A Green Grand Tour

During October and November of 2000, a quintet of NESEA aficionados (Bruce Coldham, Steve Loken, Nadav Malin, Marc Rosenbaum, and Andy Shapiro) spent three weeks touring 34 of the most celebrated green buildings in four European countries—Germany, Switzerland, Holland, and England. In the 18th and 19th centuries, it was not uncommon for European gentlemen and ladies to make what was known as a "Grand Tour" of European capitals cities to enhance their sophistication and worldliness. Something of the same spirit was attached to our endeavor.

Specifically, however, our goals were:

- To unearth and to understand real design innovation towards an architectural expression of the essence(s) of ecological/environmental building.
- To unearth innovative, practical, and transferable green building strategies.
- To separate the hype from the heroic.

Different Places, Different Buildings
There are important differences between northern Europe and the US Northeast that affect building design. Northern European temperatures seldom drop below freezing in winter nor rise above 90 degrees Fahrenheit in summer. Summer relative humidity is significantly lower.

Jubilee Campus of Nottingham University, UK. Glazed atria between the two building wings are tightly constructed and function well as student gathering spaces. The exhaust ventilation towers atop the stairways are visible.
Architect: Michael Hopkins & Partners

Depending upon the location, buildings in the US northeast need cooling and/or dehumidification during 6-10% of the hours of the year to retain comfortable conditions (and 4 to 7% of the hours are beyond any passive capability). In contrast, in Frankfurt, for example, fewer than half of one percent of hours during the year require cooling or dehumidification (either passive or mechanical).

Sun angles are lower too and solar intensity is lower. We measured ambient daylight on overcast days at around 300 foot-candles. Freeze-thaw cycles, however are significantly more frequent.

In Europe, control of carbon dioxide emissions is considered to be a serious issue; one which receives the attention of government, the civil service, business and industry, and the electorate. There is also a greater acceptance of the value of long-term investment, and accordingly buildings are designed and constructed to be more durable. There appears to be a higher expectation that buildings will and should actually work—that they should be healthy, pleasant, comfortable, and uplifting places.

Lots of Mass

Most of the buildings we visited were reinforced concrete structures with their mass exposed and coupled to finished occupied space. Probably stemming from post-war shortages of steel, buildings are inclined to reinforce concrete and, in consequence, have higher structural mass those their equivalents in this country (perhaps twice that of US conventional concrete-encased steel frame and deck structures).

Shafbruhl Housing, Tubingen, Germany. Stucco terra cotta exterior mass walls with wood beams and terra cotta planks. Architect: Joachim Eble

Buckminster Fuller asked "How much does your building weigh?" with an eye to shaming architects into designing low mass structures. With the European buildings we visited, the mass appears to earn its keep, because mechanical systems are downsized or eliminated because of the coupling to the high thermal (structural) mass within the conditioned envelope. We saw quite a variety of massive floor systems including integral beam-and-plank systems variously combining concrete or wood beams with concrete or terracota planks/blocks.

Where's the Suspended Acoustic Tile?

We were struck by the complete absence of suspended acoustic tile (SAT) ceilings. None of the 34 buildings we visited exhibited any significant amount of this material. The commitment to coupling structure and occupied space caused the SAT to disappear. Elements such as air ducts, cable trays, conduits, and receptacle boxes were all commonly mounted and exposed in the finished space.

We observed a contrast of rough and smooth (juxtaposition of cheap and chic) as a common characteristic. Rough frame dimension lumber, plywood, in-situ formed concrete (usually magnificently poured), and metal conduit were all juxtaposed to high-tech glazing junctions and support assemblies, high-finished metal fabrications, and intricate solar control elements.

Sound attenuation appears as a significant unresolved component of the pattern described above. There were interesting, and some times desperate, measures to introduce sound absorption elements. Sound absorption was typically handled with dedicated elements when it was handled at all, and were either of Tectom-type material or a rockwool-backed heavy perforated plaster tile attached directly to the concrete slab soffit (decommissioning the mass coupling in those areas). There appears to be no consensus on how to manage sound attenuation, which varies according to the size and function of the space and the design sense of the architect. However, sound control is less of a challenge with the narrow plan forms (a high proportion of exterior wall to floor area) that we mostly encountered. And the absence of SAT ceilings means that partitions are less likely to offer flanking paths for errant noise.

A common feature of the buildings we visited was the complexity of facades which routinely included fixed or movable exterior shades/brise-soleils, as well as interior blinds. Daylighting strategies appeared to favor evenness over quantity of available natural light, and daylighting solutions tended to suppress the natural light level at the window wall so as to reduce the differential between the light level there and at the interior wall. We initially found this curious in a part of the world with significantly lower solar intensity than in the US. However, the buildings tended to have large amounts of glass, and then, with solar controls, to diminish the high contrast between perimeter and inboard levels so as to dispel the perception as one enters the room that it is dark and that the lights should be turned on (both an economic and an aesthetic or light quality consideration).

