What is Passive Solar Design?

Worksheet

Passive solar design is an architectural strategy that positions glazing, thermal mass and shading to capture free solar heat in winter and block excess solar heat in summer, reducing a building's need for mechanical heating and cooling.

Questions

1. Solar heat gain through a window is calculated as?

A) Q = A + SHGC + I
B) Q = A SHGC I
C) Q = A / SHGC
D) Q = SHGC / I

2. In passive solar design, glazing for winter heat gain should mainly face which direction (northern hemisphere)?

A) North
B) East
C) South
D) West

3. A fixed overhang sized for a site's latitude does what?

A) Blocks all sunlight year-round
B) Blocks high summer sun, admits low winter sun
C) Only works in winter
D) Increases summer heat gain

4. What role does thermal mass play?

A) Blocks all sunlight
B) Stores daytime solar heat and releases it at night
C) Increases window SHGC
D) Cools the building in winter

5. A room has 8 m of south-facing glass with SHGC = 0.6, under winter irradiance of 600 W/m. Find the instantaneous solar heat gain.

6. The same 8 m window uses low-SHGC summer glass (SHGC = 0.25) under peak summer irradiance of 900 W/m. Find the heat gain and compare to Example 1.

7. A designer wants to limit summer heat gain to 1,500 W through a 10 m south window at 800 W/m irradiance. What maximum SHGC is allowed?

8. Define: What is passive solar design?

9. Define: What is the solar heat gain formula?

10. Define: What does thermal mass do in passive solar design?

Answer Key

1. B) Q = A SHGC I - Heat gain is glazing area times SHGC times solar irradiance.

2. C) South - South-facing glazing receives the most direct winter sun in the northern hemisphere.

3. B) Blocks high summer sun, admits low winter sun - The overhang length is calculated from summer and winter sun angles at that latitude.

4. B) Stores daytime solar heat and releases it at night - Mass (concrete, masonry, water) absorbs excess daytime heat and radiates it back after sunset.

5. Q = A SHGC I Q = 8 0.6 600 Q = 2,880 W

6. Q = 8 0.25 900 Q = 1,800 W Despite higher irradiance, lower SHGC glass admits less heat than the winter case - this is the point of seasonal sun control.

7. Q = A SHGC I SHGC = Q / (A I) SHGC = 1,500 / (10 800) SHGC = 0.1875, so glass with SHGC 0.19 is needed

8. Using a building's orientation, glazing and mass to collect and store winter sun and reject summer sun, without mechanical systems.

9. Q = A SHGC I - glazing area times solar heat gain coefficient times solar irradiance.

10. Absorbs solar heat during the day and slowly releases it at night, smoothing indoor temperature swings.