

Lecture 11:
Chapter 9: Shading



9.1 History of Shading



Figure 9.1a Ancient Greek architecture made full use of colonnades and porticoes for protection against the elements and especially the sun. Stoa of Attalos II, Athens.



Figure 9.1b Greek Revival architecture was especially popular in the South, where it contributed greatly to thermal comfort. The Hermitage, Andrew Jackson's home near Nashville, Tennessee.



Figure 9.1c Postmodernism, with its allusion to classical architecture, could draw on time-tested ideas for thermal comfort, as in the public library for San Juan Capistrano, California, designed by Michael Graves.



Figure 9.1d Loggias supported on arcades and colonnades shielded the large windows necessary for natural ventilation in the hot and humid climate of Venice, Italy. Sometimes an open-walled extra floor was added above the top floor to ventilate the heat collecting under the roof.



Figure 9.1e Victorian architecture made much use of the porch and the covered balcony to shade the building and create cool outdoor spaces. Eufaula, Alabama.



Figure 9.1f Much Asian architecture is dominated by large overhangs. Golden Pavilion, Kyoto, Japan. (Courtesy of the Japan National Tourist Organization.)



Figure 9.1h The Gamble House in Pasadena, California, 1908, by Greene and Greene, shows the strong influence of Japanese architecture. Note especially the large roof overhangs. Model by Gary Kamemoto and Robert Takei, University of Southern California.



Figure 9.1i Large overhangs dominate the design of the Robie House, Chicago, 1909, by Frank Lloyd Wright.



Figure 9.1j
Sunshades known as brise-soleil were retrofitted on the Cité de Refuge, Paris, which Le Corbusier designed in 1932 without sunshades. (Photograph by Alan Cook.)

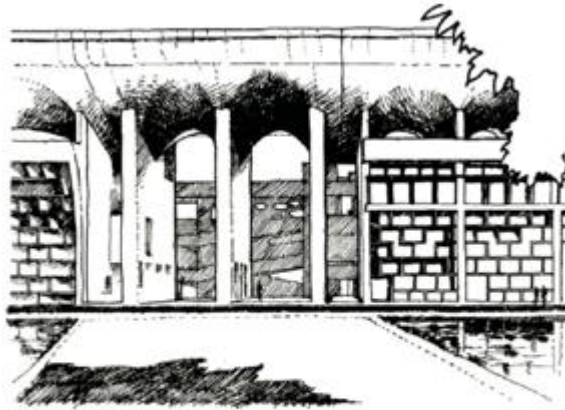


Figure 9.1k The brise-soleil and parasol roof shade the High Court Building at Chandigarh, India. Evaporation from the reflecting pool helps cool the air.



Figure 9.1n As this architect's rendering indicates, awnings were considered desirable in the early twentieth century for both their functional and their aesthetic benefits. (From *Golf and Country Clubs* by Clifford C. Wendehack.)

