Active Design Strategies

Engineering Your Way To Net-Zero

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Abstract

The architecture of a building directly correlates to the energy it consumes over its lifetime. Passive and active design strategies can reduce energy dependency if implemented properly. Daylighting and thermal mass are beneficial passive design strategies, where as ground source heat pumps, automatic venetian blinds, and electrochromic windows are possible implementations of active design strategies. While passive design is beneficial, only through active design strategies can a building have net-zero energy. The Bullitt Center, an experimental commercial office building in Seattle, WA, is attempting to reach net-zero energy through its utilization of the surrounding climate and its implementations of active design strategies. This paper will use the Bullitt Center as a case study to analyze the implementation of active design strategies to reach net-zero energy.

Reaching Net-Zero Energy

Architecture is responsible for about 48% of all energy consumed in the US. (Architecture 2030) Energy efficient designs combined with renewable energy sources are essential to reducing the carbon footprint of buildings. These methods become even more important as fossil fuel resources are depleted. Active design not only gives sustainability to a building, but also longevity to a building. Renewable energy is simply one method under the active design branch. Active design strategies can play a big role on reducing the energy impact of new buildings, and can also be applied to pre-existing buildings to make them more energy efficient. While passive design strategies are useful the only way to achieve net zero is through the utilization of multiple active design strategies and energy harvesting. The goal is to achieve a net-zero status, in which buildings draw no energy from the grid on an annual basis. In the case of the Bullitt Center the goal is achieved through a combination of energy efficiency, active design strategies, and on-site power generation.

The Bullitt Center

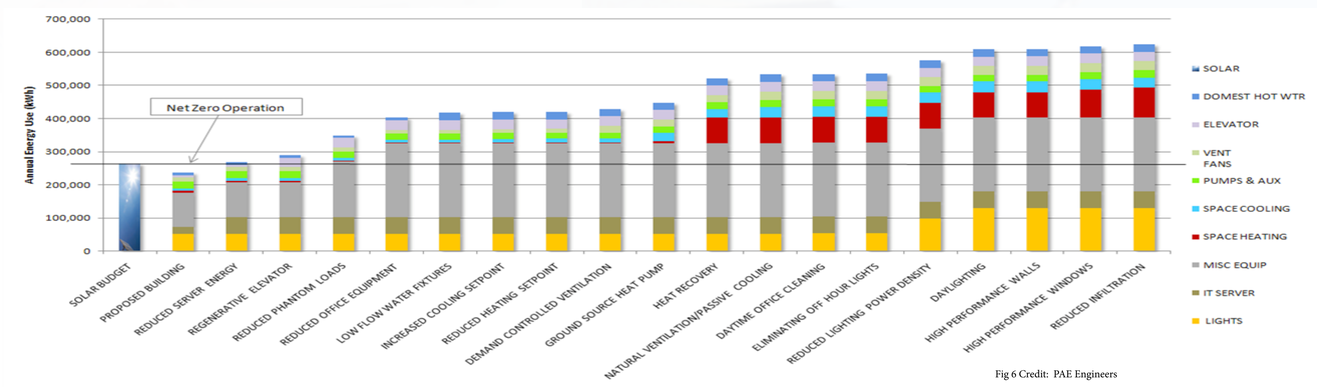

Fig 6 Credit: PAE Engineers

Credit: Miller/Hull Partership

Cutting energy through active design

Fig. 6 illustrates he path to net-zero in the Bullitt Center This graph shows step by step the implementations it's made to turn the Bullitt Center from what would have been a typical office building, to a self-sufficient, net-zero building. The final two bars show the result after the design strategies, the remaining amount of electrical energy will be generated from the building itself via the 400-pannel solar array.

