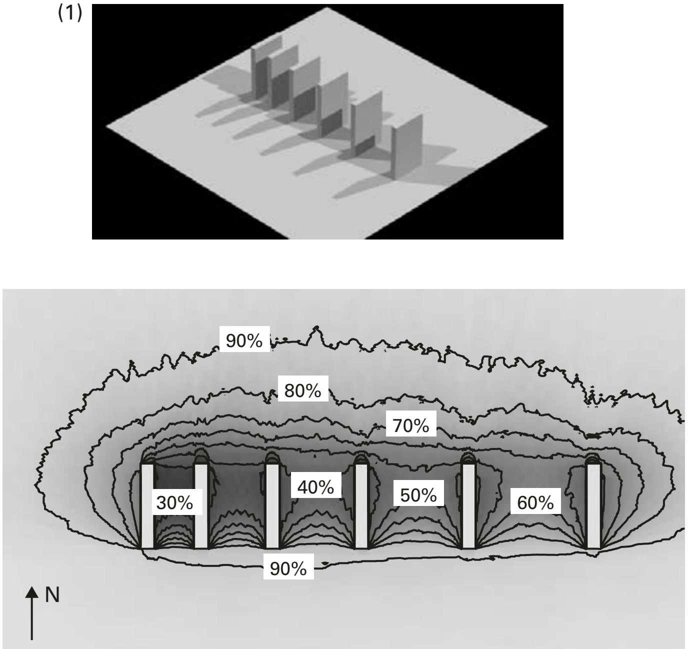
(1)
(2)



Figures 19.7
Ground level solar access around variously spaced tower blocks.

new-build creating or adding to the overshadowing of existing BIPV arrays. Any introduction of, or increase in, overshadowing will reduce the power output from a BIPV array. The degree of injury to a BIPV array caused by overshadowing will be closely related to the decrease in total annual irradiation. The ICUE approach can compute this decrease using a simple technique called '*difference mapping*'. Here the ICUE simulations are carried out for the scene both *without* and *with* the proposed building: viewpoints showing the 'at-risk' facades would be chosen. The total annual irradiation image with the proposed building in place is subtracted from that of the original scene. Thus it is possible to visualize, and indeed quantify, the impact of the proposed building in terms of the reduction in the incident total annual irradiation on the existing buildings. This can then form the basis for a measure of financial injury resulting from reduced power output.

The financial injury due to overshadowing on a BIPV array is a relatively straightforward quantity to estimate. Putting a price on injury due to reduced solar access at a window, however, is considerably more problematic because, unlike electricity, units of daylight (e.g. the Luxh) do not have a tangible monetary value. In part, this is because effective daylighting for buildings needs artificial lighting controls that respond to varying levels of daylight illumination. Recent field trials in San Francisco have shown that daylight responsive lighting control systems can ‘bring about sustainable reductions of 30–41% in electrical energy for an outermost row of lights in a perimeter zone, and 16–22% for the second row of lights’ (Rubinstein *et al.*, 1999). The field trials should be repeated for other settings and locales. However, it is clear that there is considerable potential to reduce the electricity demand for lighting. Thus it should be possible to place a monetary value on daylight. However, as noted in the previous section, solar gain and the resulting cooling also figure in the estimation of overall energy consumption. It may be that additional overshadowing could *reduce* the energy consumption of the ‘injured’ building if the reduction in cooling exceeds the increase in electric lighting consumption.[13] These interactions are complex, but it is conceivable that the irradiation mapping could be enhanced to include some representation of the energy flows across the building perimeter. Then it would be possible to carry out fairly detailed energy modelling of the facade and perimeter zone of the building using only the building envelope and a ‘virtual construct’ for the internal spaces. The theoretical basis for an enhanced version of ICUE is currently being formulated.

Solar access responsive facade configurations

The building facade is a key determining factor for the lighting and cooling requirements of a building. Use of daylight can displace electric lighting for long periods of the year. However, a facade that brings in ample daylight may also admit high solar gains, leading to electric cooling requirements that could outweigh the savings in displaced electric lighting. An ‘optimum’ facade design would be one that maximizes the energy-saving potential of daylight against the solar cooling load. Although the precise relation is complex, the ideal transmission properties for an energy-saving facade depend in some way on the solar access. Evidently, the largest degree of solar control is needed where the solar access is the greatest. In urban settings, the total annual irradiation can vary by an order of magnitude or more across just one facade of a tall building. The degree of variation is greater still when all of the facade orientations are taken into account. Although there is work to be done to calibrate the facade transmission properties for energy performance with respect to total annual irradiation, the ICUE images provide an indication of how building facades