9.2 Shading

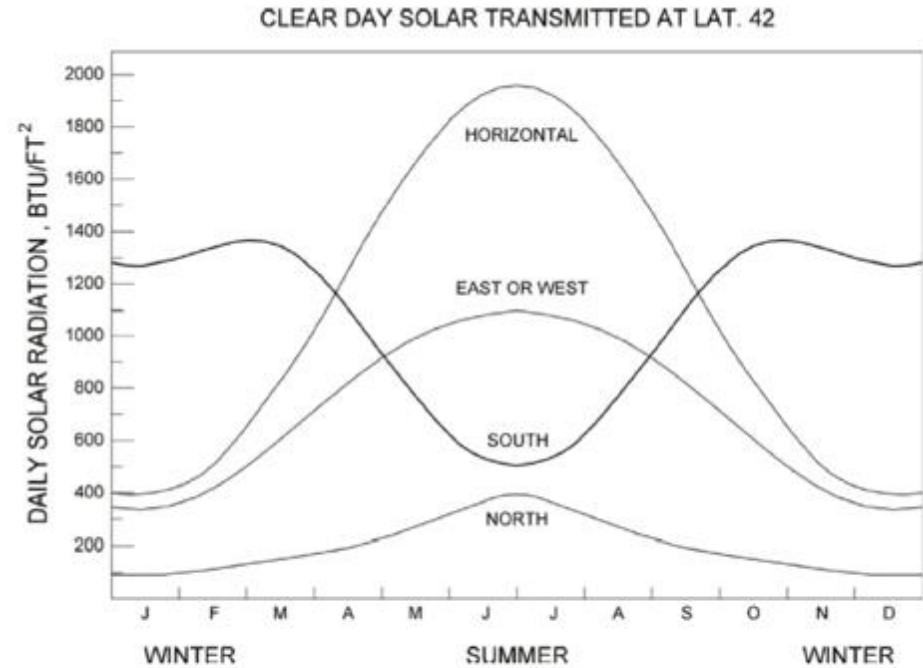


Figure 9.2b All orientations except south receive maximum solar radiation in summer. A skylight receives about four times the solar heating that south windows receive on June 21. (After the *Workbook for Workshop on Advanced Passive Solar Design*, by J. Douglas Balcomb and Robert Jones, © J. Douglas Balcomb, 1987.)

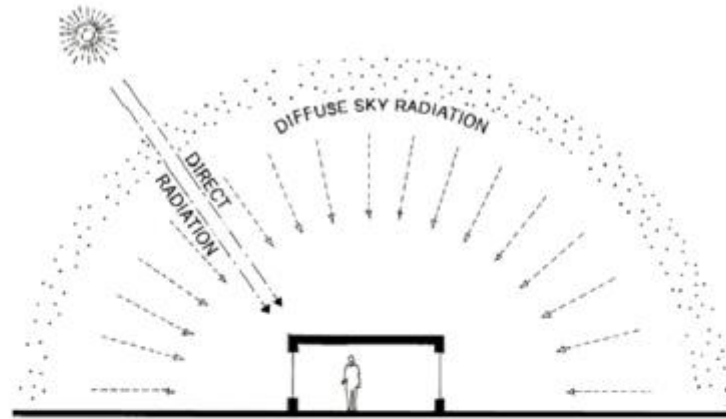


Figure 9.2d In humid, polluted, and dusty regions, the diffuse-sky component is a large part of the total solar load.

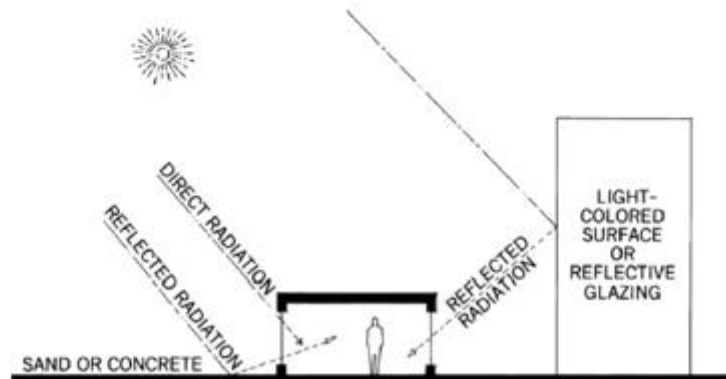


Figure 9.2e In dry regions, the solar load consists mainly of the direct and reflected components. However, reflective glazing can be a problem in all climates.



Figure 9.2f Glass facades without exterior shading devices reflect much of the sun. The bright spots on the north side of this building are a result of reflections from the building on the left.

SHADING SYSTEMS

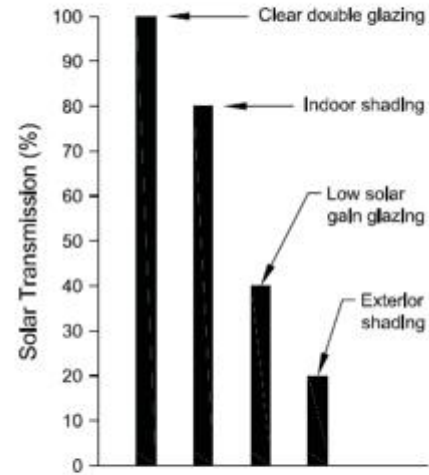


Figure 9.2g Exterior shading devices block about 80 percent of the solar gain through clear windows, while indoor shading blocks only about 20 percent. Low solar gain glazing blocks almost as much solar gain as exterior shading, but, unfortunately, also blocks much of the winter sun and light from the view.

