CODE OF PRACTICE

FOR

OVERALL THERMAL TRANSFER VALUE

IN BUILDINGS

1995

BUILDING AUTHORITY

HONG KONG

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Foreword

A consultancy study in 1991 found that if the envelope of a building was constructed to a suitable overall thermal transfer value (OTTV), electricity demand from air-conditioning and thus the emission of greenhouse gases from power generation could be reduced. The Government's aim is to establish a comprehensive building energy code to control the total energy consumption of a building, of which OTTV controls would form a part. As a first step, legislative control over OTTV has been introduced in the Building (Energy Efficiency) Regulation (Cap. 123 sub. leg.).

This Code of Practice provides technical guidance for authorized persons, registered structural engineers and other persons responsible for the design and construction of buildings. Compliance with the provisions in this Code may be deemed to satisfy the requirement of a suitable OTTV for a building under the Building (Energy Efficiency) Regulation.

This Code will be regularly reviewed. The Building Authority welcomes suggestions for improving this Code or for enhancing the energy efficiency of buildings in general.

Other options for achieving equivalent and better performance standards are available and will of course be considered in isolation or in combination for the purpose of establishing acceptability.

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1. General Principles of Control of Overall Thermal Transfer Value

1.1 For the design and planning of energy - efficient buildings, Government is developing a comprehensive energy code to cover inter alia lighting and air-conditioning. Overall thermal transfer value (OTTV) is one aspect of energy conservation.

General approach

1.2 An OTTV is a measure of the energy consumption of a building envelope. Its formulation allows authorized persons, registered structural engineers and other persons responsible for the design and construction of buildings freedom to innovate and vary important envelope components such as type of glazing, window size, external shading to windows, wall colour and wall type to meet the maximum OTTV criteria. Any measure to improve energy efficiency or to save energy should be considered in planning a building.

1.3 Siting a building to avoid extensive glazed facades with a southerly aspect or introducing shades to window areas can reduce solar heat gain. Appropriate choice of windows with a low thermal transmittance characteristic will also minimize solar heat transmission.

1.4 Artificial lighting consumes electricity and creates heat. This increases the cooling load of a building and in turn increases energy consumption. Consequently, when determining the size and location of windows as well as choice of glass in the envelope of a building, efforts should be made to provide as much natural lighting into the building as possible. For example, with glazing, the visible lighting transmittance should be acknowledged in addition to its thermal transmittance properties; daylight can supplement artificial lighting and consequently reduce the cooling load.

1.5 Other measures include more extensive use of energy-efficient building services equipment and appliances, e.g. energy-saving lamps, low-loss luminaries and high-efficiency air-conditioning and more sophisticated building services control systems.

Scope

1.6 The provisions in this Code apply to all hotels and commercial buildings as defined in the Building (Energy Efficiency) Regulation. They aim at reducing heat transfer through the building envelope and thus the electricity required for air-conditioning.

1.7 The concept of OTTV is based on the assumption that the envelope of a building is completely enclosed.

1.8 In the OTTV formulation, the following factors are not addressed or allowed for :

(a) Internal shading devices, such as draperies and blinds.

(b) Solar reflection or shading from adjacent buildings.

2. Definitions

In this Code, unless otherwise stated, words and expressions have the meaning attributed to them by the Building (Energy Efficiency) Regulation. It should also be noted that :

"building tower" means that part of a building above the podium of the building;

"fenestration" means any glazed aperture in the building envelope;

"lightwell" means a vertical shaft of open air enclosed on all sides by parts of a building;

"opaque" wall or roof means that solid part of the wall or roof which is not part of the fenestration;

"podium" means that part of a building which,

(a) if having a site coverage exceeding the permitted percentage site coverage, is -

(i) within 15 m above ground level as permitted under Building (Planning) Regulation 20(3); or

(ii) within such height as is permitted by the Building Authority by way of a modification of that regulation granted under section 42 of the Buildings Ordinance; and

(b) if having a site coverage within the permitted percentage site coverage, is within 15 m above ground level.

"refuge floor" has the meaning assigned to it in the Code of Practice for Means of Escape and means a protected floor that serves as a refuge for the occupants of the building to assemble in case of fire.

3. Suitable OTTV

3.1 The external walls and roofs of a building to which the Building (Energy Efficiency) Regulation applies should be designed and constructed to have the following OTTV :

(a) in the case of a building tower; the OTTV should not exceed 35 W/m^2; and

(b) in the case of a podium; the OTTV should not exceed 80 W/m^2.

3.2 The maximum OTTV specified in paragraph 3.1 should apply to the overall building envelope, i.e. all the external walls and roofs, as the case may be, in average and do not apply to the individual wall or roof.

3.3 The OTTV of the external walls and roofs of a building tower or podium should be assessed in accordance with methods set out in this Code. A sample of OTTV calculations for a typical commercial building is set out in Appendix for illustration.

4. Principles of OTTV Calculations

External walls and roofs not included in OTTV calculations

4.1 All external walls and roofs of a building should be included in OTTV calculations except -

(a) an external wall of a refuge floor;

(b) an external wall or roof of a carparking floor;

(c) an external wall of a lightwell having an area on plan not exceeding 21 m^2; and

(d) any wall on any roof.

Party wall

4.2 An external wall of a building which is a party wall should be included in OTTV calculations whether an adjoining building exists or not. Shading to the party wall from adjoining buildings should not be considered in calculating the OTTV.

5. OTTV of External Walls

The OTTV of the external walls of a building tower or a podium, $OTTV_W$, should be calculated using the following formula -

$$OTTV_W = \frac{(A_W \times U \times \alpha \times TD_{EQW}) + (Af_W \times SC \times ESM \times SF)}{Ao_W}$$

where

A_W = Area of opaque wall, m^2

U = Thermal transmittance of opaque wall, $W/m^2°C$ (See para 7.1)

α = Absorptivity of the opaque wall (Table 4)

TD_{EQW} = Equivalent temperature difference for wall, °C (Table 5)

Af_W = Area of fenestration in wall, m^2

SC = Shading coefficient of fenestration in wall (See para 7.5)

ESM = External shading multiplier (Table 6 and 7)

SF = Solar factor for the vertical surface, W/m^2 (Table 8)

Ao_W = Gross area of external walls, i.e. $A_W + Af_W$, m^2

6. OTTV of Roofs

The OTTV of the roofs of a building tower or a podium, $OTTV_r$, should be calculated using the following formula :-

$$OTTV_r = \frac{(A_r \times U \times \alpha \times TD_{EQr}) + (Af_r \times SC \times SF)}{Ao_r}$$

Where

A_r = Area of opaque roof, m^2

U = Thermal transmittance of opaque roof, $W/m^2°C$ (See para 7.1)

α = Absorptivity of the opaque roof (Table 4)

TD_{EQr} = Equivalent temperature difference for roof, °C (Table 9)

Af_r = Area of fenestration in roof, m^2

SC = Shading coefficient of fenestration in roof (See para 7.5)

SF = Solar factor for horizontal surface, W/m^2 (Table 8)

Ao_r = Gross area of roof, i.e. $Ar + Af_r$, m^2

7. Calculation of Component Coefficients and Parameters of OTTV

Thermal transmittance of opaque construction (U)

7.1 Opaque walls and roofs usually involve a composite of materials. The thermal transmittance of an opaque wall or roof should be derived by the following formula :

$$U = \frac{1}{R_i + \frac{x_1}{k_1} + \frac{x_2}{k_2} + \ldots\ldots \frac{x_n}{k_n} + R_a + R_o}$$

x = Thickness of building material of the wall or roof or part thereof, m

k = Thermal conductivity of the building material, W/m°C (Table 1)

R_i = Surface film resistance of internal surface of the wall or roof, m²°C/W (Table 2)

R_o = Surface film resistance of external surface of the wall or roof, m²°C/W (Table 2)

R_a = Air space resistance, m²°C/W (Table 3)

Component coefficients and parameters of thermal transmittance

7.2 The component coefficients and parameters used in calculating the thermal transmittance of opaque construction should be assessed as follows :

(a) Thermal conductivity of building materials (k)

The thermal conductivity of the building materials of walls and roofs should be obtained from Table 1.

Table 1 Thermal Conductivity of Building Materials

Material	Density kg/m^3	Thermal Conductivity (k) W/m°C
Asphalt, mastic with 20% grit	2350	1.15
Boards		
a) cork	145	0.042
b) hardboard high density	1010	0.144
c) mineral fibre	265	0.053
d) plasterboard	950	0.16
Brick (common)	1900	0.95
Concrete		
a) normal weight aggregate	2400	2.16
b) lightweight aggregate	1300	0.44
c) flat roof tiles or slabs	2100	1.10
Glass	2500	1.05
Mosaic tile cladding	2500	1.50
Insulating materials		
a) glass fibre mat or quilt	32	0.035
b) mineral wool felt	50	0.039
c) polystyrene expanded	25	0.034
d) polyurethane foam	30	0.026
Metals		
a) aluminium alloy typical	2800	160
b) copper commercial	8900	200
c) steel, carbon	7800	50
Plaster/render		
a) gypsum	1120	0.38
b) gypsum, sand aggregate	1570	0.53
c) cement/sand	1860	0.72
Screeding		
a) cement sand	1860	0.72
b) terrazzo	2435	1.59
Stone		
a) granite	2650	2.9
b) marble	2500	2.0

Note :

If other materials are used the thermal conductivity values should be subject to the acceptance of the Building Authority and the source of the information from which the thermal conductivity values are obtained should be submitted for his consideration for this purpose.

(b) Surface film resistance for walls and roofs (R_i, R_o)

The surface film resistance for walls and roofs should be obtained from Table 2.

Table 2 Surface Film Resistance for Walls and Roofs

Type of surface	Surface film resistance $m^2°C/W$
Surface film resistance for walls	
1. Internal surface (R_i)	
(a) Absorptivity (0.5 and above)	0.120
(b) Absorptivity (below 0.5)	0.299
2. External surface (R_o)	0.044
Surface film resistance for roofs	
1. Internal surface (R_i)	
(a) Absorptivity (0.5 and above)	
(i) Flat roof	0.162
(ii) Sloped roof 22½°	0.148
(iii) Sloped roof 45°	0.133
(b) Absorptivity (below 0.5)	
(i) Flat roof	0.801
(ii) Sloped roof 22½°	0.595
(iii) Sloped roof 45°	0.391
2. External surface (R_o)	0.055

(c) Air space resistance for walls and roofs (R_a)

The air space resistance for walls and roofs should be obtained from Table 3.

Table 3 Air Space Resistance for Walls and Roofs

Type of air space	Air space resistance (R_a) m²°C/W					
	5 mm	10 mm	20 mm	50 mm	75 mm	100 mm
Air space resistance for walls						
Vertical air space (heat flows horizontally)						
(a) Absorptivity (0.5 and above)	0.110	0.123	0.148	0.153	0.156	0.160
(b) Absorptivity (below 0.5)	0.250	0.359	0.578	0.589	0.597	0.606
Air space resistance for roofs						
Horizontal or sloping air space (heat flows downward)						
(a) Absorptivity (0.5 and above)						
(i) horizontal air space	0.110	0.123	0.148	0.158	0.166	0.174
(ii) sloped air space 22½°	0.110	0.123	0.148	0.154	0.160	0.165
(iii) sloped air space 45°	0.110	0.123	0.148	0.152	0.155	0.158
(b) Absorptivity (below 0.5)						
(i) horizontal air space	0.250	0.357	0.572	0.891	1.157	1.423
(ii) sloped air space 22½°	0.250	0.357	0.571	0.768	0.931	1.095
(iii) sloped air space 45°	0.250	0.357	0.570	0.644	0.706	0.768

Absorptivity (α)

7.3 Energy simulation studies for Hong Kong have shown that the external surface and colour of walls and roofs, and therefore their absorptivity, have a significant effect on chiller energy used. This should be included in the heat gain calculation as a multiplication constant to the equivalent temperature difference. The absorptivity for wall and roof surfaces should be obtained from Table 4.

