BUILDING DIGEST

CENTRAL BUILDING RESEARCH INSTITUTE, INDIA

# COOLING LOAD AND INDOOR AIR TEMPERATURE OF OFFICE BUILDINGS UNDER TROPICAL CLIMATE

The indoor thermal conditions depend on many factors such as climatic condition, thermal characteristics of materials used in the structure and utility. Methods are available to precisely include all these factors in the computation of cooling loads and indoor air temperatures. To account for all these factors, about 30 cases were studied. A double-storey building having number of rooms in a row was considered for the purpose. The envisaged plan of the building is shown in Fig. 1. General features of the building considered are given below :

Walls : 23 cm brick with plaster on both sides.
Roof : 9 cm lime concrete over 10 cm R.C.C. slab.
Intermediate floor : 15 cm R.C.C. slab.
Floor : 2.5 cm cement concrete + 7.5 cm brick blast + 20 cm soil.
Window : all on longer wall, 3 mm glass, 12½% of floor area or 25% of wall area.
Door : 2.5 cm teak wood.

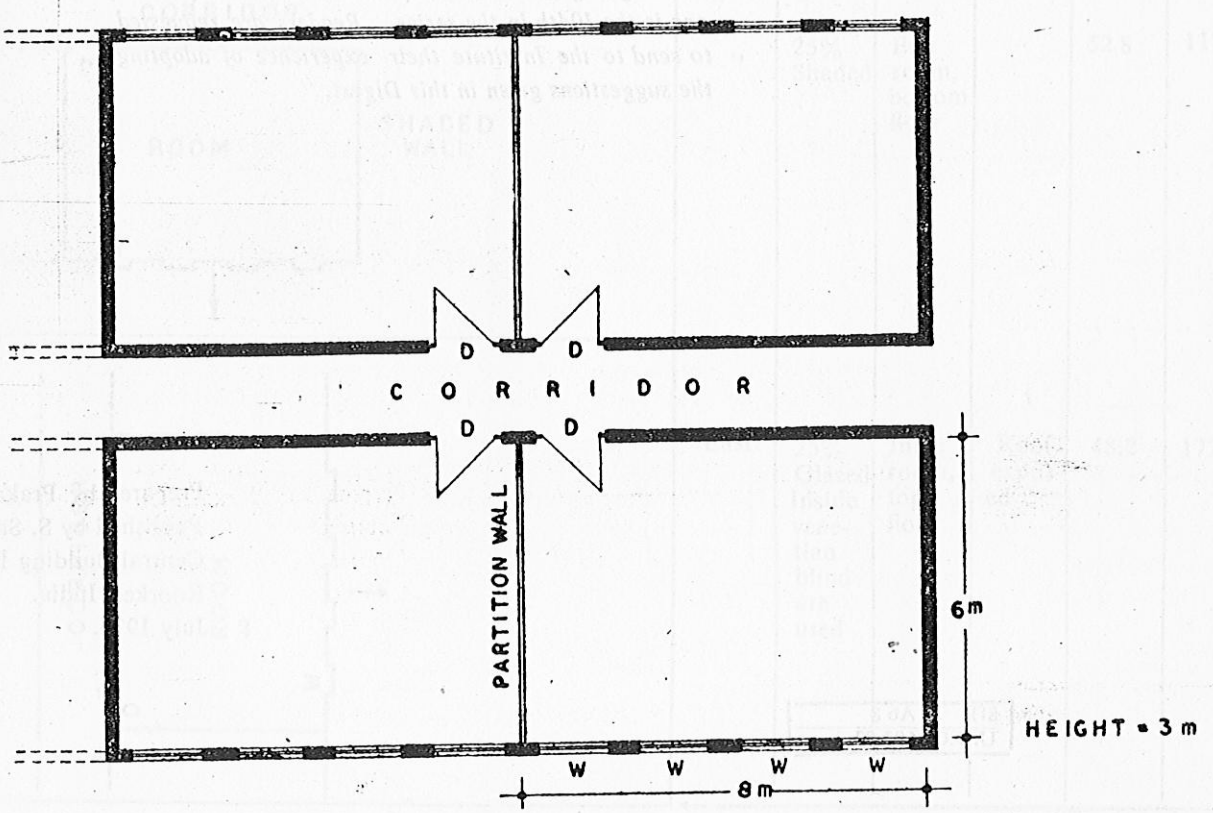



Fig. 1. Plan of the building studied.