9.3 Fixed Exterior Shading

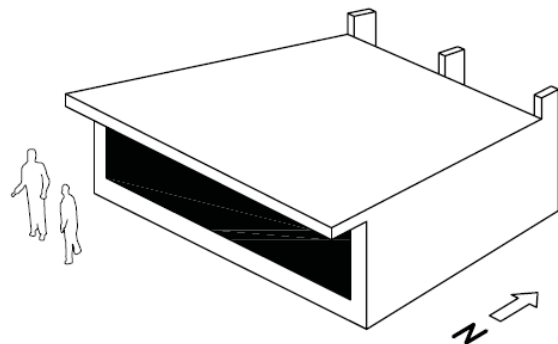


Figure 9.3a Each orientation requires a different shading strategy. From a shading point of view, east and west windows are best avoided, because they cannot be shaded well.

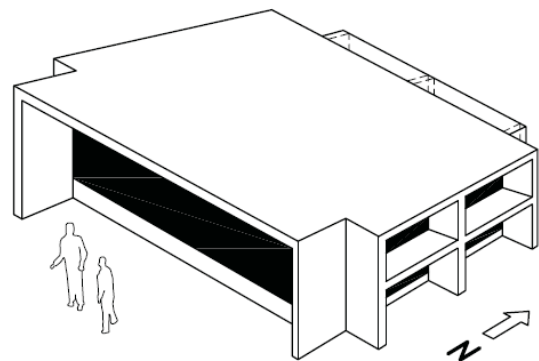


Figure 9.3f Shading is improved when a combination of vertical and horizontal elements is used.

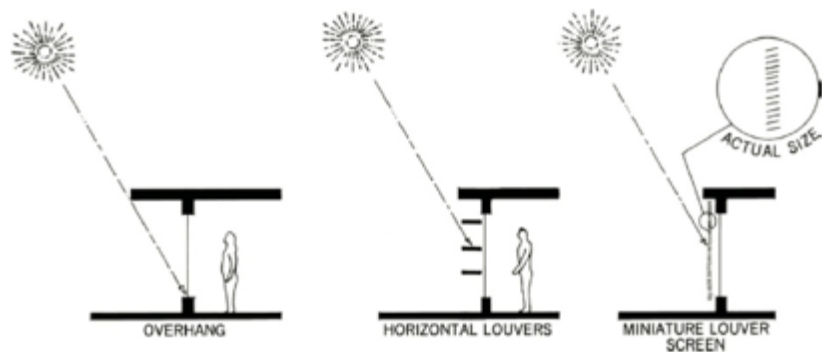


Figure 9.3g Many small elements can create the same shading effect as one large device. However, the view is best with the large overhang.