Table 4 Absorptivity for wall and roof surfaces

Material	Absorptivity α	Paint	Absorptivity α
Black glass	1.0	Optical flat black paint	0.98
Black concrete	0.91	Flat black paint	0.95
Stafford blue brick	0.89	Black lacquer	0.92
Red brick	0.88	Dark grey paint	0.91
Bituminous felt	0.88	Dark blue lacquer	0.91
Blue grey slate	0.87	Black oil paint	0.90
Roofing, green	0.86	Dark olive drab paint	0.89
Brown concrete	0.85	Azure blue or dark green lacquer	0.88
Asphalt pavement, weathered	0.82	Dark brown paint	0.88
Wood, smooth	0.78	Dark blue-grey paint	0.88
Uncoloured concrete	0.65	Medium brown paint	0.84
White marble	0.58	Medium light brown paint	0.80
White mosaic tiles	0.58	Brown or green lacquer	0.79
Light buff brick	0.55	Medium rust paint	0.78
Built-up roof, white	0.50	Light grey oil paint	0.75
Bituminous felt, aluminized	0.40	Red oil paint	0.74
Gravel	0.29	Medium dull green paint	0.59
White on galvanized iron	0.26	Medium orange paint	0.58
White glazed brick	0.25	Medium yellow paint	0.57
Polished aluminium reflector sheet	0.12	Medium blue paint	0.51
Aluminized mylar film	0.10	Medium kelly green paint	0.51
Tinned surface	0.05	Light green paint	0.47
		Aluminium paint	0.40
		White semi-gloss paint	0.30
		White gloss paint	0.25
		Silver paint	0.25
		White lacquer	0.21
		Laboratory vapour deposited coatings	0.02

Note :

Absorptivity for other materials or surfaces should be subject to the acceptance of the Building Authority and the source of the information from which the absorptivity values are obtained should be submitted for his consideration.

Equivalent temperature difference for walls (TD_{EQw})

7.4 Energy simulation studies for Hong Kong have indicated that thermal mass affects the total heat flow through walls sufficiently to warrant its inclusion in the formulation of an OTTV. The equivalent temperature difference for walls should take into account the wall mass, density and orientation. Heavyweight construction gives a better performance than lightweight construction because it resists the passage of heat. The equivalent temperature difference for walls should be obtained from Table 5.

Table 5 Equivalent Temperature Difference for Walls

Orientation	Density of wall construction				
	less than 22 kg/m²	23-199 kg/m²	200-379 kg/m²	380-569 kg/m²	570 kg/m² or greater
N	3.70	3.38	2.72	2.05	1.70
NNE	4.65	4.21	3.30	2.36	1.88
NE	5.60	5.03	3.86	2.67	2.05
ENE	6.55	5.86	4.44	2.98	2.23
E	7.50	6.68	5.01	3.28	2.40
ESE	7.05	6.26	4.65	3.00	2.15
SE	6.60	5.85	4.30	2.71	1.90
SSE	6.15	5.43	3.95	2.43	1.65
S	5.70	5.01	3.60	2.15	1.40
SSW	6.15	5.42	3.92	2.37	1.58
SW	6.60	5.82	4.23	2.59	1.75
WSW	6.55	5.81	4.29	2.73	1.93
W	6.50	5.79	4.35	2.86	2.10
WNW	5.80	5.19	3.94	2.66	2.00
NW	5.10	4.59	3.54	2.45	1.90
NNW	4.40	3.98	3.13	2.25	1.80

Shading coefficient of fenestration (SC)

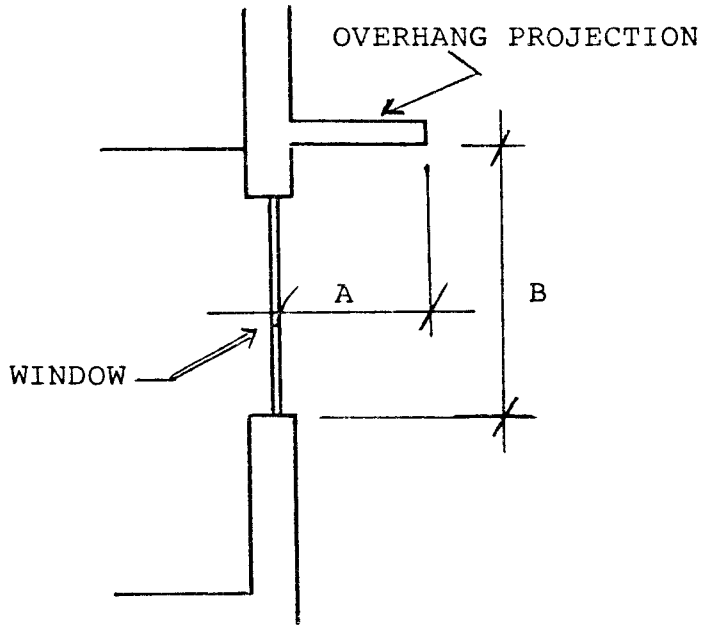
7.5 The shading coefficient of fenestration is the ratio of the solar heat gain through a particular type of glass under a specific set of conditions to the solar heat gain through double strength sheet clear glass under the same conditions. Allowances for Hong Kong's latitude and solar effects have been taken into account in the solar factor and therefore the shading coefficient of glass published by glass manufacturers in Hong Kong or overseas can be used without modification provided that the calculations have been based on a normal angle of incidence.

External shading multiplier (ESM)

7.6 Shading of windows is of paramount importance in reducing solar heat gain to the building. This shading can be provided by projections over the window, at the side of the window, or a combination of both. For the purpose of simplicity in OTTV calculations this shading effect is taken into account as an external shading multiplier which should be assessed as follows :

(a) Overhang projections to windows

The external shading multiplier for overhang projections to windows should be obtained from Table 6 according to the overhang projection factor (OPF) and the orientation of the window. The OPF should be calculated as follows :



$$OPF = \frac{A}{B}$$

Table 6 External Shading Multiplier for Overhang Projections to Windows

OPF	ESM			
	N	NE/NW	S/E/W	SE/SW
0.00	1.000	1.000	1.000	1.000
0.05	0.975	0.969	0.962	0.962
0.10	0.951	0.939	0.926	0.926
0.15	0.928	0.909	0.890	0.890
0.20	0.905	0.880	0.856	0.856
0.25	0.883	0.853	0.823	0.823
0.30	0.861	0.826	0.790	0.790
0.35	0.840	0.800	0.759	0.759
0.40	0.820	0.774	0.729	0.729
0.45	0.800	0.750	0.700	0.700
0.50	0.781	0.726	0.672	0.672
0.55	0.762	0.704	0.645	0.645
0.60	0.744	0.682	0.620	0.620
0.65	0.726	0.661	0.595	0.595
0.70	0.710	0.641	0.572	0.572
0.75	0.693	0.621	0.549	0.549
0.80	0.678	0.603	0.528	0.528
0.85	0.663	0.585	0.507	0.507
0.90	0.648	0.568	0.488	0.488
0.95	0.634	0.552	0.470	0.470
1.00	0.621	0.537	0.453	0.453

Notes :

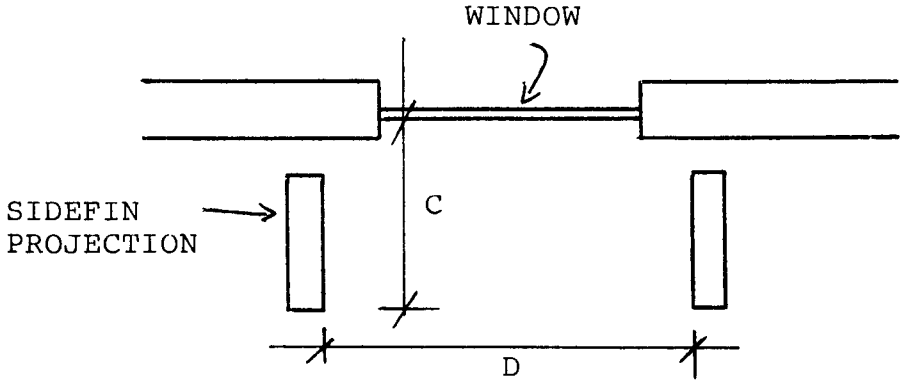
(i) Should the OPF value fall in between increments, adopt the multiplier related to the next larger OPF value.

(ii) OPF values above 1.0 are considered to produce too great an error in estimation.

(iii) ESM for South, East and West orientations are combined since the figures are very similar.

(b) Sidefin projections to windows

The external shading multiplier for sidefin projections to windows should be obtained from Table 7 according to the sidefin projection factor (SPF) and the orientation of the window. The SPF should be calculated as follows :



$$SPF = \frac{C}{D}$$

Table 7 External Shading Multiplier for Sidefin Projections to Windows

SPF	ESM							
	N	NE	E	SE	S	SW	W	NW
0.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
0.05	0.955	0.964	0.974	0.968	0.962	0.968	0.968	0.964
0.10	0.911	0.929	0.948	0.937	0.925	0.936	0.947	0.929
0.15	0.869	0.896	0.923	0.906	0.890	0.906	0.922	0.895
0.20	0.828	0.863	0.898	0.877	0.855	0.876	0.897	0.863
0.25	0.789	0.832	0.875	0.848	0.822	0.848	0.873	0.831
0.30	0.751	0.801	0.852	0.821	0.790	0.820	0.850	0.800
0.35	0.714	0.772	0.829	0.794	0.759	0.793	0.828	0.771

(Cont'd)

Table 7 External Shading Multiplier for Sidefin Projections to Windows (Cont'd)

SPF	ESM							
	N	NE	E	SE	S	SW	W	NW
0.40	0.679	0.743	0.807	0.768	0.729	0.767	0.806	0.742
0.45	0.645	0.716	0.786	0.743	0.700	0.743	0.785	0.715
0.50	0.613	0.690	0.766	0.719	0.673	0.719	0.765	0.689
0.55	0.582	0.664	0.746	0.696	0.646	0.696	0.746	0.664
0.60	0.553	0.640	0.727	0.674	0.621	0.674	0.727	0.640
0.65	0.525	0.617	0.709	0.653	0.596	0.653	0.709	0.617
0.70	0.499	0.595	0.691	0.632	0.573	0.633	0.692	0.595
0.75	0.473	0.574	0.674	0.613	0.551	0.613	0.675	0.574
0.80	0.450	0.554	0.658	0.594	0.531	0.595	0.660	0.555
0.85	0.428	0.535	0.642	0.577	0.511	0.578	0.645	0.536
0.90	0.407	0.517	0.627	0.560	0.493	0.561	0.630	0.519
0.95	0.388	0.500	0.613	0.544	0.475	0.546	0.617	0.502
1.00	0.370	0.484	0.599	0.529	0.459	0.531	0.604	0.487
1.05	0.354	0.470	0.586	0.515	0.444	0.518	0.592	0.473
1.10	0.339	0.456	0.574	0.502	0.430	0.505	0.581	0.460
1.15	0.325	0.444	0.562	0.490	0.417	0.494	0.570	0.448
1.20	0.313	0.432	0.551	0.478	0.406	0.483	0.560	0.437
1.25	0.302	0.422	0.541	0.468	0.395	0.473	0.551	0.427
1.30	0.293	0.412	0.531	0.458	0.386	0.464	0.543	0.418
1.35	0.286	0.404	0.522	0.450	0.377	0.456	0.535	0.410
1.40	0.279	0.396	0.514	0.442	0.370	0.449	0.528	0.404
1.45	0.274	0.390	0.506	0.435	0.364	0.443	0.522	0.398
1.50	0.271	0.385	0.499	0.429	0.359	0.438	0.517	0.394

Notes :

(i) SPF values above 1.5 are considered to produce too great an error in estimation.

(ii) Should the SPF value fall in between increments, adopt the multiplier related to the next larger SPF value.

(c) Combination of overhang and sidefin projections

For windows with both overhang and sidefin projections each external shading multiplier should be calculated separately as described in (a) and (b) and the smaller of the two values obtained should be used as the external shading multiplier in the OTTV calculations.

Solar factor (SF)

7.7 The solar factor for vertical surfaces at various orientations and that for horizontal surfaces should be obtained from Table 8. The solar factors have been calculated for the Hong Kong climate. Any sloping or angled wall or roof can be resolved into vertical and horizontal components. The vertical components of the sloping or angled wall or roof can be treated as a vertical surface with a solar factor at that respective orientation; whereas the horizontal component can be treated as a horizontal surface.

Table 8 Solar Factor

orientation	N	NE	E	SE	S	SW	W	NW
SF for vertical surface	104	138	168	197	191	202	175	138
orientation	NNE	ENE	ESE	SSE	SSW	WSW	WNW	NNW
SF for vertical surface	121	153	183	194	197	189	157	121
SF for horizontal surface	264							

Equivalent temperature difference for roofs (TD_{EQr})

7.8 The equivalent temperature difference for roofs should take into account the roof mass and density and should be obtained from Table 9.

Table 9 Equivalent Temperature Difference for Roofs

Density of roof construction	less than 22 kg/m²	23-199 kg/m²	200-379 kg/m²	380-569 kg/m²	570 kg/m² or above
TD_{EQr}	18.60	16.88	13.37	9.75	7.90

8. **Windows and doors**

Buildings should not have unenclosed doorways and entrances. For commercial buildings where heavy traffic of people is anticipated, self-closing doors without restrainers, revolving doors or other similar means of minimizing heat gain should be employed. Careful attention should also be paid to the sealing of windows to guard against leakage during service.