People : 40
Furniture : 40 tables and chairs
Ventilation : 4 air changes/hour

Venetian blinds were considered whenever the glass area was fully sunlit.

**Rating Criterion**

For conditioned buildings, the volume of air cooled to 25°C by a one-ton refrigeration unit has been taken as the basis. Peak degree hours above a base temperature of 30°C forms the basis of rating unconditioned building. However, in case of unconditioned buildings, 6°C of peak degree hours has been taken as equivalent to 100 in T.P.I. A.T.P.I. value of 50 or less should provide comfortable indoor conditions. Furthermore, the more the volume of air cooled by one ton of refrigeration the better is the enclosure. Based on these criteria, the data for all the 30 cases has been computed and given in table 1.

From the data presented in table 1, computatio cooling load for a particular enclosure is simple. An illustrative example for the computa of peak indoor air temperature from the T values is as follows :

**Example**

A south oriented building has an inner room on bottom floor. The glass area is 25% of the wall and is shaded. The number of air changes are 4 hour. Calculate the peak indoor air temperature.

From table 1 the T.P.I. value (ref A)=122
Therefore

$$\text{Peak indoor air temperature} = \frac{122 \times 6}{100} + 30$$
$$= 7.2 + 30$$
$$= 37.2\ ^{\circ}\text{C}.$$

---

*There is a demand for short notes summarising available information on selected building topics for the use of Engineers and Architects in India. To meet the need this Institute is bringing out a series of Building Digests from time to time and the present one is the 104th in the series. Readers are requested to send to the Institute their experience of adopting the suggestions given in this Digest.*

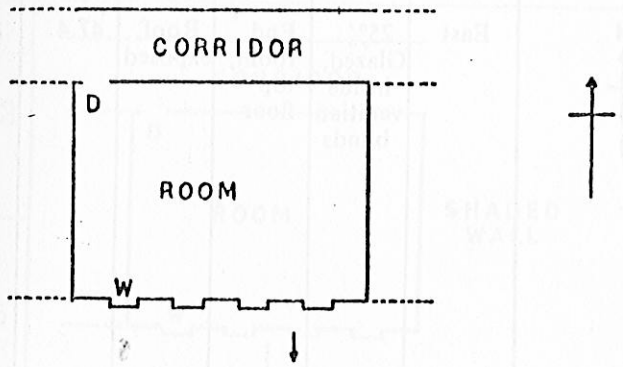
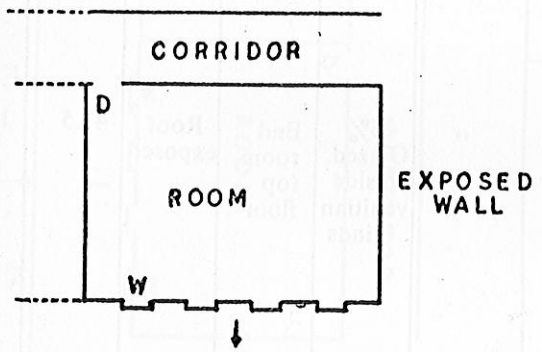
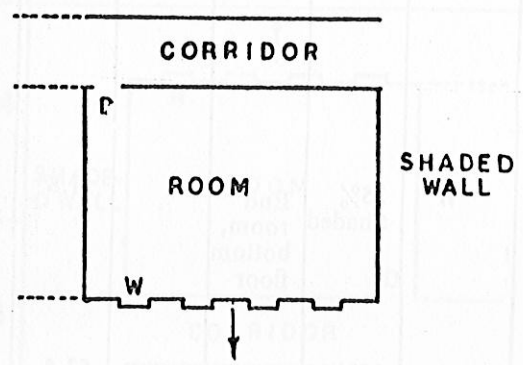
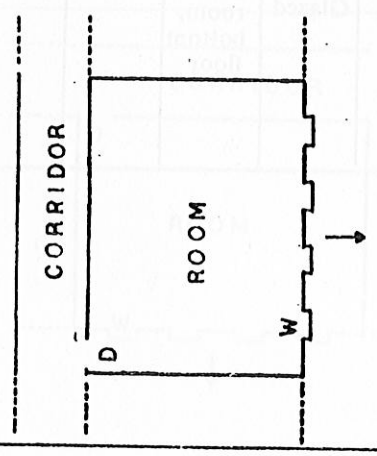
Prepared by Prakash Chandra
Published by S. Srinivasan
Central Building Research Institu
Roorkee, India.
July 1973.

