

**Case Study No: 04**

## **TITLE:** Best practices in Day lighting& Passive Systems for Smaller Commercial Buildings

## **SOFTWARE REQUIREMENTS:**

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| --- | --- | --- |
| **Sr.No** | **Name of Software and Hardware** | **Latest Version** |
| 1 | Operating System | Windows 10 |
| 2 | CPU, RAM | 2500 MHz, 8 GB |

1. **Introduction to Daylighting**

Daylighting is the practice of using natural sunlight to illuminate interior spaces. It aims to reduce dependence on artificial lighting, lower energy consumption, and improve occupant comfort and well-being. In smaller commercial buildings, effective daylighting contributes significantly to **energy efficiency** and **sustainable design** goals.

1. **Importance of Passive Systems**

Passive systems refer to **non-mechanical methods** used to control indoor environments, such as natural ventilation, thermal insulation, and solar shading. These systems:

* **Reduce energy costs** by minimizing HVAC load
* **Improve thermal comfort** without active equipment
* **Promote sustainability** by reducing carbon emissions They are especially effective in low-rise commercial buildings where mechanical systems can be over-dimensioned.

1. **Techniques and Strategies**

Key strategies for effective daylighting and passive design include:

* **Building Orientation:** Aligning the building for maximum daylight exposure while minimizing glare.
* **Window Placement:** Using clerestory windows, skylights, or light shelves to distribute light evenly.
* **Shading Devices:** External louvers, brise-soleils, and overhangs to block unwanted solar heat.
* **Zoning:** Separating areas based on lighting needs and usage patterns.

1. **Building Materials and Technologies**

Modern materials improve daylighting efficiency:

* **High-performance glazing:** Low-E glass minimizes heat gain while allowing visible light.
* **Reflective surfaces:** Interior paints and finishes enhance light diffusion.
* **Insulated wall systems:** Maintain temperature without heavy reliance on HVAC.

1. **Case Study: EcoHub Workspace, Pune, India**

EcoHub is a co-working space that integrates daylighting and passive cooling in a compact 2-story commercial building.

* Large south-facing windows with automated blinds optimize daylight.
* Courtyards and openable skylights allow cross-ventilation.
* Solar chimneys passively extract hot air during peak hours.
* The use of exposed brick and lime plaster improves thermal mass and indoor air quality. Result: Energy savings of 35% and 15% higher user satisfaction compared to standard office spaces.

1. **Tools for Simulation**

Designers use simulation tools to test daylight and energy performance:

* **Autodesk Ecotect:** 3D solar and daylight analysis
* **Dialux:** Lighting design and lux level predictions
* **Radiance:** Physically-based light simulation tool used for accurate daylight prediction These tools help optimize orientation, fenestration, and material selection in early design stages.

**7. Challenges & Solutions**

* **Cost Constraints:** Passive features may increase initial construction cost → Offset by long-term energy savings
* **Space Limitations:** Smaller plots limit orientation → Use vertical strategies (e.g., skylights)
* **Aesthetic Concerns:** Shading devices can alter facade look → Integrate design into architectural language

1. **Impact Analysis**

Benefits of daylighting and passive systems:

* **Energy Savings:** Up to 40% reduction in lighting and cooling loads
* **Occupant Well-being:** Increased productivity, mood, and health
* **Sustainability Goals:** Contributes to green certifications like GRIHA and LEED

1. **Conclusion**

Incorporating daylighting and passive systems is a crucial step toward **eco-efficient and occupant-friendly commercial buildings**. Especially in small-scale developments, these strategies offer a low-tech yet high-impact approach to energy conservation and climate resilience. As simulation tools evolve and awareness grows, passive design is becoming a **mainstream solution** in sustainable architecture.