9. **Submission of Information**

9.1 Information and calculations required by the Building Authority are specified in the Building (Energy Efficiency) Regulation. Simplified version of OTTV calculations can be included in the first submission of building plans, provided that detailed calculations have to be submitted before consent to commence works will be granted. The following information and calculations should be submitted on the standard forms set out in the schedule to this Code :

(a) Calculation of 'U' value of composite wall and roof and details of other component coefficients and parameters of OTTV on Form OTTV 1.

(b) Window and rooflight schedule on Form OTTV 2.

(c) OTTV calculations on Form OTTV 3 and Form OTTV 4.

9.2 OTTV calculations should be made to two places of decimals.

Schedule of Standard Forms

Form OTTV 1

Form OTTV 2

Form OTTV 3

Form OTTV 4

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A _____ BD Ref 2/____/___/___

Building address _____

Physical data of Opaque *Wall/Roof

Facade Orientation facing _____ Solar Factor (SF) is _____

*Wall/Roof Code No.	$*W_1/R_1$	$*W_2/R_2$	$*W_3/R_3$	$*W_4/R_4$
Location of Wall/Roof				
External Finish Material				
Conductivity W/m°C				
Density kg/m^3				
Thickness m				
Absorptivity (α)				
Intermediate component				
Conductivity W/m°C				
Density kg/m^3				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m^3				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m^3				
Thickness m				
Intermediate component				
Conductivity W/m°C				
Density kg/m^3				
Thickness m				
Internal Finish Material				
Conductivity W/m°C				
Density kg/m^3				
Thickness m				
Absorptivity α				
'U' value of composite *Wall/Roof				
Area of *Wall/Roof m^2				
Density of composite *Wall/Roof kg/m^2				
Equivalent temperature difference (TD_{EQ})				

*Delete as appropriate
First issue April 1995

Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B _____ BD Ref 2/____/___/___

Building address _____

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor (SF) is _____

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C _____ BD Ref 2/____/___/___

Building address _____

Facade Orientation facing _____.

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
	Subtotals		(A)		Heat Gain	(C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
	Subtotals		(B)		Heat Gain	(D)

Gross Heat Gain (C + D) _____

Gross Area (A + B) _____

$$OTTV = \frac{C + D}{A + B} = \_\_\_\_\_ W/m^2$$

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 4

Summary of OTTV of Building Envelope

Sheet No. D _____ BD Ref. 2/____/____/____

Building address _____

Total Envelope Heat Gain (* Tower/Podium)

Facade Orientation	Gross Area from Form OTTV 3	Gross Heat Gain from Form OTTV3
a. b. c. d. e. f.		
Subtotal	(E)	(G)
Roof		
a. b.		
Subtotal	(F)	(H)

* Tower/Podium Walls OTTV = $\frac{G}{E}$ = _____ W/m²

* Tower/Podium Roofs OTTV = $\frac{H}{F}$ = _____ W/m²

* Tower/Podium OTTV = $\frac{G + H}{E + F}$ = _____ W/m²

* Delete as appropriate

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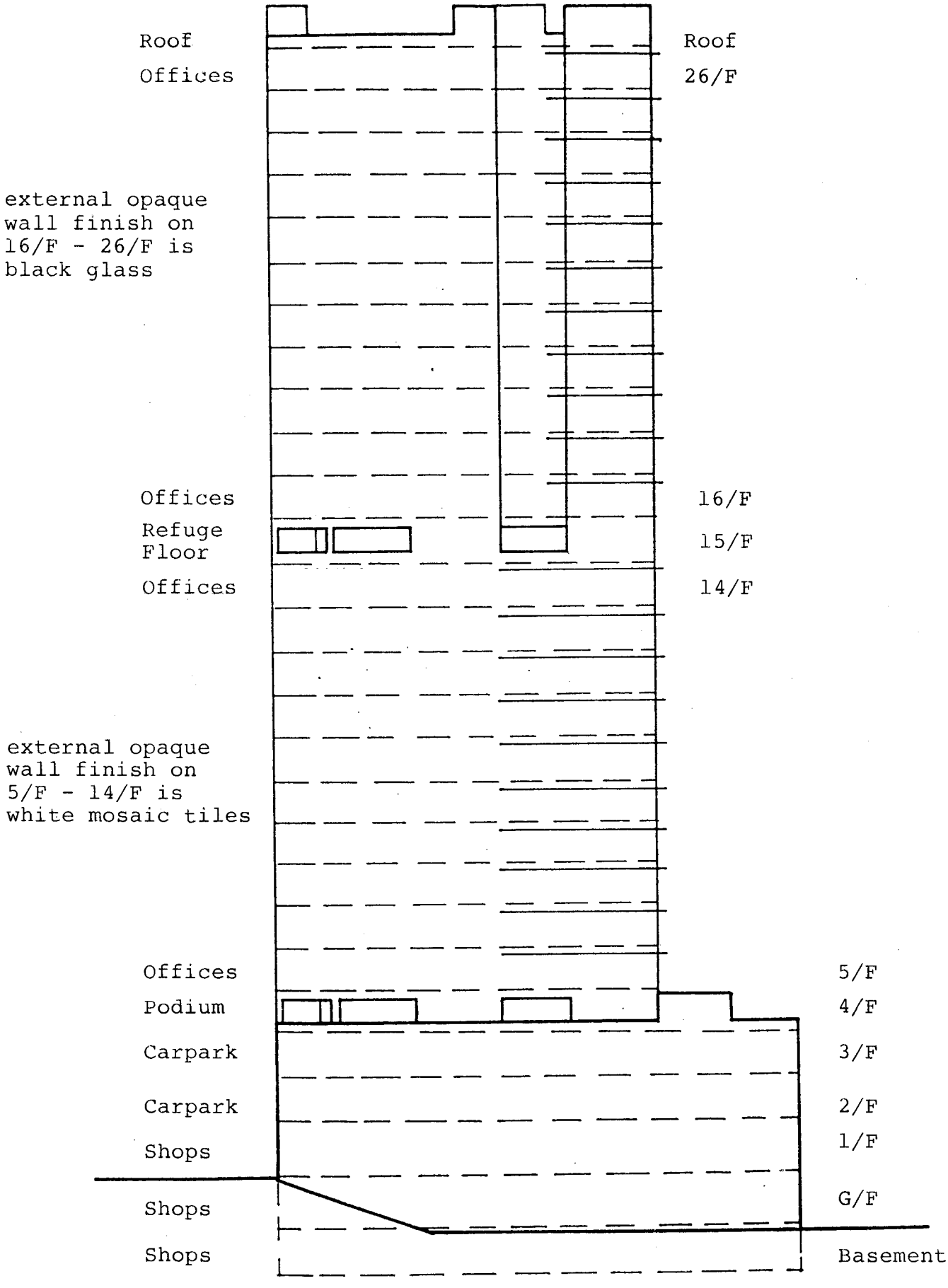
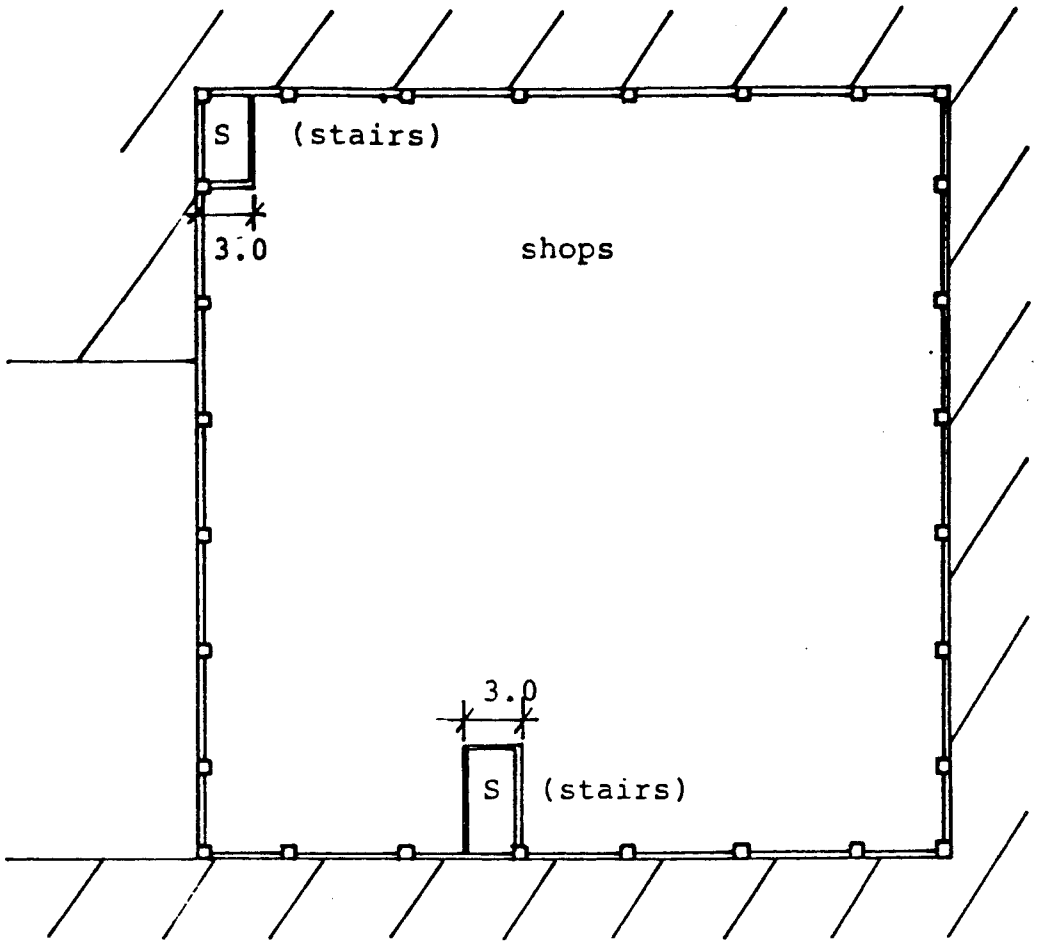
Appendix A

A sample of OTTV calculation for a typical commercial building

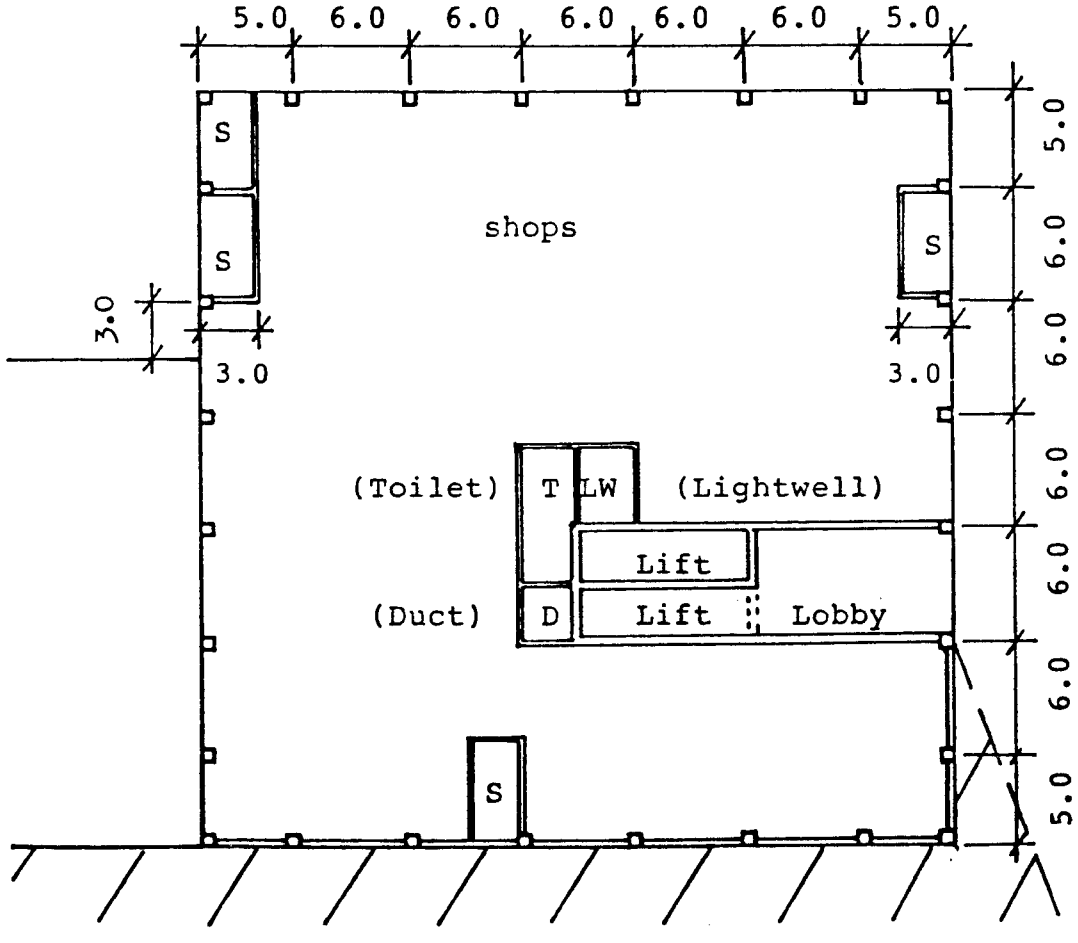
Plans and Elevation of a Typical Commercial Building