SfB Ab 8
U.D.C. 697.97

Lakshmi Printers, Saharanpur (India)

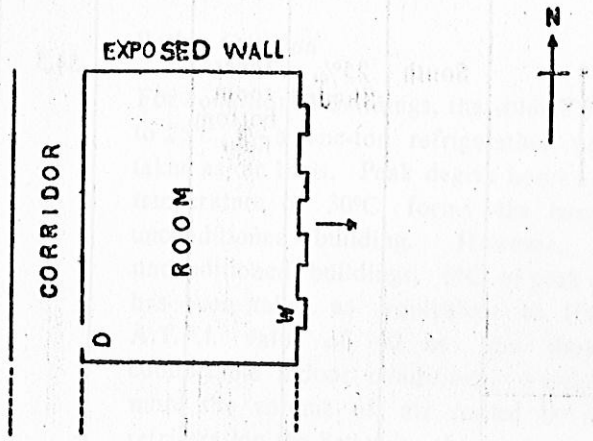
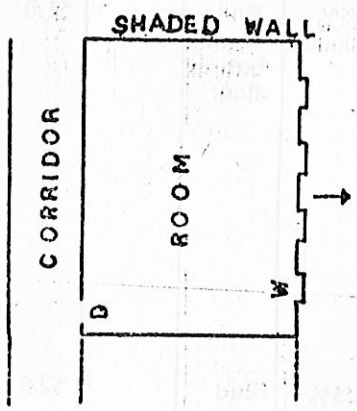
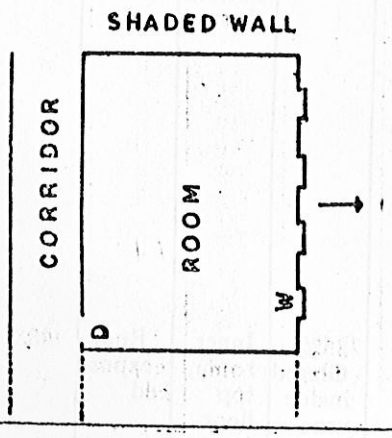
**TABLE I**

**Thermal Performance values of Office Buildings for Various Combinations of Thermal Factors**

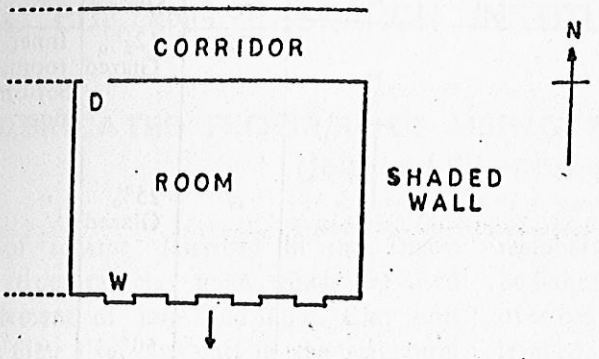
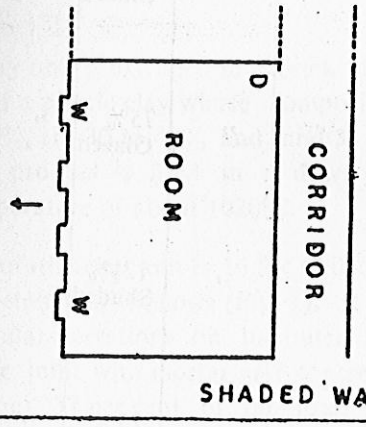
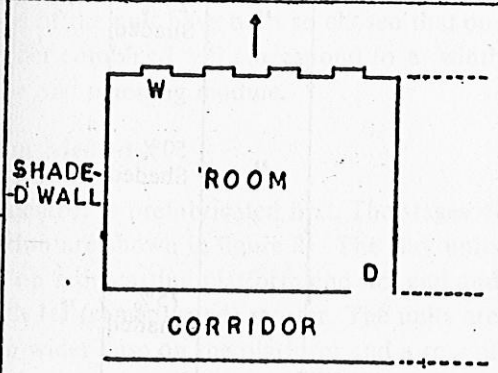
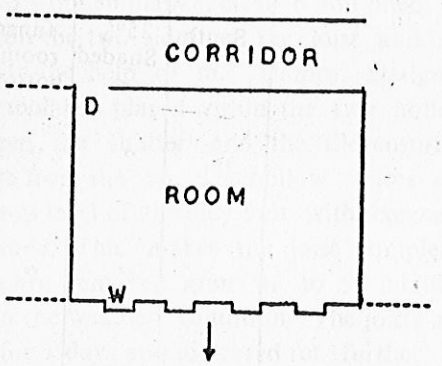
| DESIGNATION | CASE | Orientation | Glass area. Shaded or Glazed | Location | Remarks | * Volume $m^3$/ton | † T.P.I. Value |
|---|---|---|---|---|---|---|---|
| A |  | South | 25%, Shaded | Inner room bottom floor | | 54.5 | 122 |
| B |  | ,, | 25% Shaded | End room, bottom floor | | 51.0 | 125 |
| C |  | ,, | 25% Shaded | End room, bottom floor | | 52.8 | 117 |
| D |  | East | 25% Glazed inside venetian blind are used | Inner room, top floor | Roof exposed | 48.2 | 177 |

