Naturally Ventilated Daycare Building - Design and LEED Certification

Project Details

Project type:	LEED BD+C: Schools v3, LEED 2009 Silver, new construction
Location:	Karlsruhe, Germany
Building type:	Daycare
Floor area / Stories / Occupancy:	7141 ft² (663 m²) / 1 / avg 52, max 86
Project stage:	Design Development

LEED Facts

for LEED BD+C: Schools (v2009)

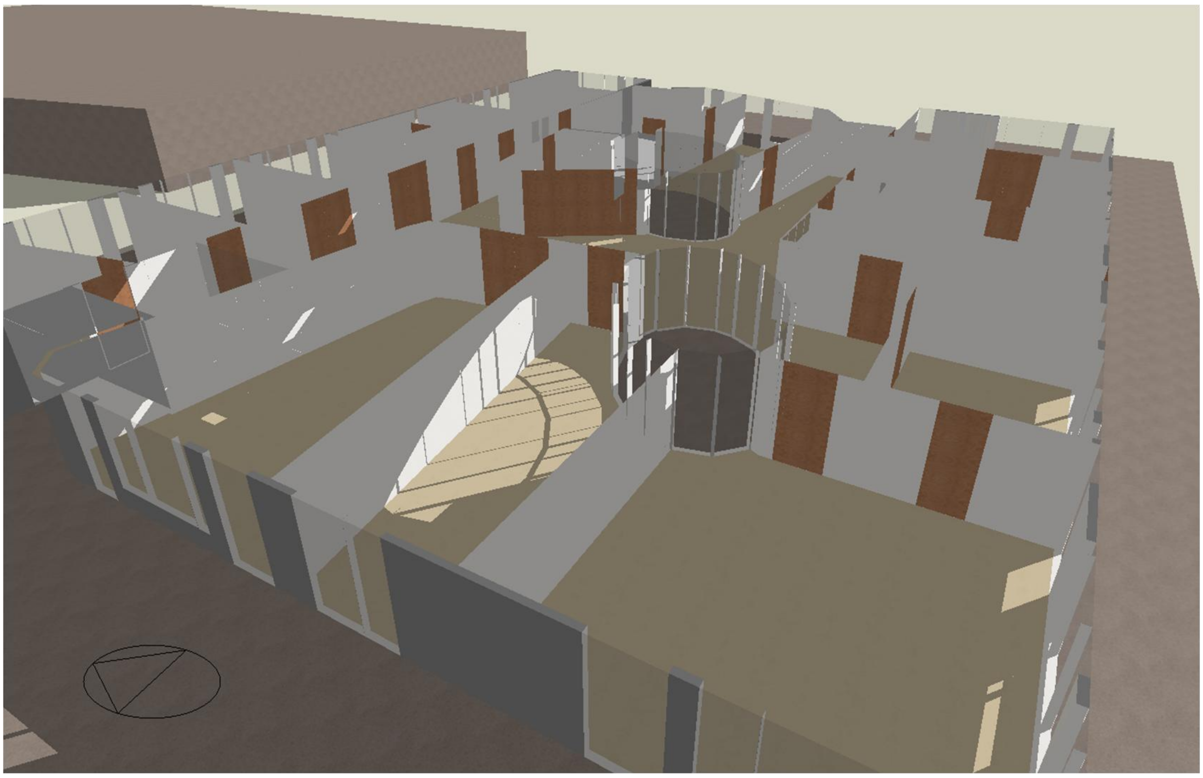
Certification awarded Nov 2014	
Silver	**51**
Sustainable sites	16/24
Water efficiency	6/11
Energy & atmosphere	18/33
Material & resources	0/13
Indoor environmental quality	5/19
Innovation	4/6
Regional priority credits	2/4

Project Description / Features

The project is built on an existing underground parking facility. Key facts and features include:

- Saves 36% energy costs and 30% water
- Mainly timber build and façade with wooden terraces with large canopies

- Floor heating
- Low energy lighting
- Window ventilation as part of a designed natural ventilation concept
- Green roof for decreasing peak storm water run-off and reducing heat-island effects
- Water saving devices on low flow faucets, scald protection on hot water faucets
- Skylights and partition windows to promote use of daylight
- Glazed internal courtyards to promote use of daylight



Challenges / Questions

The following had to be ***quantified*** using simulation:

1. Energy cost savings as per ASHRAE 90.1 PRM for LEED
2. Daylighting effectiveness
3. Prove natural ventilation is an effective strategy that would increase occupant comfort

Solutions / Answers

The first part was supposed to be easy…it wasn't…because it was **window-ventilated**.

New builds of today's "style" provide very air tight, highly insulated structures. When new builds don't have mechanical ventilation and are not occupied at night, the structure has no way to release heat. To make matters worse, current architectural trends often use more glazing than they should. The result is that many naturally window-ventilated new builds show overheating for many hours during the year.

To be consistent across LEED credits, it made sense to use one model to cover all 3 points. DesignBuilder does this perfectly. What's more, it was as easy as pressing a button to set up the very complex air flow network for the natural ventilation simulation. The same goes for the daylighting simulation (which was very fast and helpful during the schematic design phase).

The biggest challenge was handling the human driven window ventilation within the bounds of ASHRAE 90.1. As soon as you open a window in winter, the heated floor heating system will not meet the setpoint resulting in unmet load hours exceeding the maximum 300. Also, the baseline building must have the same 0 cfm (m^3/h) mechanical outdoor air rates whilst keeping the infiltration and window ventilation the same as that of the design case model, even though it uses different glazing sizes!

Furthermore, the discomfort that occurs during short periods of opening a window or overheating had to be quantified and included "norm-defined" definitions of discomfort due to thermal (temperature, humidity, airspeed), draught and CO2 to prove the 3rd point.

The project dealt with this by having auxiliary (small) venting windows that only open 4 inches (10 cm), to avoid over-ventilating, whilst the large windows could fully open mainly for cooling. Motorized shading was included on the south façade (also human driven and manually controlled).

On the modeling side, the human driven control of windows based on comfort proved to be challenging and the EnergyPlus Energy Management System (EMS) had to be used. This is a powerful means of adding custom logic to the model and has since been implemented in DesignBuilder to make the EMS much easier and faster to use. This resulted in a paper WINDOW SIMULATION METHODS REQUIRED FOR MANUAL WINDOW VENTILATED BUILDINGS and the new object incorporated as of EnergyPlus v8.3 called the AirflowNetwork:OccupantVentilationControl object. EMS was also used to drive the shading and lights in a similar manner. Seasonal tree transmittance was modeled to ensure that beneficial solar gains in winter and summer shading were accounted for.

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MEP design from conception to commissioning is honed not only by the use of highly advanced software, but also by the expertise of the personnel using that software. At b.i.g. bechtold we are proud to have motivated staff of this calibre on board. Certified BIM Managers and LEED APs work on opposite sides of the desk with Building Modellers and MEP designers to bring innovation to fruition.