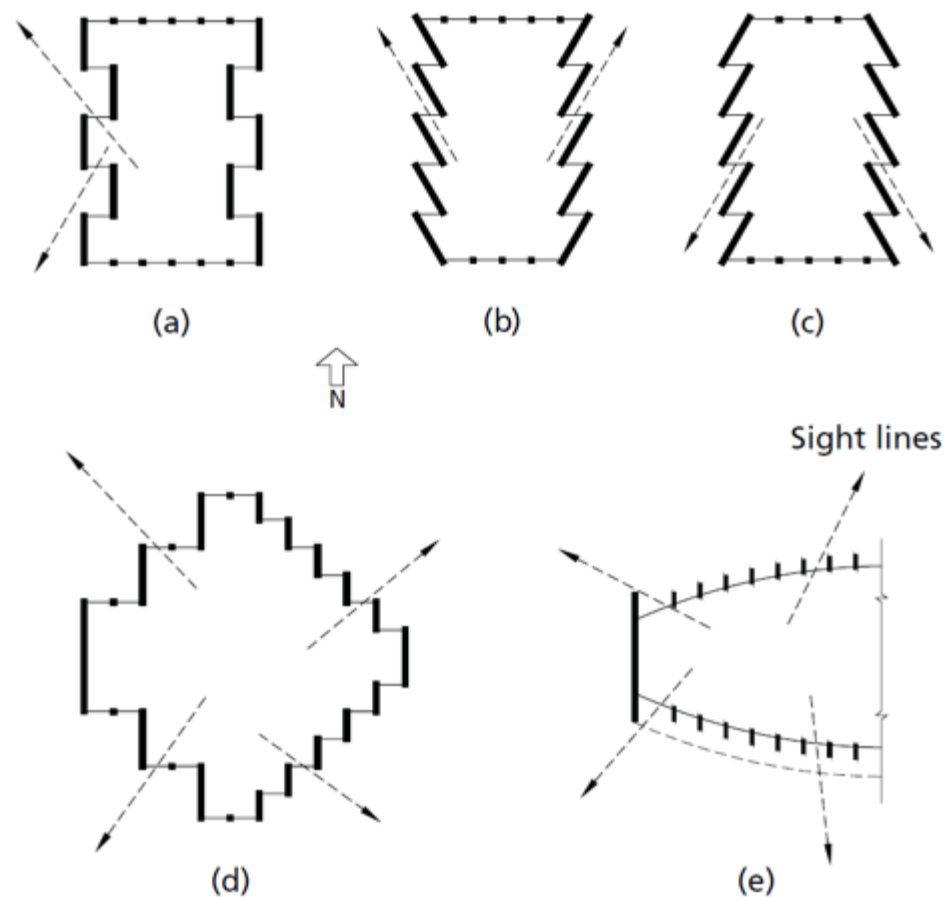


Figure 9.3b These plans illustrate how windows on east and west facades can face either north or south.

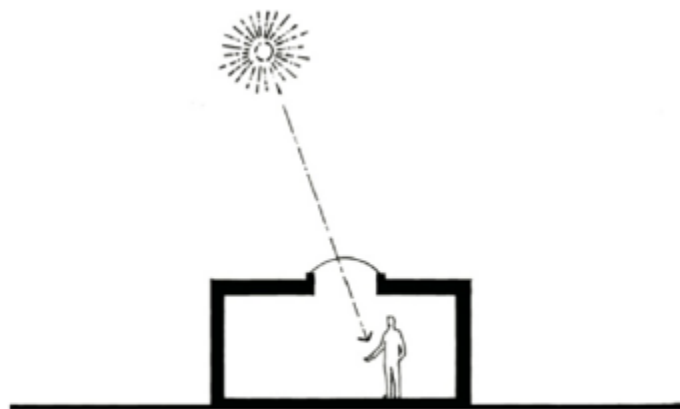


Figure 9.3h Skylights (horizontal glazing) should usually be avoided because they collect the most sunlight in the summer and the least in the winter.

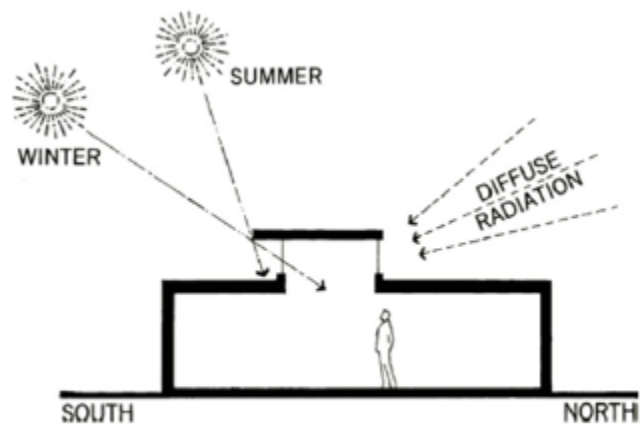


Figure 9.3i Clerestory windows should be used instead of skylights because they allow the sun to enter in a controlled manner, and south-facing clerestories collect more sun in the winter than the summer.