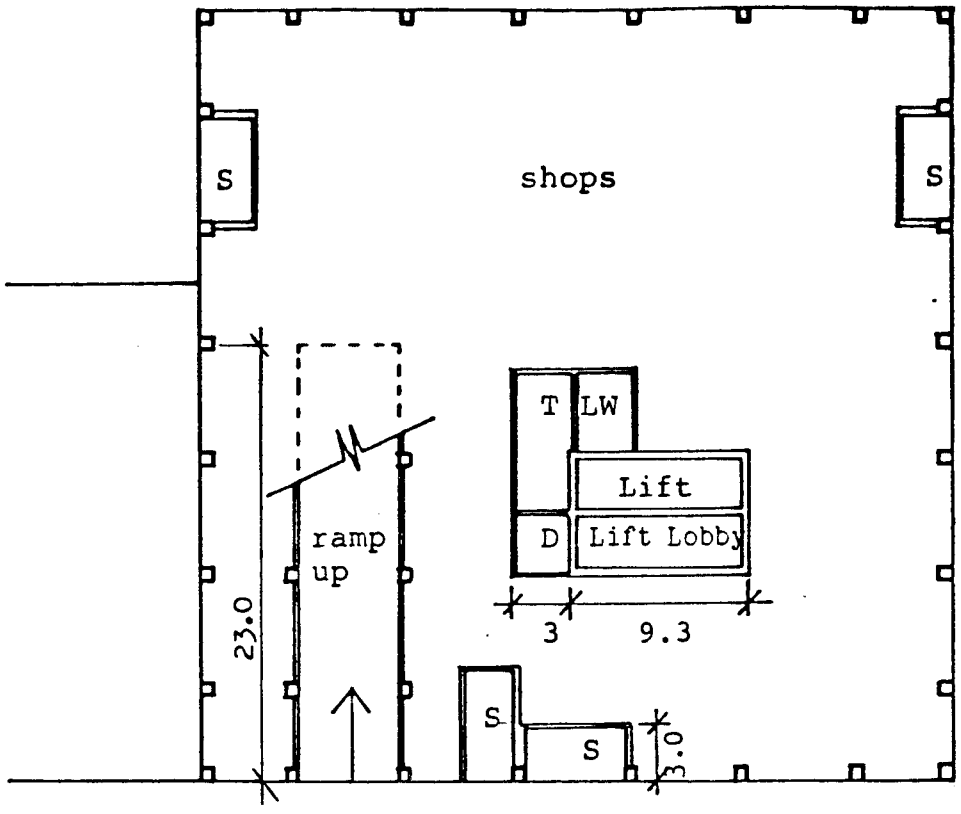
East Elevation


S
(stairs)
3.0
shops
3.0
S
(stairs)

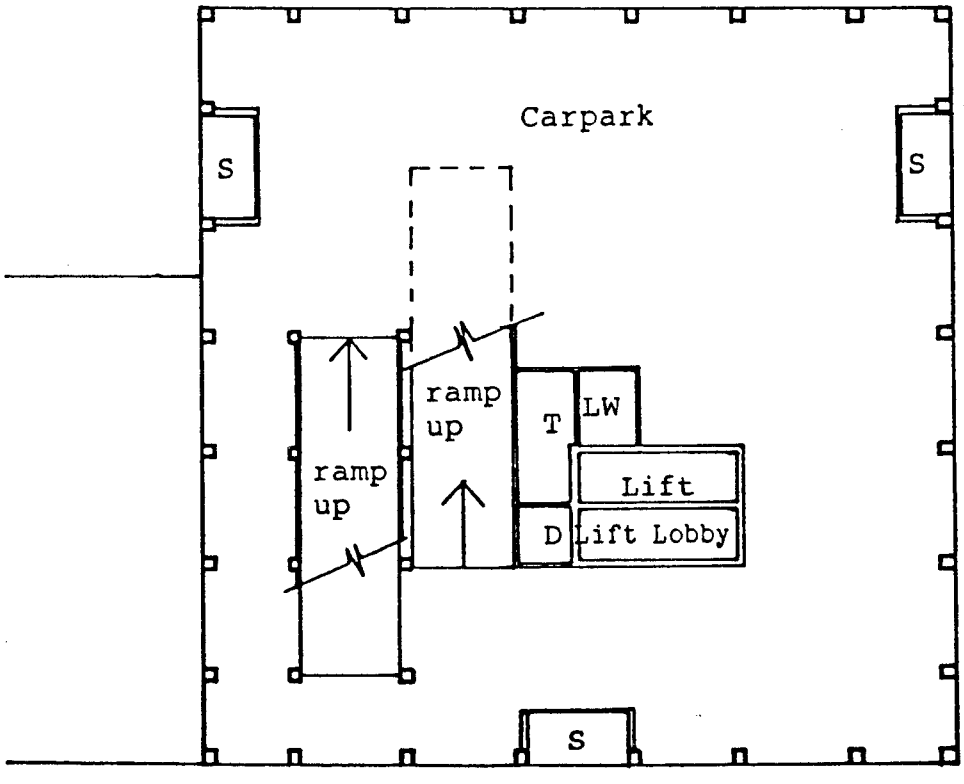
Basement


5.0
6.0
6.0
6.0
6.0
6.0
5.0
S
S
shops
S
3.0
3.0
3.0
(Toilet)
T
LW
(Lightwell)
Lift
(Duct)
D
Lift
Lobby
S
5.0
6.0
6.0
6.0
6.0
6.0
5.0

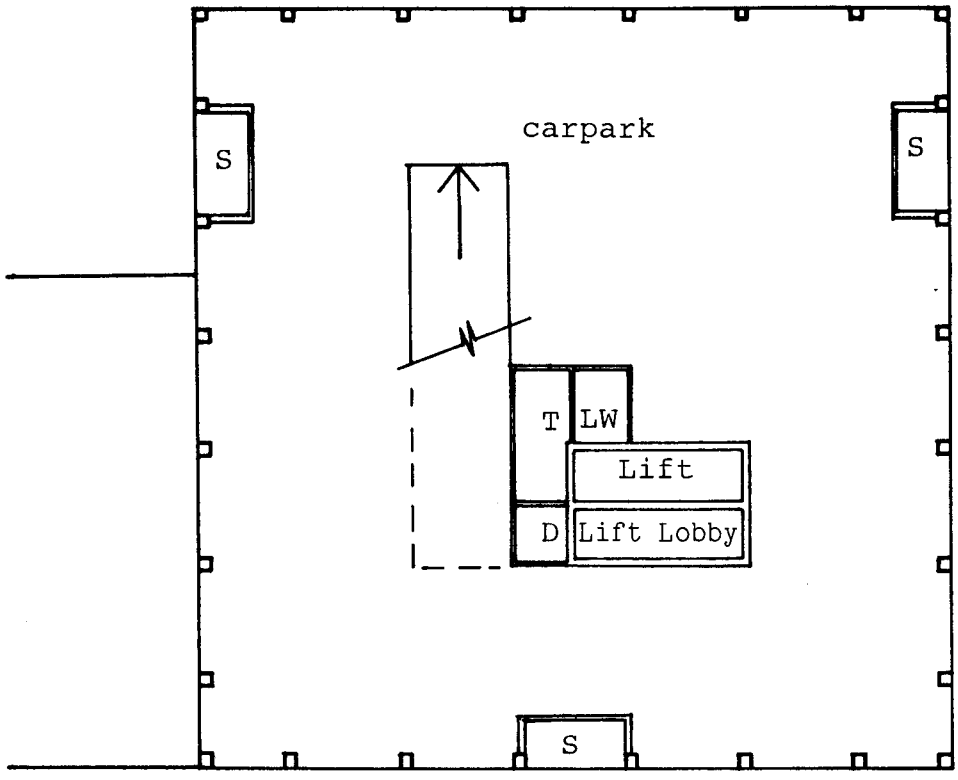
G/F


S
shops
S
T
LW
Lift
D
Lift Lobby
ramp
up
23.0
3
9.3
S
S
3.0

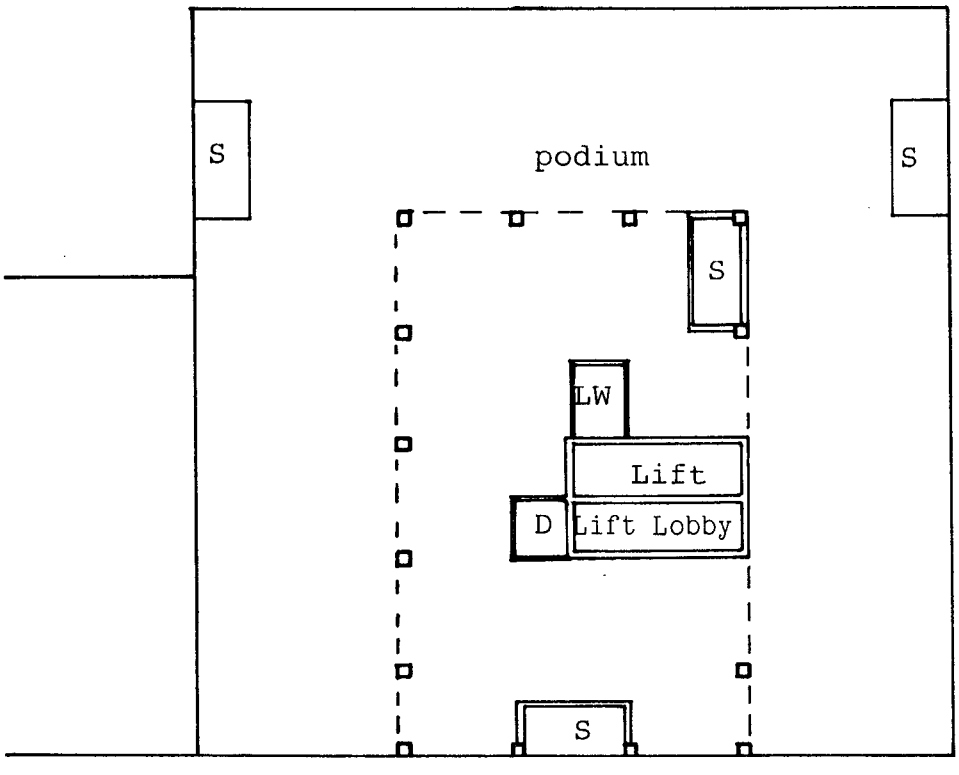
1/F


Carpark
S
S
ramp
up
ramp
up
T
LW
Lift
D
Lift Lobby
S

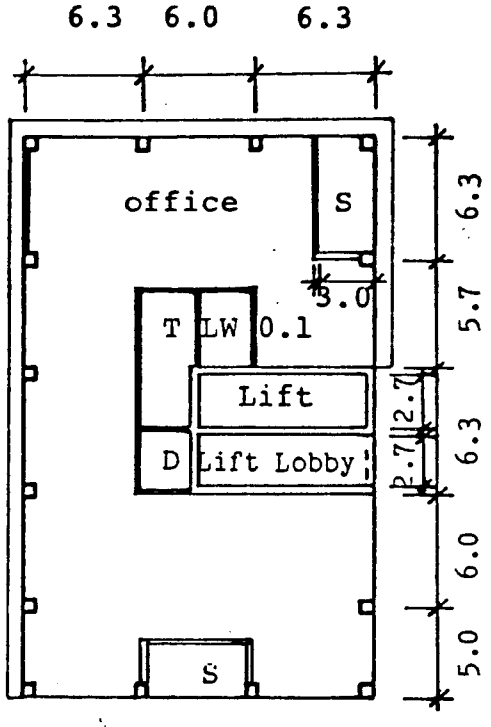
2/F


carpark
S
S
T
LW
Lift
D
Lift Lobby
S

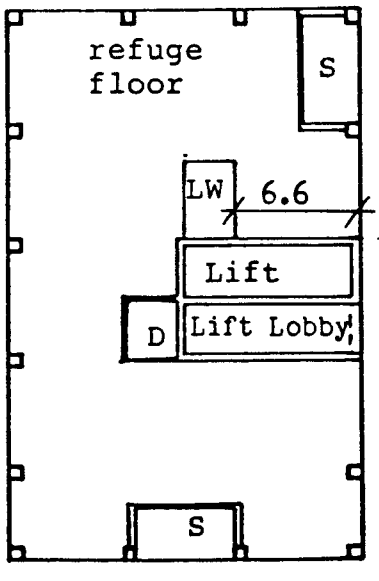
3/F


podium
S
S
S
LW
Lift
D
Lift Lobby
S

4/F

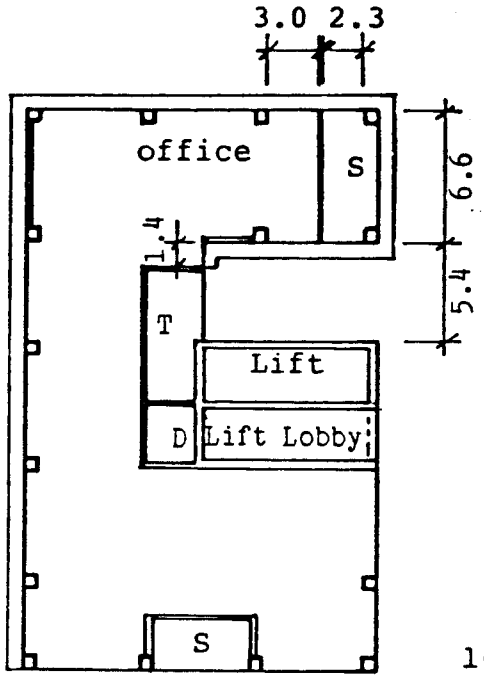

6.3
6.0
6.3
office
S
3.0
T
LW
0.1
Lift
D
Lift Lobby
2.7
2.7
6.3
5.7
6.3
6.0
5.0
S

