



Examples of the shapes created by adhering to a solar envelope as researched by Prof. Ralph Knowles

Urban Planning: Part 1 – The Passive City

Architects have demonstrated the usefulness of buildings that are heated and cooled by design rather than fossil fuels, but can this approach be scaled up to the neighbourhood or even a city level?

Planning a densely populated city where each building is heated or cooled using natural energy sources is a very different prospect to the design of a single free standing solar house. Current research and technology indicates that passive solar cities are a feasible option, they just require sophisticated planning with more variables. These must account for latitude, slope, building shape and height, orientation, street width and orientation.

Passive solar design requires that buildings are oriented to take advantage of the sun for heating. Wind and shading are used for passive cooling. Passive design lowers lifecycle costs while preserving resources and minimising GHG emissions.

The basic principles and use of materials can often be found in vernacular buildings that have evolved to deal with local climatic conditions. Care needs to be taken not to overshadow neighbouring buildings, while assuring access to both active and passive solar systems. Designers need to balance the solar envelope while allowing high population densities, by defining the largest space container that would not cast shadows on neighbouring buildings, unless located near the equator.

Conventional design practice does not take account of orientation and its solar impact. A solar envelope, or the path taken by the sun with the light and shade to either heat or cool a building, produces limits based on the vertical dimensions from the sun's daily and seasonal movements. As a result, buildings that fill these envelopes have unique shapes. Building designs in the solar envelope lend themselves to roof terraces, courtyards and clerestories.

This series of city related policy and information briefs draws on lessons learned from cities and infrastructure work carried out by Triple Line over the past five years. It is intended to contribute to more sustainable, inclusive and climate-resilient cities that generate equitable economic growth opportunities for all by identifying market-driven solutions to urbanisation challenges and strengthening democracy and decentralisation processes through capacity building of government agencies at national, regional and city levels.

How do we treat existing buildings and urban planning?

While it is easier to work within a newly defined solar envelope, it is more complicated when it comes to existing buildings and urban layouts. When the solar envelope is applied in line with existing buildings, new construction should be created and sized with reference to the old. The solar envelope only protects neighbouring properties. Architects need to ensure that their designs fall within the envelope and adopt the same approach at the building scale.

Professor Ralph Knowles and the Solar Envelope

Sustainable architecture can be defined as an architecture that meets the needs of the present without affecting the ability of future generations to meet their needs. It is possible that sustainable architecture will also be forced upon architects by the increasing confluence of ecological, social, and economic forces. It is in this light that architects ought to adopt these practices for themselves, and their profession first.

Through the design research work of Professor Ralph Knowles at the School of Architecture, University of Southern California (USC), concern has been expressed about the energy implications of building design. Professor Knowles began, in 1976, to develop and test the solar envelope as a zoning concept to provide urban solar access. It was assumed that solar-envelope zoning would eventually result in a shift from fossil fuels to sustainable energy. It would also evoke a profound change in the way we identify with and relate to our environments. This would also create a different way of judging the aesthetics and function of buildings.

The study for a mixed-use development shown on the previous page demonstrates how the solar envelope determines the form of the development. The design ensures that every unit has at least four hours of direct sun exposure, as well as cross ventilation.

What should cities do?

- Urban planners should familiarise themselves with the principles of the solar envelope
- Conduct pilot projects in neighbourhoods conducive to solar envelope implementation
- Develop regulations in line with these principles for all newly developed parts of the city
- Develop a set of indicators to be used to measure the impact of the solar envelope
- Conduct educational programmes for built environment professionals to align their design skills with these principles

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