

# Re-Arch: The Initiative for Renewable Energy in Architecture

# Fact Sheet



## Technology: Passive Solar Design

### Common Uses:

Passive solar design is especially useful in smaller buildings with envelope-dominant heat loss and heat gain issues, as opposed to larger internal-load dominated buildings. A direct-gain approach, allowing direct sun penetration in winter and full shading in summer, is the most common approach. A high level of interior thermal-mass provides a thermal fly-wheel effect, with the building responding slowly to temperature spikes and dips.

### Site Considerations:

Orientation and building configuration are important to take advantage of passive solar design strategies. An elongated east-west axis is best, with the building set to minimize shading by objects or vegetation to the south. A slight southeast orientation often provides an earlier response to available solar energy and maximizes shading from the western sun.

### Size Considerations:

Allocate 50% of the overall glazing to walls within 30 degrees of south. Provide 7-15% of the floor area in south-facing glazing. Limit east or west-facing glazing to less than 5% of the floor area. Lightweight structures exceeding 7% of the floor area in south-facing glazing should have additional thermal mass. Provide 3-4 sq ft of thermal mass for each 1 sq ft of south-facing glazing for areas exposed to direct sunlight, more if remote from direct sunlight. Surface area of interior thermal mass is more important than thickness.

### Design Considerations:

Maximize southern exposure while minimizing western exposure. Provide horizontal exterior shading elements on the south and vertical shading elements on the west. Choose south-facing glazing with a higher Solar Heat Gain Coefficient (SHGC). Consider using heavier interior finish materials, such as brick, stone, tile, thicker drywall or plaster, to augment thermal mass.

### System Costs:

There is minimal additional cost involved, since passive solar design involves a re-allocation and optimization of glazing by orientation, and reconfiguration of the building layout with an elongated east-west axis. The use of heavier interior finish materials may involve a cost premium, depending on what might alternatively been considered.

### More Information:

There are several books and reference guides that outline basic principles of passive solar design. Some of these publications are currently out of print but are readily available through libraries and inter-library loan. In addition, there are several web-based sets of guidelines with downloadable case studies and design briefs. Some have interactive programs to generate customized solar charts and shading configurations.

### Books and Resources:

- Passive Solar Energy Book, Ed Mazria, Rodale Press, 1979, ISBN 978-0878572373
- Sun, Wind & Light: Architectural Design Strategies, G.Z. Brown & Mark DeKay, Wiley 2000 ISBN 978-0471348771
- Climatic Building Design: Energy-Efficient Building Principles and Practices, Kenneth labs & Donald Watson, McGraw-Hill, 1993, ISBN 978-0070684881
- Sunlighting As Formgiver for Architecture, William Lam, Van Nostrand Reinhold, 1986, ISBN 978-0442259419
- Passive Solar Energy: The Homeowner's Guide to Natural Heating and Cooling, Bruce Anderson & Malcolm Wells, Brick House, 1996, ISBN 978-0931790225
- The Solar House: Passive Heating and Cooling, Daniel Chiras, Chelsea Green, 2002, ISBN 978-1931498128
- The Solar Home Book: Heating, Cooling, and Designing with the Sun, Bruce Anderson, RPM, 1976, ISBN 978-0917352010
- Sun Angles for Design, Robert Bennett, Melrose Plantation Press, 1978, ISBN 978-0960171811
- The Passive Solar Design and Construction Handbook, Steven Winter Associates, Wiley, 1997, ISBN 978-0471183082
- Solar Architecture: The Direct Gain Approach, Timothy Johnson, McGraw-Hill, 1981, ISBN 978-0070325982

Websites:

- Whole Building Design Guide [wbdg.org](http://wbdg.org)
- U.S. DOE Energy Efficiency & Renewable Energy [eere.energy.gov](http://eere.energy.gov)
- National Renewable Energy Laboratory [nrel.gov](http://nrel.gov)
- Natural Resources Canada [advancedbuildings.org](http://advancedbuildings.org)
- Canada RetScreen Renewable Energy Software [retscreen.net](http://retscreen.net)
- Build It Solar [builditsolar.com](http://builditsolar.com)
- Sustainable By Design [susdesign.com](http://susdesign.com)
- U. of Oregon Solar Laboratory [solardat.uoregon.edu/solarchartprogram](http://solardat.uoregon.edu/solarchartprogram)
- Pilkington-LOF Sun Angle Calculator [sbse.org](http://sbse.org)
- Archi-Physics Solar Tools [archiphysics.com](http://archiphysics.com)
- Green Builder Resources [greenbuilder.com](http://greenbuilder.com)

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