5/F - 14/F

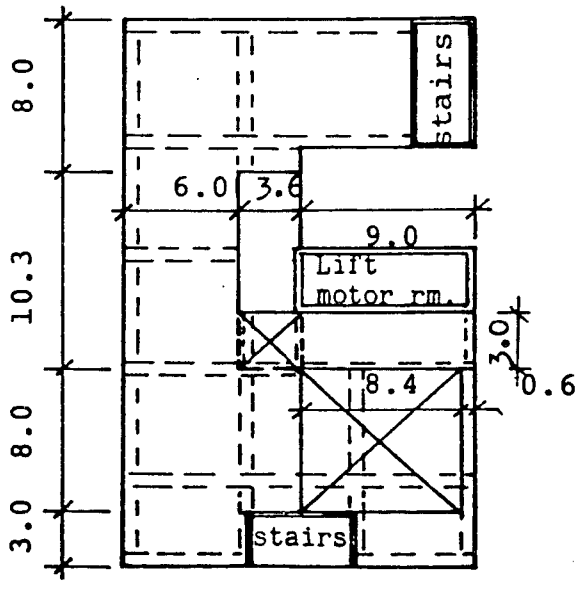

refuge
floor
S
LW
6.6
Lift
D
Lift Lobby
S

15/F

0.1

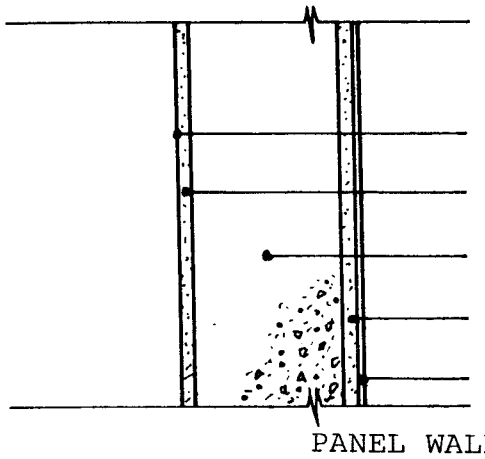


16/F - 26/F



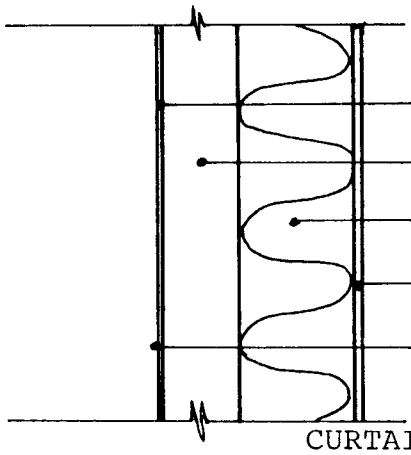
Roof

Construction of Walls
and Roof



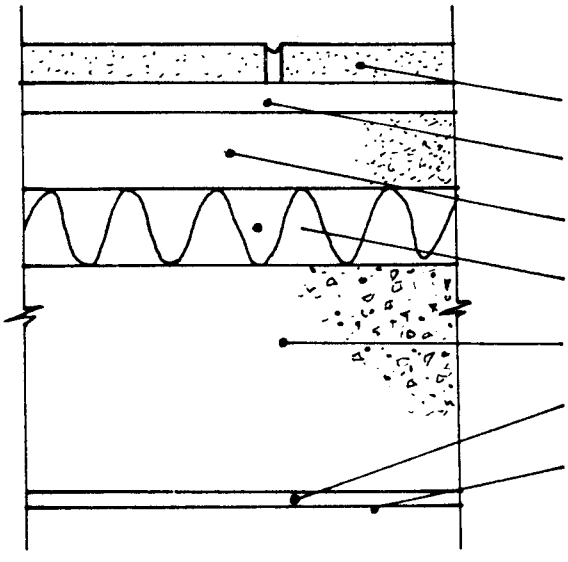
white semi gloss paint
10 mm gypsum plaster
100 mm concrete wall
10 mm cement/sand render
5 mm mosaic tiles

PANEL WALLS
GROUND - 15TH FLOOR



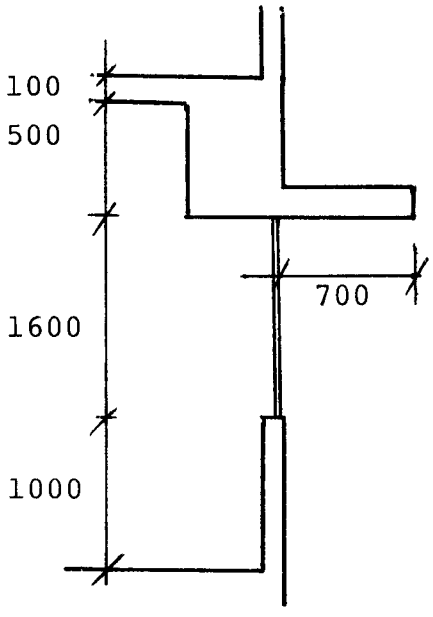
2 mm steel facing panel
50 mm air gap
75 mm mineral wool insulation
8 mm black glass
white semi gloss paint

CURTAIN WALL
16TH FLOOR - 26TH FLOOR



25 mm concrete tiles
20 mm asphalt
50 mm cement/sand screed
50 mm expanded polystyrene
150 mm concrete
10 mm gypsum plaster
white semi gloss paint

ROOF



TYPICAL SECTION
5TH FLOOR - 26TH FLOOR

Gross Wall Calculations

Storey heights :
Ground and First Floors 4.0 m
2nd & 3rd floors 3.5 m
4th to 26th floors 3.2 m
All columns 600 x 600 mm All beams 600 x 600 mm

East Elevation

P	G/F	11.0 x 4.0 ÷ 2 + 29 x 4.0	=	138.00 m²	
	1/F	40 x 4.0 + 23 x 4 x 0.5	=	206.00 m²	344.00 m²
T	5/F-14/F	23.0 x 3.2 x 10	=	736.00 m²	
	16/F-26/F	23.0 x 3.2 x 11	=	809.60 m²	1,545.60 m²
	5/F-14/F	6.3 x 3.2 x 10	=	201.60 m²	
	16-26/F	6.3 x 3.2 x 11	=	221.76 m²	423.36 m²

North Elevation

P	G/F	40.0 x 4.0	=	160.00 m²	
	1/F	40.0 x 4.0	=	160.00 m²	320.00 m²
T	5-14/F	18.6 x 3.2 x 10	=	595.20 m²	
	16-26/F	(18.6 + 9) x 3.2 x 11	=	971.52 m²	1,566.72 m²

West Elevation

P	G/F	40 x 4.0	=	160.00 m²	
	1/F	40 x 4.0 + 23 x 4 x 0.5	=	206.00 m²	366.00 m²
T	5/F-14/F	29.3 x 3.2 x 10	=	937.60 m²	
	16/F-26/F	29.3 x 3.2 x 11	=	1,031.36 m²	1,968.96 m²

South Elevation

P	G/F	Nil	=	-	
	1/F	40 x 4.0 + (5.4x23.35-5.4x4.0)	=	264.49 m²	264.49 m²
T	5/F-14/F	18.6 x 3.2 x 10	=	595.20 m²	
	16/F-26/F	(18.6 + 9) x 3.2 x 11	=	971.52 m²	1,566.72 m²

Window Schedule

Building Address Typical Commercial Building

Orientation of Facade	Floor	Class Thickness m	Type	Sizes and no./floor m	Total area per floor m^2
East	G/F	0.012	plain	(5.4 x 4 + 4.1) 3.4	87.38
	1/F	0.012	plain	(4.1x2 + 5.4x5) 3.4	119.68
	2-4/F	Nil	Nil		-
	5-14/F	0.008	tinted	(4.1+5.7+5.4x2) 1.6	32.96
	5-14/F	0.008	tinted	2.7 x 1.6	4.32
	15/F	Nil	tinted	-	-
	16-26/F	0.008	tinted	(4.1+5.7+1.4+5.4) 1.6 +3.9x0.8	29.68
	16-26/F	0.008	tinted	2.7 x 1.6	4.32
North	G/F	0.012	plain	(4.1+5.4x5+1.7+2.3) 3.4	119.34
	1/F	0.012	plain	(4.1x2+5.4x5) 3.4	119.68
	2-4/F	Nil	Nil	-	-
	5-14/F	0.008	tinted	(2.3+3.0+5.4x2) 1.6	25.76
	15/F	Nil	Nil	-	-
	16-26/F	0.008	tinted	(2.3+3.0+5.4x2) 1.6	25.76
West	G/F	0.012	plain	(4.1+5.4+2.7) 3.4	41.48
	1/F	0.012	plain	(4.1+5.4+2.7) 3.4	41.48
	2-4/F	Nil	Nil	-	-
	5-14/F	0.008	tinted	(5.4x3+4.1) 1.6	32.48
	15/F	Nil	Nil	-	-
	16-26/F	0.008	tinted	(5.4x3+4.1) 1.6	32.48
South	G/F	Nil	Nil	-	-
	1/F	0.012	plain	(4.1x2+2.7+2.6+5.4x3) 3.4	100.98
	2-4/F	Nil	Nil	-	-
	5-14/F	0.008	tinted	(5.4x3) 1.6	25.92
	15/F	Nil	Nil	-	-
	16-26/F	0.006	reflect-ive	(5.4x3) 1.6	25.92
	16-26/F	0.008	tinted	(3.0 + 2.3) 1.6	8.48

East Elevation (Tower) Gross Wall Area 1,545.60 + 423.36 = 1,968.96 m²

Wall composite areas

Beams and Column Areas

5/F - 14/F	[0.6 (11.0+5.7+6.3)+(0.6x2.6x4)] 10	=	200.40 m²	
15/F	Nil			
16/F - 26/F	[0.6 (11.0+5.4+6.6)+(0.6x2.6x4)] 11	=	220.44 m²	420.84 m²

Glazing Areas in 100 mm panel/curtain wall from Window Schedule

5/F - 14/F	32.96 x 10	=	329.60 m²	
15/F	Nil			
16/F - 26/F	29.68 x 11	=	326.48 m²	656.08 m²

Glazing Area in 300 mm Structural Walls from Window Schedule

5/F - 14/F	4.32 x 10	=	43.20 m²	
15/F	4.32 x 11	=	47.52 m²	90.72 m²

100 mm Panel/Curtain Wall Areas

5/F - 14/F	736.00 - (200.40 + 329.60)	=	206.00 m²	
15/F	Nil			
16/F - 26/F	809.60 - (220.44 + 326.48)	=	262.68 m²	468.68 m²

300 mm Structural Walls to Lift & Lift Lobby

5/F - 14/F	0.3 x 3.2 x 3 x 10	=	28.80 m²	
16/F - 26/F	0.3 x 3.2 x 3 x 11	=	31.68 m²	60.48 m²

300 mm Panel Walls to Lift & Lift Lobby

5/F - 14/F	201.60 - (43.20 + 28.80)	=	129.60	
16/F - 26/F	221.76 - (47.52 + 31.68)	=	142.56 m²	272.16 m²

Lift shaft walls without gypsum plaster

5/F - 14/F	2.7 x 3.2 x 10	=	86.40 m²	
16/F - 26/F	2.7 x 3.2 x 11	=	95.04 m²	181.44 m²

Fenestration between 5/F - 14/F

Total Glazing in 100 mm panel walls	=	329.60	
(4.1 + 5.7) 1.6 x 10	=	156.80	unshaded
		172.80	shaded