Plug Loads

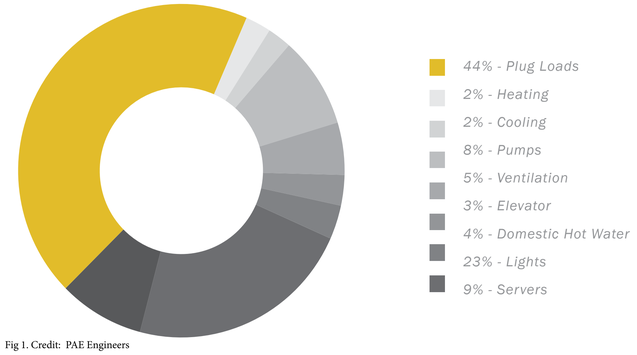

Fig 1. Credit: PAE Engineers

Because the Bullitt Center is so energy efficient, plug loads contributes to a large portion of the energy usage. Compared to the typical commercial office building whose plug loads draw up to 15% of the energy, the Bullitt's plug loads consume 44% of the building energy. This allows for greater efficiency because plug loads can be monitored, and adjustments in occupant engagement can be made to affect plug loads. Fig. 1 represents the breakdown of energy usage within the Bullitt Center.

Heating

Fig. 2 shows the average weekly temperatures in Seattle, and with it being so low, the Bullitt Center had to use an efficient method of heating the building. Fig. 2 illustrates just that, by showing the buildings ground source heating systems. With this active design strategy, air naturally heated water from under the surface is collected in a reservoir and then used to heat the building when needed. This provides controllable heat, in an efficient, and energy effective way.

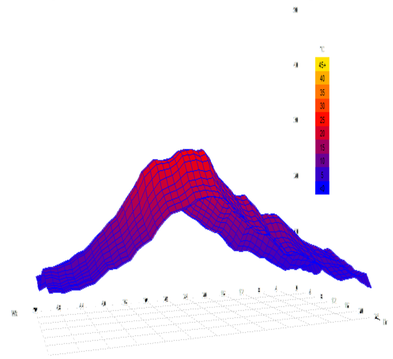

Fig 2.

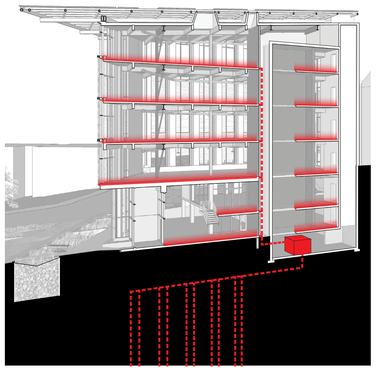

Fig 3. Credit: Integrated Design Lab

Solar Power

Fig. 4 illustrates the solar harvesting capacity of the 400-pannel solar array on the Bullitt Center. This solar radiation allows the Bullitt Center to fully compensate its energy need with its massive photovoltaic array. Fig 5 demonstrates the energy cycle from solar panels, to energy storage. Once stored, the energy can be used as needed to power the building.

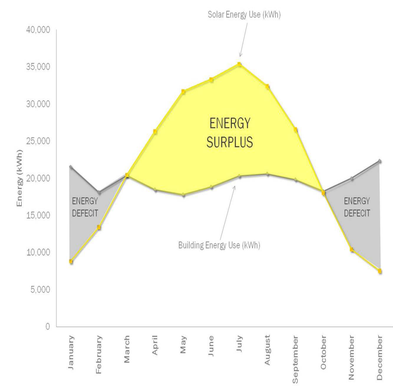

Fig 4. Credit: PAE Engineers

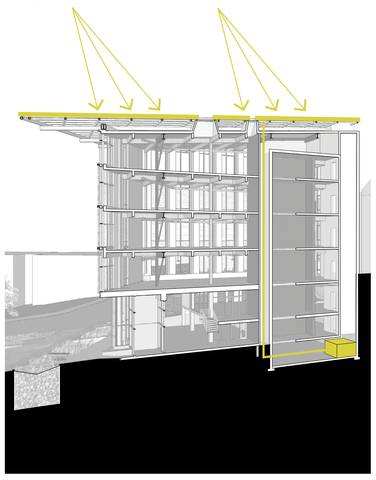

Fig 5. Credit: Integrated Design Lab