Building Systems
We saw a number of very cleverly, carefully designed mechanical systems that reduced fan energy (a surprisingly big energy user in commercial buildings) to as little as one tenth that of typical US buildings. Some of the buildings used ventilation systems that rely on gravity and wind for the power to move air—several using only these natural forces, while others combined mechanical and natural power.

Wessex Water Building, Bath, UK. Elaborate fixed sun control devices on the fully glazed south facade. Architect: Rob Bennetts Architects

In a number of projects, towers or "stacks" were conspicuous elements. Some, such as the Queen’s building at DeMontford University in Coventry, England used ventilation towers as dominant architectural elements in the building design and massing. The Cable and Wireless building, also in Coventry, instead used cross ventilation because studies by the Arups office found it to be a more effective ventilation strategy. The Cable and Wireless building is a predominantly horizontal building form, avoiding the expensive ventilation towers. With its sinuously curvaceous roof, the building demonstrates the architectonic opportunities associated with this natural ventilation strategy.

The Jubilee Campus complex of Nottingham University is an especially interesting building. It is not solely naturally ventilated, but rather a "mixed mode" system, which exploits a combination of three natural ventilation strategies (cross-ventilation, the stack affect, and a wind capture technique). This sophisticated natural ventilation design is supplemented to a significant degree by fan power. (The elaborately configured cowls atop the stairwells, which provide the stack effect component of the natural system, provide but 1% of the overall contribution to the ventilation system power, though Chris Twinn of Arups' London Office noted that this meager contribution could have been increased if Arups had been given a freer reign in the cowl design.)

The significant achievement of the Jubilee Campus complex is the reduction of static pressure in the overall air flow— it is approximately one tenth of what would ordinarily be expected in a conventional building system. This is partly due to the use of the corridors, stairwells, and other large architectural spaces as "ducts" through which the supply and exhaust air moves, as well as air bypasses such that, for the 99% of hours of the year where cooling is not required, the air does not have to fight its way through the cooling coils. In addition, a small, sealed combustion gas heater is located in the air intake chamber rather than using pressure reducing coils in the ducts themselves. The net result is that the fan power requirements are very low and can be operated reasonably by a photovoltaic system included in the glazed roofs of the atria.

Paul Sloman, Arup principal design engineer for this project, says the wind capture component is the most reliable and stable method of drawing air naturally through the building. Sloman also notes that the fully wind-driven supply with mechanically supplemented exhaust allows for heat recovery which is impossible with fully natural ventilation systems. This "mixed-mode" approach probably has the greatest significance for integrating natural ventilation strategies in buildings in the United States.

The Jubilee Campus, like many other buildings we visited, tempers ventilation air (cooled in summer, warmed in winter, each by approximately 10°F) by drawing it in through earth-coupled tubes. It appears that, by using a somewhat porous material such as concrete, the small percentage of hours in the year when condensation might occur is insufficient to cause any microbial activity in these tubes. But this strategy is not likely to be appropriate in the more humid US northeast.

Designing for High Performance

High performing European buildings have no unifying design quality — other than the absence of SAT. They range in appearance from the highly resourceful glass box (Mader School in Austria) to the colorful and organically overgrown buildings by Joachim Eble — equally resourceful, though by different means. However, we did stumble upon an interesting and useful appraisal by the British building analyst, Bill Bordass who classifies buildings as either reliable "robust plateaux" or problematic "optimized pinnacles." By and large the former are characterized by an airtight envelope with a respectable amount of insulation, less than half of the façade glazed, a respectable amount of interior mass, and fewer moving parts (dynamic elements). The second class inevitably results from an excess of glazing leading to shades, operable glass, and the consequent complexity of controls necessary to avoid glare and interior temperature extremes.

Finally, and of fundamental significance, high performing European buildings are the result of thoroughly integrated design teams working together through a succession of projects, and fully engaged from the outset of each one. Two architectural firms, Michael Hopkins & Partners and Rab Bennetts, have built a series of recent buildings that show how lessons learned from one building are applied to the next one. (The Jubilee Campus is the present culmination for Hopkins and the Wessex Water building in Bath, UK for the Bennetts' office.)

Gunther Lonhert, the leader of the German team to the Oct 2000 Sustainable Buildings Conference at Maastricht, Holland, was unequivocal in predicating cost-effective high performance buildings on interdisciplinary teams of mutually respectful design professionals. This approach eliminates the cost premium of creating green buildings by expanding the functional capabilities of various building components. Success requires innovation, which in turn requires design team members to be fully supportive and trusting of one another.

More Information

Further information about the Green Grand Tour, including detailed performance reports on many of the buildings visited, is available on the web at www.coldhamarchitects.com.

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