Fenestration between 16/F - 26/F

Total Glazing in curtain wall	=	326.48	
[(4.1+5.7)1.6+(3.9x0.8)] 11	=	206.80	unshaded
		119.68	shaded

'U' value of composite wall of columns and beams :-
G/F, 1/F, 5/F-14/F

W_1 for beam and column		Weight
external surface film	Ro = 0.044	
5 mm white mosaic tiles	$\frac{0.005}{1.5}$ = 0.003	0.005 x 2500 = 12.50
10 mm cement/sand render	$\frac{0.01}{0.72}$ = 0.014	0.01 x 1860 = 18.60
600 mm concrete beam & column	$\frac{0.60}{2.16}$ = 0.278	0.60 x 2400 = 1440.00
10 mm gypsum plaster	$\frac{0.01}{0.38}$ = 0.026	0.01 x 1120 = 11.20
Internal surface film (absorptivity below 0.5)	Ri = 0.299	
Totals	0.664	1482.30 kg/m²

$$U_W = \frac{1}{0.664} = 1.51 \text{ W/m}^2\text{°C}$$

(for west podium wall without tiles or render 'U' value is 1.55 W/m²°C)

'U' value of composite wall panels :-
G/F, 1/F, 5/F-14/F

W_3 for wall panel		Weight
external surface film	Ro = 0.044	
5 mm white mosaic tiles	= 0.003	0.005 x 2500 = 12.50
10 mm cement/sand render	= 0.014	0.01 x 1860 = 18.60
100 mm concrete panel	$\frac{0.1}{2.16}$ = 0.046	0.10 x 2400 = 240.00
10 mm gypsum plaster	= 0.026	0.01 x 1120 = 11.20
Internal surface film	Ri = 0.299	
Totals	0.432	282.30 kg/m²

$$U_W = \frac{1}{0.432} = 2.32 \text{ W/m}^2\text{°C}$$

(for west podium wall without tiles and render 'U' value is 2.41 W/m²°C)

'U' value of composite columns and beams :-
16/F - 26/F

W_2 for beam and column		Weight
External surface film	Ro = 0.044	
8 mm black glass	$\frac{0.008}{1.05}$ = 0.0076	0.008 x 2500 = 20.00
50 mm Air space resistance (absorptivity above 0.5)	Ra = 0.153	
600 mm concrete beam and column	$\frac{0.60}{2.16}$ = 0.278	0.6 x 2400 = 1440.00
10 mm gypsum plaster	$\frac{0.01}{0.38}$ = 0.026	0.01 x 1120 = 11.20
Internal surface film	Ri = 0.299	
Totals	0.808	1471.20 kg/m²

$$U_W = \frac{1}{0.808} = 1.24 \text{ W/m}^2\text{°C}$$

'U' value of composite curtain wall panels :-
16/F - 26/F

W_4 for panel wall		Weight
External surface film	Ro = 0.044	
8 mm black glass	$\frac{0.008}{1.05}$ = 0.0076	0.008 x 2500 = 20.00
75 mm mineral wool felt insulation	$\frac{0.075}{0.039}$ = 1.923	0.075 x 50 = 3.75
50 mm Air space resistance (absorptivity above 0.5)	Ra = 0.153	-
2 mm pressed steel panel	$\frac{0.002}{50}$ = 0.00004	0.002 x 7800 = 15.60
Internal surface film	Ri = 0.299	
Totals	2.427	39.35 kg/m²

$$U_W = \frac{1}{2.427} = 0.41 \text{ W/m}^2\text{°C}$$

'U' value of structural walls :-

G/F, 1/F, 5/F-14/F

W_5 for wall panel		Weight
external surface film	Ro = 0.044	
5 mm white mosaic tiles	$\frac{0.005}{1.5}$ = 0.003	0.005 x 2500 = 12.50
10 mm cement/sand render	$\frac{0.01}{0.72}$ = 0.014	0.01 x 1860 = 18.60
300 mm concrete wall	$\frac{0.30}{2.16}$ = 0.139	0.30 x 2400 = 720.00
10 mm gypsum plaster	$\frac{0.01}{0.38}$ = 0.026	0.01 x 1120 = 11.20
Internal surface film (absorptivity below 0.5)	Ri = 0.299	
Totals	0.525	762.3 kg/m²

$$U_W = \frac{1}{0.525} = \underline{1.91} \ W/m^2°C$$

(for carpark ramp and walls without tiles or render 'U' value is 1.97 W/m²°C)
(for lift wall without gypsum plaster 'U' value is 3.13 W/m²°C)

'U' value of structural walls :-

16/F-26/F

W_6 for beam and column		Weight
external surface film	Ro = 0.044	
8 mm black glass	$\frac{0.008}{1.05}$ = 0.0076	0.008 x 2500 = 20.00
50 mm Air space resistance (absorptivity above 0.5)	Ra = 0.153	
300 mm concrete wall	$\frac{0.30}{2.16}$ = 0.139	0.3 x 2400 = 720.00
10 mm gypsum plaster	$\frac{0.01}{0.38}$ = 0.026	0.01 x 1120 = 11.20
Internal surface film	Ri = 0.299	
Totals	0.669	751.20 kg/m²

$$U_W = \frac{1}{0.669} = \underline{1.50} \ W/m^2°C$$

(for lift wall without gypsum plaster 'U' value is 2.16 W/m²°C)

'U' value of Lift Lobby wall :-

5/F - 14/F

W_7 for beam and column		Weight
External surface film	Ro = 0.044	
5 mm white mosaic tiles	= 0.003	0.005 x 2500 = 12.50
10 mm cement/sand render	= 0.014	0.01 x 1860 = 18.60
*3.0 m concrete lobby wall	$\frac{3.00}{2.16}$ = 1.389	3.00 x 2400 = 7200.00
Totals	1.450	7231.10 kg/m²

$$U_W = \frac{1}{1.45} = \frac{0.69}{} \text{ W/m²°C}$$

* 3.0 m length assumed for simplicity

'U' value of Lift Lobby wall :-

16/F - 26/F

W_8 for beam and column		Weight
External surface film	Ro = 0.044	
8 mm black glass	= 0.0076	0.008 x 2500 = 20.00
50 mm Air space resistance (absorptivity above 0.5)	Ra = 0.153	
*3.0 m concrete lobby wall	= 1.389	3.00 x 2400 = 7200.00
Totals	= 1.594	7220.00 kg/m²

$$U_W = \frac{1}{1.594} = \frac{0.63}{} \text{ W/m²°C}$$

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 1 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing East (Tower) Solar Factor (SF) is 168

*Wall/Roof Code No.		$*W_1/R_1$	$*W_2/R_2$	$*W_3/R_3$	$*W_4/R_4$
Location of Wall/Roof		Beams & Cols 5/F-14/F	Beams & Cols 16/F-26/F	Panel Curtain Walls 5/F-14/F	Panel Curtain Wall 16/F-26/F
External Finish Material					
Conductivity	W/m°C	1.50	1.05	1.50	1.05
Density	kg/m^3	2500	2500	2500	2500
Thickness	m	0.005	0.008	0.005	0.008
Absorptivity	(α)	0.58	1.00	0.58	1.00
Intermediate component		cement render	air gap	cement render	mineral wool
Conductivity	W/m°C	0.72		0.72	0.039
Density	kg/m^3	1860		1860	50
Thickness	m	0.01	0.05	0.01	0.075
Intermediate component		r. concrete	r. concrete	r. concrete	air gap
Conductivity	W/m°C	2.16	2.16	2.16	
Density	kg/m^3	2400	2400	2400	
Thickness	m	0.60	0.60	0.10	0.05
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white semi gloss paint			white semi gloss paint on
Internal Finish Material			on gypsum plaster		steel panel
Conductivity	W/m°C	0.38	0.38	0.38	50
Density	kg/m^3	1120	1120	1120	7800
Thickness	m	0.01	0.01	0.01	0.002
Absorptivity	α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof		1.51	1.24	2.32	0.41
Area of *Wall/Roof	m^2	200.40	220.44	206.00	262.68
Density of composite *Wall/Roof	kg/m^2	1482	1471	282	39
Equivalent temperature difference	(TD_{EQ})	2.40	2.40	5.01	6.68

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 1(A) BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing East (Tower) Solar Factor (SF) is 168

*Wall/Roof Code No.		$*W_5/R_5$	$*W_6/R_6$	$*W_7/R_7$	$*W_8/R_8$
Location of Wall/Roof		300 Panel Walls 5/F-14/F	300 Panel Walls 16/F-26/F	Lift Lobby Wall 5/F-14/F	Lift Lobby Wall 16/F-26/F
External Finish Material		white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity	W/m°C	1.50	1.05	1.50	1.05
Density	kg/m^3	2500	2500	2500	2500
Thickness	m	0.005	0.008	0.005	0.008
Absorptivity	(α)	0.58	1.00	0.58	1.00
Intermediate component		cement render	air gap	cement render	air gap
Conductivity	W/m°C	0.72		0.72	
Density	kg/m^3	1860		1860	
Thickness	m	0.01	0.05	0.01	0.05
Intermediate component		r. concrete	r. concrete	r. concrete	r. concrete
Conductivity	W/m°C	2.16	2.16	2.16	2.16
Density	kg/m^3	2400	2400	2400	2400
Thickness	m	0.30	0.30	3.00	3.00
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Internal Finish Material		white semi gloss paint on gypsum plaster			
Conductivity	W/m°C	0.38	0.38		
Density	kg/m^3	1120	1120		
Thickness	m	0.01	0.01		
Absorptivity	α	0.30	0.30		
'U' value of composite *Wall/Roof		1.91(3.13)	1.50(2.16)	0.69	0.63
Area of *Wall/Roof	m^2	43.20(86.4)	47.52(95.04)	28.80	31.68
Density of composite *Wall/Roof	kg/m^2	762(751)	751(740)	7231	7220
Equivalent temperature difference	(TD_{EQ})	2.40	2.40	2.40	2.40

( ) Lift shaft walls without gypsum plaster

*Delete as appropriate

Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 1 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing East (Tower) Solar Factor (SF) is 168

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight	5/F-14/F shaded	5/F-14/F unshaded	16/F-26/F shaded	16/F-26/F unshaded
Glazing type	tinted	tinted	tinted	tinted
Thickness m	0.008	0.008	0.008	0.008
Shading Coefficient (SC)	0.70	0.70	0.70	0.70
Type of shading device	solid overhang	-	aluminium foils	-
External Shading Multiplier (ESM)	0.7	-	0.7	-
Area of glazing m^2	172.80	156.80	119.68	206.80

Physical data on *window/rooflight

Facade Orientation facing East (Tower) Solar Factor is 168

Window/Rooflight Code No.	*F_5/RL_5	*F_6/RL_6	*F_7/RL_7	*F_8/RL_8
Location of *Window/ Rooflight	5/F-14/F unshaded	16/F-26/F unshaded		
Glazing type	tinted	tinted		
Thickness m	0.008	0.008		
Shading Coefficient (SC)	0.70	0.70		
Type of shading device	-	-		
External Shading Multiplier (ESM)	-	-		
Area of glazing m^2	43.20	47.52		

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 1 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing East (Tower) .

