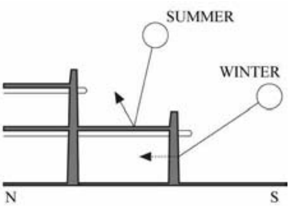
and visualize the future of any land area . . . that gives people the ability to link actions on specific parcels of land to larger regional systems."[1]

A Model for Solar Access

The model for the solar envelope is found in the ancient settlements of North America. Here, a thousand years ago, settlements were laid out for solar access. Acoma Pueblo, located on a plateau about 50 miles (80 km) west of modern Albuquerque, New Mex-

Acoma Pueblo: Terraced houses are well designed to absorb the low winter sun and protect from the higher summer sun. (Perspective drawing by Gary S. Shigemura in *Energy and Form* by Knowles 1974, 27.)

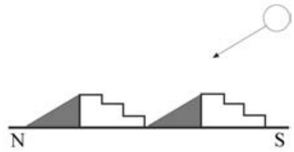
ico, exemplifies such early planning. Rows of houses are stepped down to the south. Walls are of thick masonry. Roofs and terraces are of timber and reeds, overlaid with a mixture of clay and grass.[2]



Acoma Pueblo: Low winter sun strikes the south-facing masonry walls most directly; High summer sun strikes the timber-and-reed roof terraces that transmit heat less efficiently.

Individual houses at Acoma are well suited to a high-desert climate. The sun's low winter rays strike most directly their south-facing masonry walls where energy is stored during the day, then released to warm inside spaces throughout the cold nights. In contrast, the summer sun passes high overhead, striking most directly the roof-terraces where the sun's energy is less effectively stored. What's more, east and west walls are covered by adjacent houses thus further reducing harmful summertime effects.

A small roadway separates each row of houses. The resulting space between the rows is wide enough so that winter shadows cast by any one row of houses covers only the adjoining roadway. Terraces and heat-storing walls remain exposed to the warming rays of the winter sun. It is this critical relationship of building height to shadow area that presents a model for the solar envelope.

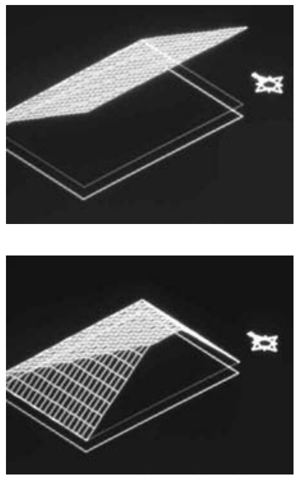


Acoma Pueblo avoids winter shadows by spacing the rows of houses.

What Is a Solar Envelope?

The solar envelope is not a physical thing. It is a set of imaginary boundaries, enclosing a building site, that regulate development in relation to the sun's motion. Buildings within this envelope do not overshadow their surroundings during critical energy-receiving periods of the day and year.

The idea of an imaginary envelope is common to all zoning in the United States.[3] Conventional zoning mostly uses an envelope shaped like a simple box with four sides and a top to establish setbacks and heights. In contrast, the solar envelope is shaped more like a multifaceted crystal or even a series of warped surfaces, generated to follow the moving rays of the sun. Adjacent envelopes can be quite different, depending on their site and particular surroundings. Consequently, buildings made within the solar envelope are more likely to have unique shapes than to repeat boxlike designs.



Generation of Solar Envelope: (Top) A solar plane generated for the instant of noon, winter solstice, slopes to meet the top of a shadow fence on the north edge of the site. (Bottom) As the period of solar access is increased, the original plane lowers and other planes are added, one generated by the winter morning sun and another by the afternoon sun. Compass rose points north.

The solar envelope is a construct of space and time: the physical boundaries of surrounding properties and the period for which access to sunshine is assured. The way these measures are set decides the envelope's final size and shape.

First, the solar envelope guarantees sunshine to others by preventing shadows above designated boundaries along neighboring property lines; these boundaries have been called *shadow fences*. A shadow fence is an imaginary wall that rises from a property line. The solar envelope is then configured to meet the top of the fence