

# Sustainable Building Design: Student Activity Worksheet

## Introduction to Thermal Imaging (15 minutes)

Study the thermal image below and complete the following tasks:

[Thermal Image Placeholder]

*Image shows a residential building facade with varying heat signatures*

1. Using different colored markers, circle and label:
  - o Red areas showing significant heat loss
  - o Blue areas showing good insulation
  - o Yellow areas showing moderate heat transfer

2. What patterns do you notice around windows and doors?

3. Why might these patterns occur?

## R-Value Calculations (20 minutes)

Working in pairs, solve the following thermal resistance problems:

Problem 1: Calculate the total R-value for this wall assembly:

Layer	Thickness (mm)	$\lambda$ (W/mK)	R-Value (m <sup>2</sup> K/W)
Brick Wall	240	0.77	
Mineral Wool	150	0.040	
Gypsum Board	12.5	0.25	

Show your calculations here:

### Material Analysis Challenge (25 minutes)

Research and complete the following comparison table for sustainable insulation materials:

Material	Thermal Properties	Environmental Impact	Cost Rating (1-5)
Sheep's Wool			
Hemp Fiber			
Cellulose			

## Thermal Bridge Investigation (30 minutes)

Using the building section diagram below, complete these tasks:

[Building Section Diagram Placeholder]

1. Identify and circle 5 potential thermal bridges on the diagram
2. For each thermal bridge identified, complete this analysis:

Location	Why is it a thermal bridge?	Proposed Solution
1.		
2.		
3.		

## Solar Gain Analysis (45 minutes)

Complete a detailed solar gain analysis for different building orientations:

[Compass Rose Diagram with Building Orientation Options]

Orientation	Morning Sun	Afternoon Sun	Shading Requirements
North Facing			
South Facing			
East Facing			
West Facing			

## Window Design Optimization (30 minutes)

Calculate the optimal window-to-wall ratio for different facades:

Window-to-Wall Ratio (WWR) = (Total Window Area ÷ Total Wall Area) × 100%

Recommended Range: 20-40% for energy efficiency

Facade	Wall Area (m <sup>2</sup> )	Window Area (m <sup>2</sup> )	WWR (%)	Optimal? (Y/N)
North	45	12		
South	45	18		

**Scenario:** Design a natural ventilation strategy for a three-story office building

Draw your ventilation strategy here, including:

- Air flow patterns
- Window positions
- Stack effect utilization
- Cross ventilation opportunities

Ventilation Element	Purpose	Expected Performance
Stack Ventilation		
Cross Ventilation		
Night Cooling		

# Green Roof Design Project (60 minutes)

[Green Roof Layer Diagram]

*Label each layer and its function*

**Complete the Green Roof Specification Table:**

Layer	Material	Thickness	Function
Vegetation Layer			
Growing Medium			
Filter Layer			
Drainage Layer			

**Calculate the Following:**

1. Total weight of green roof system (saturated condition)

2. Annual stormwater retention capacity

3. Thermal resistance value (R-value) of the complete system

## Sustainable Building Design Reflection

1. What was the most significant concept you learned about thermal efficiency today?

2. How could you apply these principles to improve your own home's energy efficiency?

3. What challenges might architects face when implementing these sustainable design features?

### Self-Assessment Checklist

Learning Objective	Achievement Level (1-5)
I can interpret thermal imaging data	
I can calculate R-values for building materials	
I can identify and solve thermal bridge issues	