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
W1	Beams & Cols 5/F-14/F	200.40	1.51	0.58	2.40	421.22
W2	Beams & Cols 16/F-26/F	220.44	1.24	1.00	2.40	656.03
W3	Panel Curtain Walls 5/F-14/F	206.00	2.32	0.58	5.01	1,388.74
W4	Panel Curtain Walls 16/F-26/F	262.68	0.41	1.00	6.68	719.43
W5	300 Panel Walls 5/F-14/F	43.20	1.91	0.58	2.40	114.86
W5A	300 Lift Walls	86.40	3.13	0.58	2.40	376.44
W6	300 Panel Walls 16/F-26/F	47.52	1.50	1.00	2.40	171.07
W6A	300 Lift Walls	95.04	2.16	1.00	2.40	492.69
W7	Lift/Lobby wall 5/F-14/F	28.80	0.69	0.58	2.40	27.66
W8	Lift/Lobby wall 16/F-26/F	31.68	0.63	1.00	2.40	47.90
	Subtotals	1,222.16	(A)		Heat Gain	4,416.04 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
F1	5/F - 14/F shaded	172.80	0.70	0.7	168	14,224.90
F2	5/F - 14/F unshaded	156.80	0.70	-	168	18,439.68
F3	16/F - 26/F shaded	119.68	0.70	0.7	168	9,852.06
F4	16/F - 26/F unshaded	206.80	0.70	-	168	24,319.68
F5	5/F-14/F unshaded	43.20	0.70	-	168	5,080.32
F6	16/F - 26/F unshaded	47.52	0.70	-	168	5,588.35
	Subtotals	746.80	(B)		Heat Gain	77,504.99 (D)

Gross Heat Gain (C + D) 81,921.03

Gross Area (A + B) 1,968.96

$$OTTV = \frac{C + D}{A + B} = 41.61 \text{ W/m}^2$$

* Delete as appropriate

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North Elevation (Tower) Gross Wall Area 1,566.72 m²

Wall composite areas

Beams and Column Areas

5/F - 14/F	(0.6 x 18.6 + 0.6 x 2.6 x 4) 10	=	174.00 m²	
15/F	Nil	=	-	
16/F - 26/F	(0.6 x 18.6 + 0.6 x 2.6 x 4) 11	=	191.40 m²	365.40 m²

300 mm Structural Wall to Lift

16/F-26/F	0.3 x 3.2 x 11	=	10.56 m²	

300 mm Structural Panel Walls to Lift

16/F-26/F	9.0 x 3.2 x 11 - 10.56	=	306.24 m²	316.80 m²

Glazing Areas

5/F - 14/F	25.76 x 10	=	257.60 m²	
15/F	Nil	=	-	
16/F - 26/F	25.76 x 11	=	283.36 m²	540.96 m²

100 mm Staircase Wall

5/F - 14/F	0.1 x 2.6 x 10	=	2.60 m²	
16/F - 26/F	0.1 x 2.6 x 11	=	2.86 m²	5.46 m²

100 mm Wall Panel Areas

5/F - 14/F	595.20 - (174.00 + 257.60 + 2.60)	=	161.00 m²	
15/F	Nil	=	-	
16/F - 26/F	971.52-(191.40+316.80+283.36+2.86)	=	177.10 m²	338.10 m²

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 2 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing North (Tower) Solar Factor (SF) is 104

*Wall/Roof Code No.		$*W_1/R_1$	$*W_2/R_2$	$*W_3/R_3$	$*W_4/R_4$
Location of Wall/Roof		Beams & Cols 5/F-14/F	Beams & Cols 16/F-26/F	Panel Walls 5/F-14/F	Curtain Wall panel 16/F-26/F
External Finish Material		white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity	W/m°C	1.50	1.05	1.50	1.05
Density	kg/m^3	2500	2500	2500	2500
Thickness	m	0.005	0.008	0.005	0.008
Absorptivity	(α)	0.58	1.00	0.58	1.00
Intermediate component		cement render	air gap	cement render	air gap
Conductivity	W/m°C	0.72		0.72	0.039
Density	kg/m^3	1860		1860	50
Thickness	m	0.01	0.05	0.01	0.075
Intermediate component		r. concrete	r. concrete	r. concrete	air gap
Conductivity	W/m°C	2.16	2.16	2.16	
Density	kg/m^3	2400	2400	2400	
Thickness	m	0.60	0.60	0.10	0.05
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white	semi gloss paint on		white semi gloss paint on
Internal Finish Material			gypsum plaster		steel panel
Conductivity	W/m°C	0.38	0.38	0.38	50
Density	kg/m^3	1120	1120	1120	7800
Thickness	m	0.01	0.01	0.01	0.002
Absorptivity	α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof		1.51	1.24	2.32	0.41
Area of *Wall/Roof	m^2	174.00	191.40	161.00	177.10
Density of composite *Wall/Roof	kg/m^2	1482	1471	282	39
Equivalent temperature difference	(TD_{EQ})	1.70	1.70	2.72	3.38

*Delete as appropriate

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 3 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing North (Tower) Solar Factor (SF) is 104

*Wall/Roof Code No.		*W_6/R_6	*W_7/R_7	*W_8/R_8	*W_{8A}/R_{8A}
Location of Wall/Roof		300mm Structural Panel Walls 16/F-26/F	100mm Staircase wall 5/F-14/F	100mm Stair wall 16/F-26/F	300mm Structural Lift Walls 16/F-26/F
External Finish Material		black glass	white mosaic tiles	black glass	black glass
Conductivity	W/m°C	1.05	1.50	1.05	1.05
Density	kg/m^3	2500	2500	2500	2500
Thickness	m	0.008	0.005	0.008	0.008
Absorptivity	(α)	1.00	0.58	1.00	1.00
Intermediate component		air gap	cement render	air gap	air gap
Conductivity	W/m°C		0.72		
Density	kg/m^3		1860		
Thickness	m	0.05	0.01	0.05	0.05
Intermediate component		r. concrete	r. concrete	r. concrete	r. concrete
Conductivity	W/m°C	2.16	2.16	2.16	2.16
Density	kg/m^3	2400	2400	2400	2400
Thickness	m	0.30	3.00	3.00	3.00
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Internal Finish Material					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Absorptivity	α				
'U' value of composite *Wall/Roof		2.16	0.69	0.63	0.63
Area of *Wall/Roof	m^2	306.24	2.60	2.86	10.56
Density of composite *Wall/Roof	kg/m^2	740	7231	7220	7220
Equivalent temperature difference	(TD_{EQ})	1.70	1.70	1.70	1.70

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 2 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing North (Tower) Solar Factor (SF) is 104

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight	5/F-14/F shaded	16/F-26/F shaded		
Glazing type	tinted	tinted		
Thickness m	0.008	0.008		
Shading Coefficient (SC)	0.70	0.70		
Type of shading device	solid overhang	aluminium foils		
External Shading Multiplier (ESM)	0.80	0.80		
Area of glazing m²	257.60	283.36		

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m²				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 2 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing North (Tower).

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
W1	Beams & Col. 5/F-14/F	174.00	1.51	0.58	1.70	259.06
W2	Beams & Col. 16/F-26/F	191.40	1.24	1.00	1.70	403.47
W3	Panels Walls 5/F-14/F	161.00	2.32	0.58	2.72	589.27
W4	Panels Walls 16/F-26/F	177.10	0.41	1.00	3.38	245.43
W6	300 mm Structural Panel 16/F-26/F	306.24	2.16	1.00	1.70	1,124.51
W7	100 mm Stair wall 5/F-14/F	2.60	0.69	0.58	1.70	1.77
W8	100 mm Stair wall 16/F-26/F	2.86	0.63	1.00	1.70	3.06
W8A	300 mm Lift wall 16/F-26/F	10.56	0.63	1.00	1.70	11.31
	Subtotals	1,025.76	(A)		Heat Gain	2,637.88 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
F1	5/F - 14/F	257.60	0.70	0.80	104	15,002.62
F2	16/F - 26/F	283.36	0.70	0.80	104	16,502.89
	Subtotals	540.96	(B)		Heat Gain	31,505.51 (D)

Gross Heat Gain (C + D) 34,143.39

Gross Area (A + B) 1,566.72

$$OTTV = \frac{C + D}{A + B} = 21.79 \text{ W/m}^2$$

* Delete as appropriate

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West Elevation (Tower) Gross Wall Area 1,968.96 m²

Wall composite areas

Beams and Column Areas

5/F - 14/F	(0.6 x 29.3 + 0.6 x 2.6 x 6) 10	=	269.40 m²	
15/F	Nil	=	-	
16/F - 26/F	(0.6 x 29.3 + 0.6 x 2.6 x 6) 11	=	296.34 m²	565.74 m²

Glazing Areas

5/F - 14/F	32.48 x 10	=	324.80 m²	
15/F	Nil	=	-	
16/F - 26/F	32.48 x 11	=	357.28 m²	682.08 m²

Wall Panel Areas

5/F - 14/F	937.60 - (269.40 + 324.80)	=	343.40 m²	
15/F	Nil	=	-	
16/F - 26/F	1,031.36 - (296.34 + 357.28)	=	377.74 m²	721.14 m²

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 3 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing West (Tower) Solar Factor (SF) is 175

*Wall/Roof Code No.		$*W_1/R_1$	$*W_2/R_2$	$*W_3/R_3$	$*W_4/R_4$
Location of Wall/Roof		Beams & Cols 5/F-14/F	Beams & Cols 16/F-26/F	Panel Walls 5/F-14/F	Curtain Wall panel 16/F-26/F
External Finish Material		white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity	W/m°C	1.50	1.05	1.50	1.05
Density	kg/m^3	2500	2500	2500	2500
Thickness	m	0.005	0.008	0.005	0.008
Absorptivity	(α)	0.58	1.00	0.58	1.00
Intermediate component		cement render	air gap	cement render	mineral felt
Conductivity	W/m°C	0.72		0.72	0.039
Density	kg/m^3	1860		1860	50
Thickness	m	0.01	0.05	0.01	0.075
Intermediate component		r. concrete	r. concrete	r. concrete	air gap
Conductivity	W/m°C	2.16	2.16	2.16	
Density	kg/m^3	2400	2400	2400	
Thickness	m	0.60	0.60	0.10	0.05
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white semi gloss paint on			white semi gloss paint on
Internal Finish Material		gypsum plaster			steel panel
Conductivity	W/m°C	0.38	0.38	0.38	50
Density	kg/m^3	1120	1120	1120	7800
Thickness	m	0.01	0.01	0.01	0.002
Absorptivity	α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof		1.51	1.24	2.32	0.41
Area of *Wall/Roof	m^2	269.40	296.34	343.40	377.74
Density of composite *Wall/Roof	kg/m^2	1482	1471	282	39
Equivalent temperature difference	(TD_{EQ})	2.10	2.10	4.35	5.79

*Delete as appropriate

Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 3 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing West (Tower) Solar Factor (SF) is 175

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight	5/F-14/F shaded	16/F-26/F shaded		
Glazing type	tinted	tinted		
Thickness m	0.008	0.008		
Shading Coefficient (SC)	0.70	0.70		
Type of shading device	solid overhang	aluminium foils		
External Shading Multiplier (ESM)	0.70	0.70		
Area of glazing m²	324.80	357.28		

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m²				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 3 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing West (Tower) .

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
W1	Beams & Col. 5/F-14/F	269.40	1.51	0.58	2.10	495.48
W2	Beams & Col. 16/F-26/F	296.34	1.24	1.00	2.10	771.67
W3	Panels Walls 5/F-14/F	343.40	2.32	0.58	4.35	2,010.04
W4	Curtain Wall Panels 16/F-26/F	377.74	0.41	1.00	5.79	896.72
	Subtotals	1,286.88	(A)		Heat Gain	4,173.91 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
F1	5/F - 14/F	324.80	0.70	0.70	175	27,851.60
F2	16/F - 26/F	357.28	0.70	0.70	175	30,636.76
	Subtotals	682.08	(B)		Heat Gain	58,488.36 (D)

Gross Heat Gain (C + D) 62,662.27

Gross Area (A + B) 1,968.96

$$OTTV = \frac{C + D}{A + B} = 31.83 \text{ W/m}^2$$

* Delete as appropriate

First issue April 1995

South Elevation (Tower) Gross Wall Area 1,566.72 m²

Wall composite areas

Beam and Column Areas

5/F - 14/F	(0.6 x 18.6 + 0.6 x 2.6 x 4) 10	=	174.00 m²	
15/F	Nil			
16/F - 26/F	[(0.6 x (18.6+9)+0.6 x 2.6 x 6)] 11	=	285.12 m²	459.12 m²

Glazing Areas

5/F - 14/F	25.92 x 10	=	259.20 m²	
15/F	Nil			
16/F - 26/F	25.92 x 11	=	285.12 m²	
16/F - 26/F	8.48 x 11	=	93.28 m²	637.60 m²

100 mm Stair case wall

16/F - 26/F	0.1 x 2.6 x 11	=	2.86 m²	2.86 m²

Wall Panel Areas

5/F - 14/F	595.20 - (174.00 + 259.20)	=	162.00 m²	
15/F	Nil			
16/F - 26/F	971.52 - (285.12+285.12+93.28+2.86)	=	305.14 m²	467.14 m²

Fenestration between 16/F - 26/F

Total Glazing	285.12 + 93.28 =	378.40 m²	
	(5.4 x 3) x 1.6 x 11 =	285.12 m²	Unshaded
		93.28 m²	Shaded

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 4 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing South (Tower) Solar Factor (SF) is 191

*Wall/Roof Code No.		$*W_1/R_1$	$*W_2/R_2$	$*W_3/R_3$	$*W_4/R_4$
Location of Wall/Roof		Beams & Col 5/F-14/F	Beams & Cols 16/F-26/F	Panel Walls 5/F-14/F	Curtain Wall panel 16/F-26/F
External Finish Material		white mosaic tiles	black glass	white mosaic tiles	black glass
Conductivity	W/m°C	1.50	1.05	1.50	1.05
Density	kg/m^3	2500	2500	2500	2500
Thickness	m	0.005	0.008	0.005	0.008
Absorptivity	(α)	0.58	1.00	0.58	1.00
Intermediate component		cement render	air gap	cement render	mineral felt
Conductivity	W/m°C	0.72		0.72	0.039
Density	kg/m^3	1860		1860	50
Thickness	m	0.01	0.05	0.01	0.075
Intermediate component		r. concrete	r. concrete	r. concrete	air gap
Conductivity	W/m°C	2.16	2.16	2.16	
Density	kg/m^3	2400	2400	2400	
Thickness	m	0.60	0.60	0.10	0.05
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white semi gloss paint on			white semi gloss paint on
Internal Finish Material		gypsum plaster			steel panel
Conductivity	W/m°C	0.38	0.38	0.38	50
Density	kg/m^3	1120	1120	1120	7800
Thickness	m	0.01	0.01	0.01	0.002
Absorptivity	α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof		1.51	1.24	2.32	0.41
Area of *Wall/Roof	m^2	174.00	285.12	162.00	305.14
Density of composite *Wall/Roof	kg/m^2	1482	1471	282	39
Equivalent temperature difference	(TD_{EQ})	1.40	1.40	3.60	5.01