Table 9.3 Examples of Fixed Shading Devices

	Descriptive Name	Best Orientation*	Comments
I	 Overhang Horizontal panel or awning	South, east, west	Traps hot air Can be loaded by snow and wind Can be slanted
II	 Overhang Horizontal louvers in horizontal plane	South, east, west	Free air movement Snow or wind load is small Small scale Best buy!
III	 Overhang Horizontal louvers in vertical plane	South, east, west	Reduces length of overhang View restricted Also available with miniature louvers
IV	 Overhang Vertical panel	South, east, west	Free air movement No snow load View restricted
V	 Vertical fin	North	Restricts view if used on east and west orientations
VI	 Vertical fin slanted	East, west	Slant toward north in hot climates and south in cold climates Restricts view significantly Not recommended
VII	 Eggcrate	East, west	For very hot climates View very restricted Traps hot air Not recommended

*For temperate climates. In the tropics, north becomes similar to south, and at the equator they are equal.
Source: Architectural Graphic Standards, 8th ed. John R. Hoke, ed. (Wiley, 1988).

Table 9.4 Examples of Movable Shading Devices

	Descriptive Name	Best Orientation	Comments
IX	 Overhang Awning	South, east, west	Fully adjustable for annual, daily, or hourly conditions Traps hot air Good for view Can be retracted during storms Best buy!
X	 Overhang Rotating horizontal louvers	South, east, west	Will block some view and winter sun
XI	 Fin Rotating fins	East, west	Much more effective than fixed fins Less restricted view than slanted fixed fins
XII	 Deciduous plants Trees Vines	East, west, southeast, southwest, northeast, northwest	View restricted but attractive for low-canopy trees Self-cooling Highly recommended
XIII	 Exterior roller shade	East, west, southeast, southwest, northeast, northwest	Very flexible, from completely open to completely closed View is restricted when shade is used Provides security