* Conditioned

† Unconditioned

| DESIGNATION | PLAN | Orientation | Glass area Shaded or Glazed | Location | Remarks | * Volume $m^3$/ton | † T.P.I. value |
|---|---|---|---|---|---|---|---|
| F3 |  | East | 25% Glazed, inside venitian blinds | End room, top floor | Roof exposed | 47.4 | 170 |
| F |  | " | 25% Glazed, inside venitian blinds | End room, top floor | Roof exposed | 47.5 | 170 |
| 01 |  | " | 25% Shaded | End room, bottom floor | | 51.8 | 122 |
| 05 | | " | 25% Glazed | End room, bottom floor | | 53.4 | 133 |

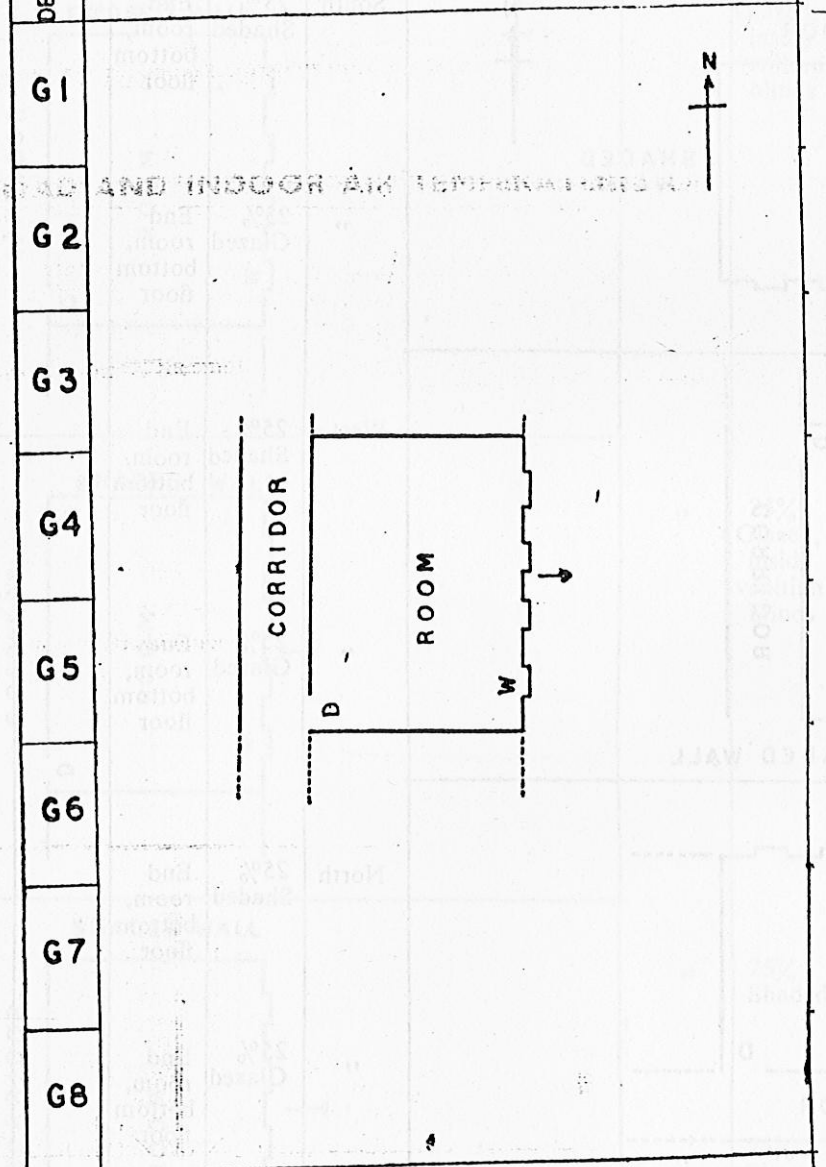
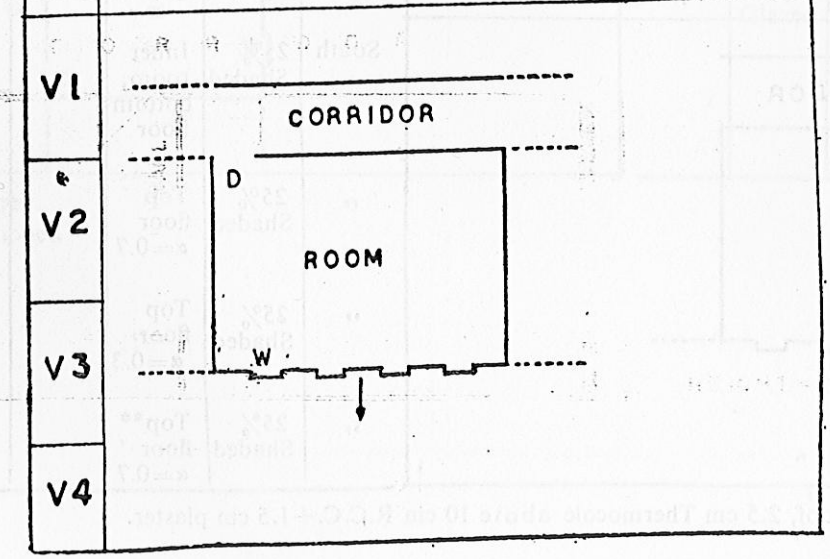
* Conditioned
† Unconditioned

