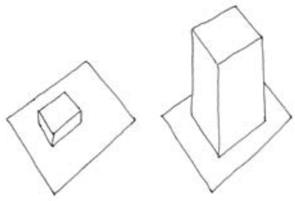
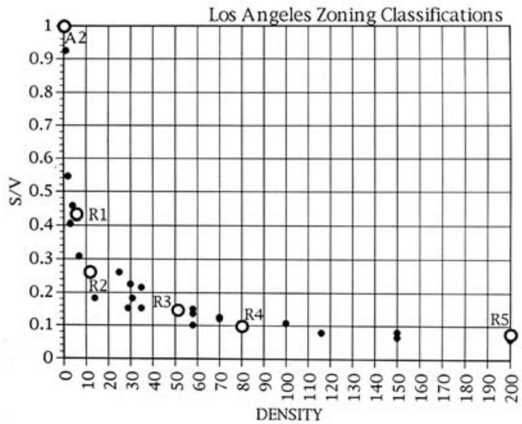


contained building volume. For the study, calculations for *surface* include all outside surfaces of the building (all roofs and walls) plus those portions of the site that are exposed. Calculations for *volume* include only the building. A small building on a large lot will have a higher S:V than will a large building on the same size lot.

S:V, measured on the vertical axis of the graph, varies indirectly with building size. Symbols at the highest end of the curve represent small buildings up to three stories on relatively large lots. Symbols at the low, extreme right end of the curve signify large buildings of unlimited height on crowded lots. Between these extremes, in the elbow of the curve, lies an important range of mid-sized buildings, three to seven stories tall, where the greatest possibilities lie for architects to conserve energy while attaining reasonable densities.



The graph shows the relationship between S:V and density for all Los Angeles housing classifications from 1 to 200 du/ac (2.5 to 494 du/ha). (A few of the more commonly used classifications, as for example R1 for a detached house and R2 for row housing, are marked with a circle.)

S:V acts both as an energy-related descriptor of form and an expression of design choices. The high S:V of a small building on a large lot means that energy must be expended, mainly to overcome surface or "skin" loads and to maintain the lot; but while this is a disadvantage, it also means a favorable architectural connection to sunshine, fresh air, and view because the designer has so many choices to site and configure the building. On the other hand, the low S:V of a very large building crowding its lot means that more energy must be expended to handle the internal stresses of overheating; and while it provides the advantages of higher densities, it also means less potential for the architect to design with nature.

Calculations for surface include exposed portions of the lot as well as the building's faces; this combination is used for three reasons. First, zoning codes usually list minimum yard and lot sizes together with building dimensions as a combined basis for classification. Second, energy is expended to maintain the lot as well as the building, and when the lot is an acre or more, the proportion used for lawns and gardens can be enormous. Finally, when assuring solar access for winter heating and access to summer winds for cooling, the lot and the building must be seen as an integral set.

Density (du/ac), measured on the horizontal axis of the graph, varies with housing classification. One-family dwellings tend to have their own yards. Also, one-family houses tend to have more floor space than a unit within an apartment building.

Density, an indicator of land values, expresses development options. High densities correspond with inflated land values; units, and even whole buildings, become compact and essentially repetitive. Low densities coincide with smaller land costs; developers concentrate on one-family houses multiplied over enormous tracts. But for urban housing on restricted sites in Los Angeles, developers usually try for the highest densities the market and zoning will support. The question is how to balance development pressures with solar access.

Exemplary Housing Designs

Four housing designs, covering a range of settings and densities, are shown as examples of the larger study. Each design respects the solar envelope over its own site, thereby guaranteeing sunshine to its neighbors. The program for each design, within its own envelope, calls for sunshine and cross-ventilation to all dwelling units, regardless of type or size, house or apartment. The solar envelopes are systematically adjusted to increase density in successive projects. A corresponding drop of S:V accurately reflects both higher densities and an increasing difficulty in achieving solar access and cross-ventilation to individual units.