailed physical models can track consumption.
- A diagnostic system that can identify deviation causes will boost the simulation's value.

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Online Commissioning Follow-up Simulation

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- A simulation calibrated to a building after commissioning can be used to monitor measured consumption.
- Monthly or quarterly comparisons are sufficient.
- Significant increases can alert commissioning follow-up when needed.
- Building operators usually don't follow up on alarms that don't directly affect comfort or occupant complaints unless they're costly.
- Thus, tracking whole-building consumption requires little hourly or daily information.
- Simple regression models and more detailed physical models can track consumption.
- A diagnostic system that can identify deviation causes will boost the simulation's value.



Online Commissioning Follow-up Simulation

- Nestle Dubai Manufacturing LLC will build an office, production, and logistics facility on Techno Park plots TP020102 and TP02102A. The 181,094-square-foot building houses offices and factories. The Dubai EHS administration requires LEED certification from the USGBC for the project. The LEED credit Energy and Atmosphere, EAc1, requires building energy optimization. The Nestle Dubai Manufacturing LLC building was energy-modeled for this. This model compares mechanical air distribution strategies, building envelope performance design criteria, and energy efficiency measures.

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Online Commissioning Follow-up Simulation

- Preliminary building energy modeling determined EHS energy savings. The modeling followed the Building Performance Rating Method (PRM) of ASHRAE/IIESNA 90.1-2004 Appendix G (up to 10 points). The base model was ASHRAE 90.1, 2004 compliant. The model simulated energy conservation with the proposed design.

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Online Commissioning Follow-up Simulation

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- The model suggests improving chiller COP, heat recovery, dampers, VSD drives, lower LPD values, a highly insulated envelope, and high-performance glazing. Energy modeling with energy conservation measures suggests 23.2% energy and 23.2% cost efficiency.

- Each application is shown. Retrocommissioning is the only routine commissioning application of calibrated simulation. The other examples have been used in research, and costs must be lowered for routine application, but simulation may be useful in commissioning.



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