| DESIGNATION | PLAN | Orientation | Glass area Shaded or Glazed | Location | Remarks | * Volume $m^3$/ton | † T.P.I value |
|---|---|---|---|---|---|---|---|
| 02 |   | South | 25% Shaded | End room, bottom floor | | 52.8 | 117 |
| 06 | | ,, | 25% Glazed | End room, bottom floor | | 49.8 | 127 |
| 03 |   | West | 25% Shaded | End room, bottom floor | | 53.1 | 118 |
| 07 | | ,, | 25% Glazed | End room, bottom floor | | 52.0 | 133 |
| 04 |   | North | 25% Shaded | End room, bottom floor | | 53.4 | 113 |
| 08 | | ,, | 25% Glazed | End room, bottom floor | | 55.5 | 108 |
| R1 |   | South | 25% Shaded | Inner room, bottom floor | | 54.5 | 122 |
| R2 | | ,, | 25% Shaded | Top floor $\alpha=0.7$ | | 47.7 | 167 |
| R3 | | ,, | 25% Shaded | Top floor $\alpha=0.3$ | | 53.7 | 125 |
| R4 | | ,, | 25% Shaded | Top** floor $\alpha=0.7$ | | 52.8 | 165 |

** Roof, 2.5 cm Thermocole above 10 cm R.C.C.+1.5 cm plaster.

* Conditioned

† Unconditioned

| DESIGNATION | PLAN | Orientation | Glass area Shaded Glazed | Location | Remarks | * Volume m³/ton. |
|---|---|---|---|---|---|---|
| G1 |  | East | 12½% Glazed | Inner room, bottom floor | — | 57.5 |
| G2 | | ,, | 25% Glazed | ,, | — | 54.3 |
| G3 | | ,, | 50% Glazed | ,, | — | 43.2 |
| G4 | | ,, | 75% Glazed | ,, | — | 35.4 |
| G5 | | ,, | 12½% Shaded | ,, | — | 56.4 |
| G6 | | ,, | 25% Shaded | ,, | — | 52.7 |
| G7 | | ,, | 50% Shaded | ,, | — | 46.7 |
| G8 | | ,, | 75% Shaded | ,, | — | 41.9 |
| V1 |  | South | 25% Shaded | Inner room, bottom floor | 2 ‡ | 71.3 |
| V2 | | ,, | ,, | ,, | 3‡ | 59.3 |
| V3 | | ,, | ,, | ,, | 4‡ | 54.5 |
| V4 | | ,, | ,, | ,, | 5‡ | 48.8 |





*Condition
†Unconditioned
‡No. of air changes per hr.