

## Daylighting design for low-energy buildings

Daylighting design is the practice of utilizing natural light within a building. By providing a direct link to the dynamic and perpetually evolving patterns of outdoor illumination, daylighting helps create a visually stimulating and productive environment for building occupants, while significantly reducing energy consumption and costs. It has been long established that access to daylight contributes to the health and well-being of building occupants, as well as having a positive effect on productivity, learning, attentiveness and recovery from illness. Successful daylighting design requires careful planning to balance heat gain and loss, control glare, and adjust for variations in daylight availability.

The UK Government's decision to move towards zero carbon buildings by 2019 has significantly increased the importance of daylighting design and in particular the role that daylight evaluation plays in the design process. There is now a greater need than ever to demonstrate compliance with new standards and performance indicators, including more accurate predictions of thermal, visual and environmental performance and energy consumption for various design options. Unlike the thermal performance of buildings where the standards are relatively simple to define and advanced modeling tools provide detailed analysis and a high level of predictability, the current standards for daylighting design are unhelpful to the designer in the pursuit of low/zero carbon design.

Most current evaluations of daylight performance are made using greatly simplified "snap-shot" or single-point-in-time methods that do not account for all the influences on daylight illumination levels nor the variation over time. Indeed, the most common method, the 'Daylight Factor', does not even include the contribution from sunlight, only skylight, and even then under the simplified assumptions of the International Commission on Illumination (CIE) standard overcast sky distribution. Alternatively, many practitioners try to understand the pattern of sunlight in a space via study of the sun-path diagram, or a dynamic solar shading analysis, but without analysis of resulting illumination levels or the contribution of light from the sky or reflected light from the sun. Both the UK building industry and the international day-lighting community are aware of the problem and are pursuing alternative more realistic evaluation methodologies such as climate-based daylight modeling, pioneered by John Mardaljevic and now the focus of development worldwide by researchers and practitioners [see links below]. An interesting paper on climate-based daylight modeling by Mardaljevic may be found in the Learning Zone of the EPG website. Whilst much of the new development in daylighting evaluation and the design methodologies are within the academic community they are being to emerge commercially so keep an eye out for developments.

Brian Spires, 02.02.11

### Key Issues

- Practitioners appreciate the reality of daylight, i.e. light from the sun and the sky acting together.
- Architects should strive for designs that achieve a 'well-tempered' daylit environment, i.e. where the fixed architectural form provides both good daylighting and effective solar protection.
- Determine a sound basis for recommending solar control devices such as landscape features, overhangs or vertical fins, light shelves, SC glass, Venetian blinds and louvers.
- Compile an evidence base to demonstrate best-practice in daylighting design and evaluation.
- Facilitate the application of climate-based daylight modelling early in the design process.

### Web Links

- John Mardaljevic's home page at de Montfort University (<http://www.iesd.dmu.ac.uk/~jm/doku.php?id=home>)
- CIBSE Society of Light and Lighting (<http://www.cibse.org/index.cfm?go=page.view&item=68>)
- MIT's Daylighting Lab (<http://daylighting.mit.edu>)
- DAYSIM daylighting analysis software (<http://www.daysim.com>)