9.4 Movable Shading Devices

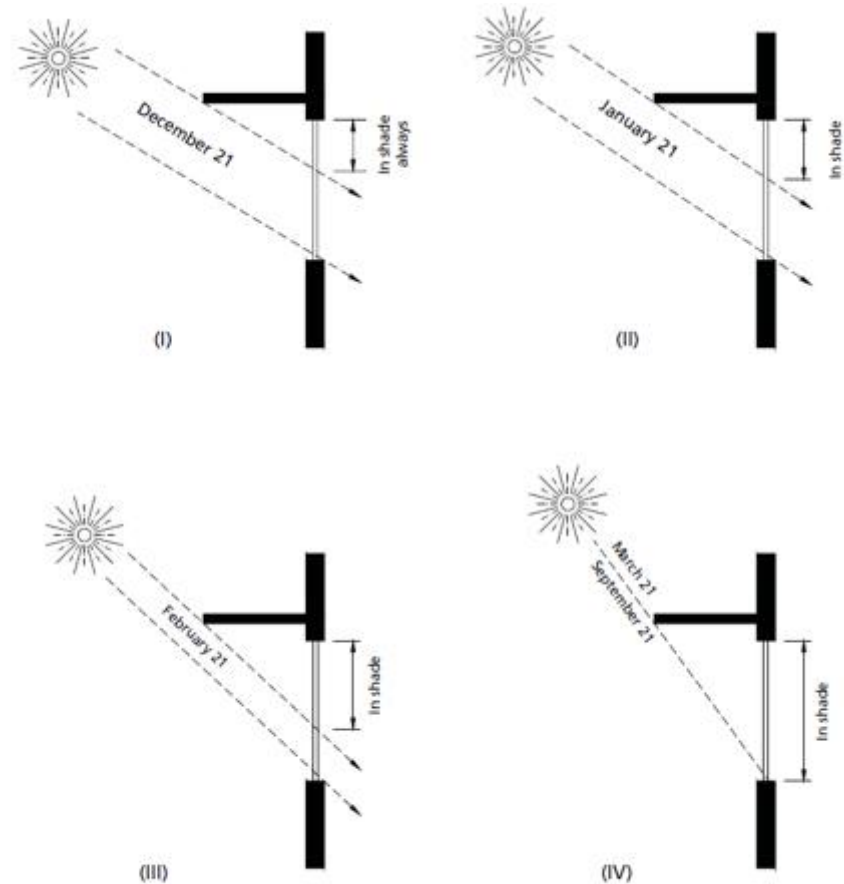


Figure 9.4a The importance of movable south overhangs is demonstrated by the poor performance of a fixed overhang. The overhang shown here was designed for a realistic location where shading is needed through September 21 and where it is cold through March 21 (see section IV). Note how much of the window is in shade during the coldest months of January and February, preventing effective passive solar heating of the building.

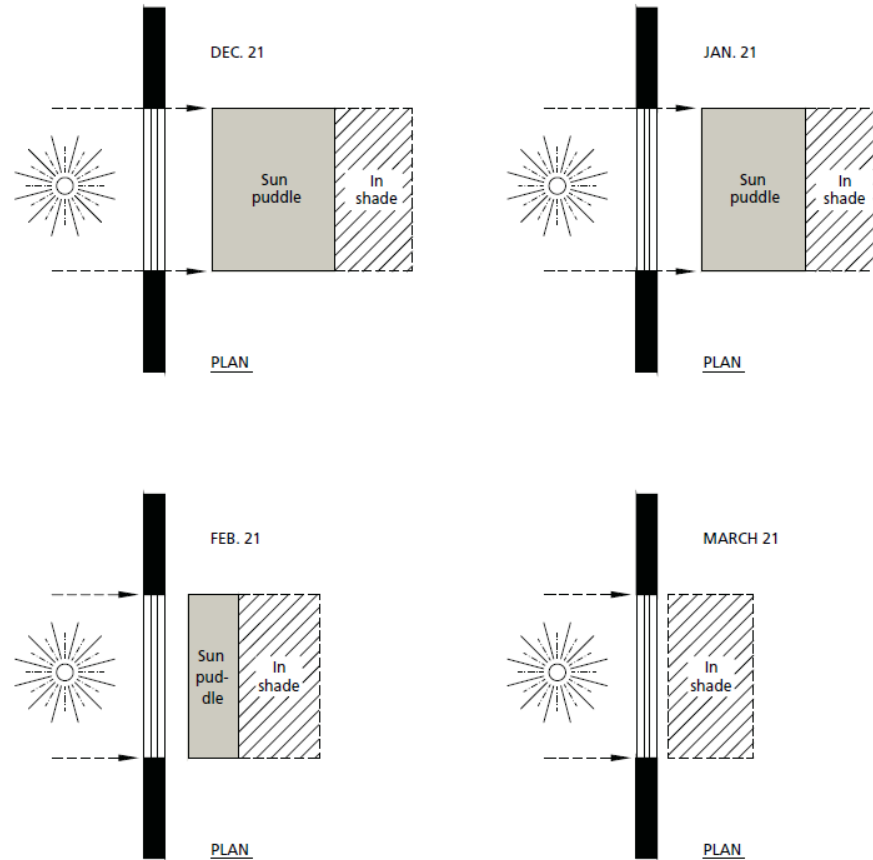


Figure 9.4b Because of the myth that fixed overhangs can both effectively shade in the summer and allow solar collection in the winter, the poor performance of a fixed overhang shown in section in Figure 9.4a is shown here in plan. Note the size of the sun puddles compared to what they would have been without shading.

