passive design

introduction

Passive design is design that does not require mechanical heating or cooling. Homes that are passively designed take advantage of natural energy flows to maintain thermal comfort.

Incorporating the principles of passive design in your home:

- **Significantly improves comfort.**
- **Reduces or eliminates heating and cooling bills.**
- **Reduces greenhouse gas emissions from heating, cooling, mechanical ventilation and lighting.**

Building envelope is a term used to describe the roof, walls, windows, floors and internal walls of a home. The envelope controls heat gain in summer and heat loss in winter.

Its performance in modifying or filtering climatic extremes is greatly improved by passive design.

Well designed envelopes maximise cooling air movement and exclude sun in summer. In winter, they trap and store heat from the sun and minimise heat loss to the external environment.

The fundamental principles of passive design, explained above are relatively simple but they must be applied to a vast range of climates, house types and construction systems in Australia.

To explain all of these combinations in sufficient detail, information has been divided into separate fact sheets:

1.1 DESIGN FOR CLIMATE

This fact sheet provides a quick reference guide to the main climatic zones in Australia as well as the key passive design responses for each climate. It also explains the conditions required for human thermal comfort and how passive design assists our bodies in achieving comfort.

1.2 CHOOSING A SITE

Choosing an appropriate site, or existing home, and developing it to make the most of its natural attributes will yield significant economic, lifestyle and environmental benefits.

The information is in three parts corresponding with the usual stages of choosing a site.

- Choosing a locality and housing type.
- Choosing a site, existing home or block.
- Choosing, designing or altering a home to suit your block.

1.3 ORIENTATION

A home that is well positioned on its site delivers significant lifestyle and environmental benefits. Correct orientation assists passive heating and cooling, resulting in improved comfort and decreased energy bills.

The information is presented in three parts:

- Principles of good orientation.
- Orientation for passive solar heating.
- Orientation for passive cooling.

1.4 PASSIVE SOLAR HEATING

Passive solar heating is about keeping the summer sun out and letting the winter sun in. It is the least expensive way to heat your home.

The sheet explains how the following key elements of passive solar heating are applied.

- Northerly orientation of window areas.
- Passive shading of glass.
- Thermal mass for storing heat.
- Minimising heat loss with insulation, draught sealing and advanced glazing.
- Using floor plan zoning to get heating to where it is most needed and keep it there.

Passive solar houses can look like any other home but they are more comfortable to live in and cost less to run.

1.5 PASSIVE COOLING

Passive cooling is the least expensive means of cooling your home. It is appropriate for all Australian climates.

This section explains how to design and modify homes to achieve summer comfort and minimise or eliminate energy use for cooling.

Four key approaches are examined:

- Envelope design for passive cooling.
- Natural cooling sources.
- Hybrid cooling systems.
- Adapting lifestyle.

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1.6a INSULATION INTRODUCTION

Insulation is an essential component of passive design. It improves building envelope performance by minimising heat loss and heat gain through walls, roof and floors.

Topics covered include:

> Insulation types and their applications.

> Recommended insulation levels for different climates.

> Strategies for cost effective insulation solutions.

1.6b INSULATION INSTALLATION

This explains where and how to install insulation, provideing detailed examples of a range of insulation solutions for various construction types providing detailed examples.

1.6c INSULATION CASE STUDIES

This outlines examples of insulation materials being used in Australian homes in various climates around the country.

1.7 THERMAL MASS

Externally insulated, dense materials like concrete, bricks and other masonry are used in passive design to absorb, store and re-release thermal energy. This moderates internal temperatures by averaging day/night (diurnal) extremes, therefore increasing comfort and reducing energy costs.

Subjects covered include:

> Where and how to use thermal mass.

> Thermal mass solutions for different climates and construction types.

> How much thermal mass to use.

1.8a GLAZING INTRODUCTION

Windows and glazing are a very important component of passive design because heat loss and gain in a well insulated home occurs mostly through the windows.

With good passive design, this is used to advantage by trapping winter heat whilst excluding summer sun. Cooling breezes and air movement are encouraged in summer and cold winter winds are excluded.

1.8b GLAZING – HOT HUMID

Case Studies showing appropriate glazing and window solutions in climates where cooling is the major thermal comfort consideration.

1.8c GLAZING – TEMPERATE

Case Studies showing appropriate glazing and window solutions in climates where both heating and cooling are important for thermal comfort.

1.8d GLAZING – COOL TEMPERATE

Case Studies showing appropriate glazing and window solutions in climates where heating is the major thermal comfort consideration.

1.8e HOW TO USE WERS

The Window Energy Rating Scheme (WERS) is a system for rating both the glass and the frame performance of windows in reducing heat loss and heat gain.

WERS will help you determine whether heating, cooling or both are more important in your climate. It assists you in choosing the most energy-efficient windows for your home and climate.

1.9 SHADING

Shading of glass is a critical consideration in passive design. Unprotected glass is the single greatest source of heat gain in a well insulated home.

Shading requirements vary according to climate and house orientation.

In climates where winter heating is required, shading devices should exclude summer sun but allow full winter sun to penetrate.

This is most simply achieved on north facing walls. East and west facing windows require different shading solutions to north facing windows.

In climates where no heating is required, shading of the whole home and outdoor spaces will improve comfort and save energy.

This sheet explains how to choose or design climate and orientation specific shading solutions for all types of Australian housing.

1.10 RATING TOOLS

A range of specific purpose modelling and rating tools has been developed to rate aspects of building performance for Australian conditions.

This sheet examines some commonly used tools and explains how to interpret the results of ratings to avoid misleading conclusions.