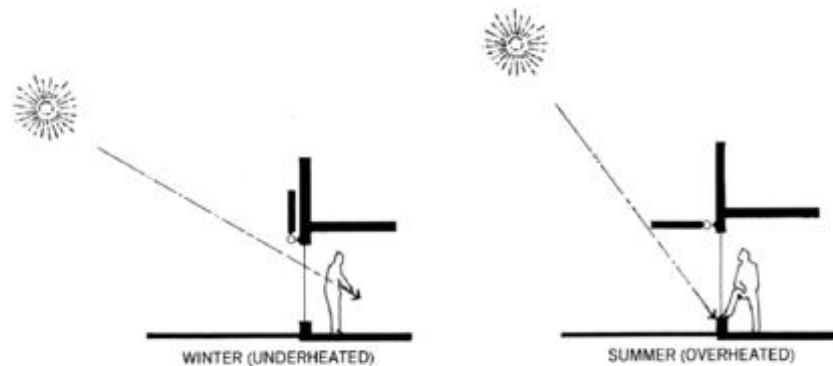


Figure 9.4d A movable shading device with just two simple adjustments per year can function extremely well.



Figure 9.4e Awnings were a common element on many buildings until air conditioning became common. After giving effective shade in the summer, they were removed in order to allow more sun and light to enter the building in the winter.

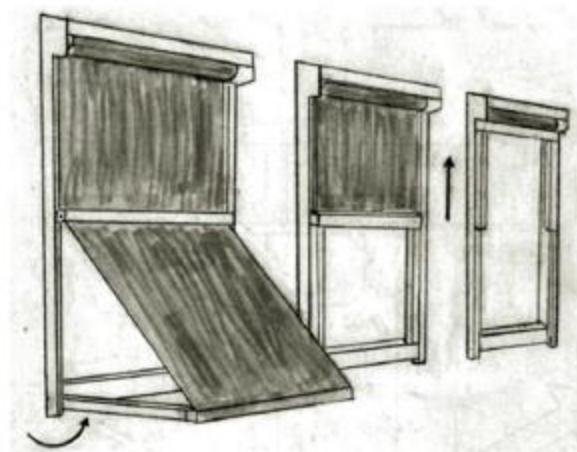


Figure 9.4f Roll-down exterior fabric shades are very popular in Europe. By folding out the lower section, they provide ventilation and a limited view.

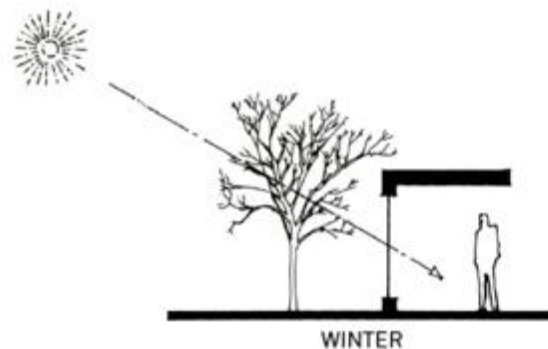
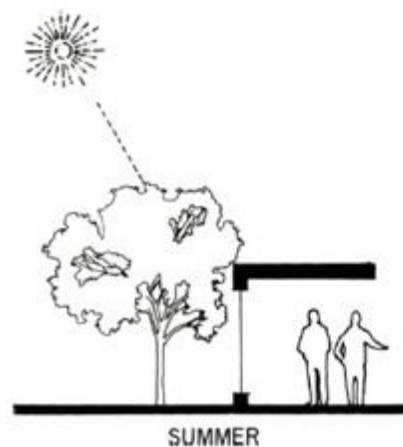


Figure 9.4g The shading from trees depends on the species, pruning, and maturity of the plants. Transmission can be as low as 20 percent in the summer and as high as 70 percent in the winter. Unfortunately, with some trees, winter transmission can be as low as 40 percent.

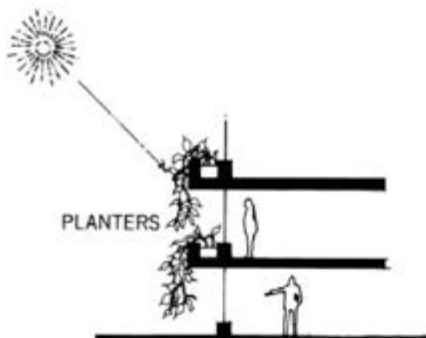
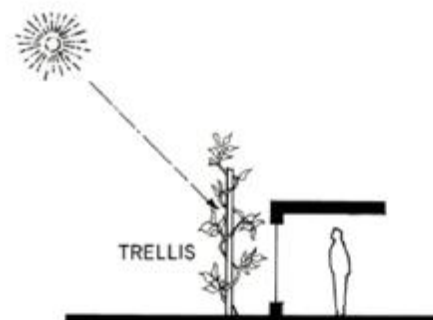


Figure 9.4h Vines can be very effective sunshading devices. Some vines grow as much as 30 ft (9 m) in one year. (See also Colorplate 30.)



Figure 9.4k The automated fabric roller shades on the exterior of east and west windows are guided by vertical support cables which keeps the shades from swaying in the wind.

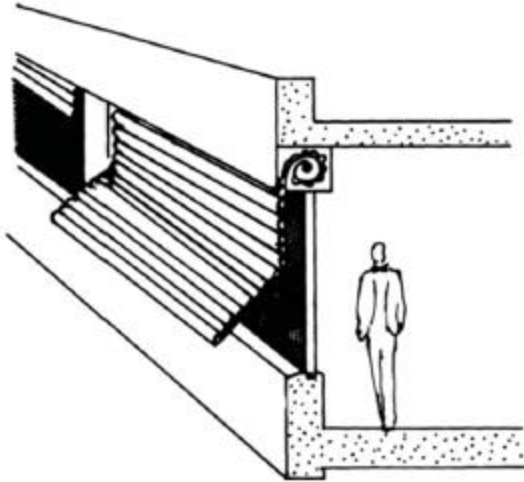


Figure 9.4l Exterior roller shades made of rigid slats move in a vertical plane, and some can also project out like an awning.

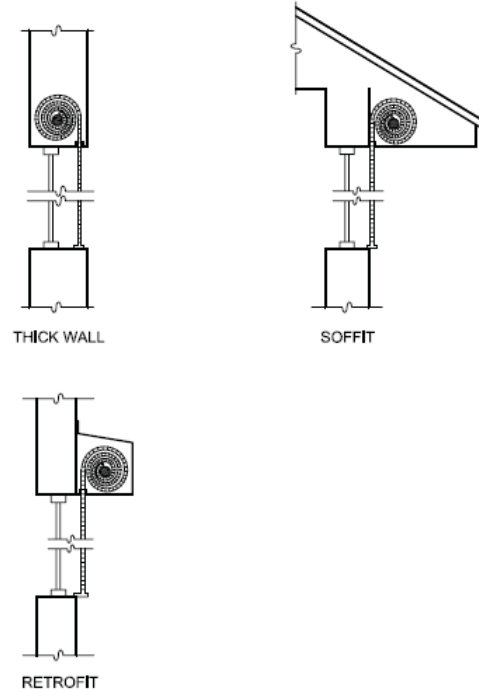


Figure 9.4m Although it is best to integrate exterior roller shades into the design of a new building, they can be added to existing buildings.



Figure 9.4n Exterior venetian blinds have all of the adjustments possible with interior venetian blinds, but they are much more effective in keeping the sun out. They also make an architectural statement on the facade. This building is in Freiburg, Germany.

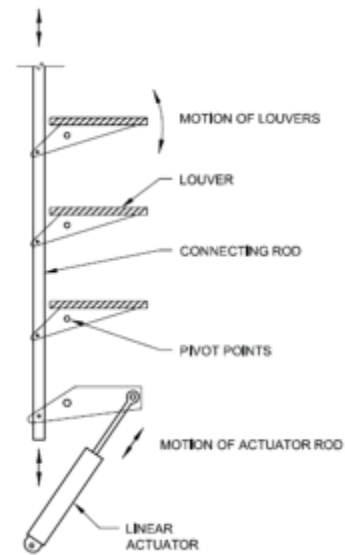


Figure 9.4o Adjustable exterior louvers are effective sun-control devices, but they will always obstruct the view somewhat, unlike exterior venetian blinds, which can be drawn up out of the way. Actuators are often used to rotate a whole column or row of movable louvers.



Figure 9.4p This employment of adjustable louvers is in the Chiswick Business Park in London, UK. (Courtesy of Enjoy-Work).