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 4 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing South (Tower) Solar Factor (SF) is 191

*Wall/Roof Code No.		$*W_8/R_8$
Location of Wall/Roof		16/F-26/F
External Finish Material		Staircase wall black glass
Conductivity	W/m°C	1.05
Density	kg/m^3	2500
Thickness	m	0.008
Absorptivity	(α)	1.00
Intermediate component		air gap
Conductivity	W/m°C	
Density	kg/m^3	
Thickness	m	0.05
Intermediate component		r. concrete
Conductivity	W/m°C	2.16
Density	kg/m^3	2400
Thickness	m	3.00
Intermediate component		
Conductivity	W/m°C	
Density	kg/m^3	
Thickness	m	
Intermediate component		
Conductivity	W/m°C	
Density	kg/m^3	
Thickness	m	
Internal Finish Material		
Conductivity	W/m°C	
Density	kg/m^3	
Thickness	m	
Absorptivity	α	
'U' value of composite *Wall/Roof		0.63
Area of *Wall/Roof	m^2	2.86
Density of composite *Wall/Roof	kg/m^2	7220
Equivalent temperature difference	(TD_{EQ})	1.40

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 4 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing South (Tower) Solar Factor (SF) is 191

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight	5/F-14/F unshaded	16/F-26/F unshaded	16/F-26/F shaded	
Glazing type	tinted	reflective	tinted	
Thickness m	0.008	0.006	0.008	
Shading Coefficient (SC)	0.70	0.40	0.70	
Type of shading device			aluminium foils	
External Shading Multiplier (ESM)			0.70	
Area of glazing m^2	259.20	285.12	93.28	

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

* Delete as appropriate

Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 4 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing South (Tower) .

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
W1	Beams & Col. 5/F-14/F	174.00	1.51	0.58	1.40	213.34
W2	Beams & Col. 16/F-26/F	285.12	1.24	1.00	1.40	494.97
W3	Panels Walls 5/F-14/F	162.00	2.32	0.58	3.60	784.75
W4	Panels Walls 16/F-26/F	305.14	0.41	1.00	5.01	626.79
W8	Stair Walls 16/F-26/F	2.86	0.63	1.00	1.40	2.52
	Subtotals	929.12	(A)		Heat Gain	2,122.37 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
F1	5/F - 14/F unshaded	259.20	0.70		191	34,655.04
F2	16/F - 26/F unshaded	285.12	0.40		191	21,783.17
F3	16/F - 26/F shaded	93.28	0.70	0.70	191	8,730.08
	Subtotals	637.60	(B)		Heat Gain	65,168.29 (D)

Gross Heat Gain (C + D) 67,290.66

Gross Area (A + B) 1,566.72

$$OTTV = \frac{C + D}{A + B} = 42.95 \text{ W/m}^2$$

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 4

Summary of OTTV of Building Envelope

Sheet No. D _____ BD Ref. 2/___/___/___

Building address Typical Commercial Building

Total Envelope Heat Gain (*Tower/Podium)

Facade Orientation	Gross Area from Form OTTV 3	Gross Heat Gain from Form OTTV 3
a. East	1,968.96	81,921.03
b. North	1,566.72	34,143.39
c. West	1,968.96	62,662.27
d. South	1,566.72	67,290.66
e.		
f.		
Subtotal	7,071.36 (E)	246,017.35 (G)
Roof		
a.	391.80	13,185.05
b.		
Subtotal	(F)	(H)

Tower/Podium Walls OTTV = $\frac{G}{E}$ = 34.79 W/m²

Tower/Podium Roofs OTTV = $\frac{H}{F}$ = 33.65 W/m²

Tower/Podium OTTV = $\frac{G + H}{E + F}$ = 34.73 W/m²

* Delete as appropriate

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Accountable Roof Areas

Roof

Gross Area =	6.0 x 6.6 + 9.6 x 8.0 + 6 x 10.3 + 9.0 x 3.0 + 18.6 x 8.0 + (6.3 x 3.0 x 2)	= 391.80 m²
Glazed area =	8.4 x 8.0	= 67.20 m²
Beam area =	[(15.6 x 2) + (6.0 x 2) + 18.6 + (6.3 x 2) + (5.4 x 9) + 1.4 + (4.1 x 2) + (1.7 x 2) + (2.4 x 2 x 0.5) + (3.6 x 0.5)] 0.6	= 84.12 m²
Lift Lobby walls =	0.3 (9+2.7)	= 3.51 m²
Panel area =	391.80 - 67.2 - 84.12 - 3.51	= 236.97 m²

15/F

Gross Area =	6.6 x 5.4 + 2.4 x 1.4	= 39.00 m²
Glazed area		= Nil
Beam area =	0.6 (5.4 x 2)	= 6.48 m²
Panel area =	39.00 - 6.48	= 32.52 m²

Podium Roof

Carpark under non-accountable — Nil

'U' value of composite roof beams (and panels) :-

15/F and Roof

R_1 (R_2) for beams (panels)	r	Weight
External surface film	Ro = 0.055	
25 mm concrete tiles	$\frac{0.025}{1.10}$ = 0.023	0.025 x 2100 = 52.50
20 mm asphalt	$\frac{0.02}{1.15}$ = 0.017	0.02 x 2350 = 47.00
50 mm cement/sand screed	$\frac{0.05}{0.72}$ = 0.069	0.05 x 1860 = 93.00
50 mm polystyrene insulation	$\frac{0.05}{0.034}$ = 1.471	0.05 x 25 = 1.25
600 mm r. concrete	= 0.278	0.6 x 2400 = 1440.00
10 mm gypsum plaster	= 0.026	0.01 x 1120 = 11.20
Internal surface film	Ri = 0.801	
Totals	2.740	1644.95 kg/m

$$U_R = \frac{1}{2.740} = 0.37 \quad W/m^2°C$$

for 150 mm slab 'U' value is 0.40 $W/m^2°C$ and weight = 564.95 kg/m

for lift lobby walls say 3.0 m deep for ease of calculation,
'U' value is 0.33 $W/m^2°C$ and weight = 7,393.75 kg/m

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 5 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing Roof (Tower) Solar Factor (SF) is 264

*Wall/Roof Code No.		$*W_1/R_1$	$*W_2/R_2$	$*W_3/R_3$
Location of Wall/Roof		Tower Roof Beam	Tower Roof Panels	Tower Roof Lift Walls
External Finish Material		concrete tiles	concrete tiles	concrete tiles
Conductivity	W/m°C	1.10	1.10	1.10
Density	kg/m^3	2100	2100	2100
Thickness	m	0.025	0.025	0.025
Absorptivity	(α)	0.65	0.65	0.65
Intermediate component		asphalt	asphalt	asphalt
Conductivity	W/m°C	1.15	1.15	1.15
Density	kg/m^3	2350	2350	2350
Thickness	m	0.02	0.02	0.02
Intermediate component		cement/sand screed		
Conductivity	W/m°C	0.72	0.72	0.72
Density	kg/m^3	1860	1860	1860
Thickness	m	0.05	0.05	0.05
Intermediate component		expanded polystyrene		
Conductivity	W/m°C	0.034	0.034	0.034
Density	kg/m^3	25	25	25
Thickness	m	0.05	0.05	0.05
Intermediate component		r. concrete	r. concrete	r. concrete
Conductivity	W/m°C	2.16	2.16	2.16
Density	kg/m^3	2400	2400	2400
Thickness	m	0.60	0.15	3.00
Internal Finish Material		white semi gloss paint on gypsum plaster		
Conductivity	W/m°C	0.38	0.38	
Density	kg/m^3	1120	1120	
Thickness	m	0.01	0.01	
Absorptivity	α	0.30	0.30	
'U' value of composite *Wall/Roof		0.37	0.40	0.33
Area of *Wall/Roof	m^2	84.12	236.97	3.51
Density of composite *Wall/Roof	kg/m^2	1645	565	7394
Equivalent temperature difference	(TD_{EQ})	7.90	9.75	7.90

*Delete as appropriate

Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 5 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing Roof (Tower) Solar Factor (SF) is 264

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight	Roof			
Glazing type	tinted			
Thickness m	0.008			
Shading Coefficient (SC)	0.70			
Type of shading device	-			
External Shading Multiplier (ESM)				
Area of glazing m^2	67.20			

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 5 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing Roof (Tower) .

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
R_1	Tower Roof Beams	84.12	0.37	0.65	7.90	159.82
R_2	Tower Roof Panels	236.97	0.40	0.65	9.75	600.72
R_3	Tower Roof Stair & Lift Walls	3.51	0.33	0.65	7.90	5.95
	Subtotals	324.60	(A)		Heat Gain	766.49 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
RL_1	Rooflight	67.20	0.70	-	264	12,418.56
	Subtotals	67.20	(B)		Heat Gain	12,418.56 (D)

Gross Heat Gain (C + D) 13,185.05

Gross Area (A + B) 391.80

$$OTTV = \frac{C + D}{A + B} = 33.65 \text{ W/m}^2$$

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 5(A) BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing Roof (15/F) Solar Factor (SF) is 264

*Wall/Roof Code No.		$*W_1/R_1$	$*W_2/R_2$
Location of Wall/Roof		15/F Beams	15/F Panels
External Finish Material		concrete tiles	concrete tiles
Conductivity	W/m°C	1.10	1.10
Density	kg/m^3	2100	2100
Thickness	m	0.025	0.025
Absorptivity	(α)	0.65	0.65
Intermediate component		asphalt	asphalt
Conductivity	W/m°C	1.15	1.15
Density	kg/m^3	2350	2350
Thickness	m	0.02	0.02
Intermediate component		cement/sand screed	
Conductivity	W/m°C	0.72	0.72
Density	kg/m^3	1860	1860
Thickness	m	0.05	0.05
Intermediate component		expanded polystyrene	
Conductivity	W/m°C	0.034	0.034
Density	kg/m^3	25	25
Thickness	m	0.05	0.05
Intermediate component		r. concrete	r. concrete
Conductivity	W/m°C	2.16	2.16
Density	kg/m^3	2400	2400
Thickness	m	0.60	0.15
Internal Finish Material		white semi gloss paint on gypsum plaster	
Conductivity	W/m°C	0.38	0.38
Density	kg/m^3	1120	1120
Thickness	m	0.01	0.01
Absorptivity	α	0.30	0.30
'U' value of composite *Wall/Roof		0.37	0.40
Area of *Wall/Roof	m^2	6.48	32.52
Density of composite *Wall/Roof	kg/m^2	1645	565
Equivalent temperature difference	(TD_{EQ})	7.90	9.75

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 5(A) BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing Roof (15/F).

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
R_3	15/F Beams	6.48	0.37	0.65	7.90	12.31
R_4	15/F Panels	32.52	0.40	0.65	9.75	82.44
	Subtotals	39.00	(A)		Heat Gain	94.75 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
	Subtotals		(B)		Heat Gain	(D)

Gross Heat Gain (C + D) 94.75

Gross Area (A + B) 39.00

$$OTTV = \frac{C + D}{A + B} = 2.43 \text{ W/m}^2$$

* Delete as appropriate

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East Elevation (Podium) Gross Wall Area 344.00 m²

Wall Composite Areas

Beam and Column Areas

G/F	0.6 x 40.0 + 0.6 (3.4 x 6 + 3.4 x 0.5*)	=	37.26 m²	
1/F	0.6 x 40.0 + 0.6 (3.4 x 8)	=	40.32 m²	
1/F (Ramp)	0.6 x 23.0 + 0.6 (3.4 x 5 x 0.5)	=	18.90 m²	
2/F - 4/F	Nil	=	-	96.48 m²

Glazing Areas

G/F	87.38 m²	=	87.38 m²	
1/F	119.68 m²	=	119.68 m²	
2/F - 4/F	Nil	=	-	207.06 m²

300 mm Retaining Wall

G/F	138.00 - (37.26 + 87.38)	=	13.36 m²

300 mm Ramp Wall

1/F	23 x 4 x 0.5 - 18.90	=	27.1 m²

* Only half column considered to contribute

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 6 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing East (Podium) Solar Factor (SF) is 168

*Wall/Roof Code No.		$*W_1/R_1$	$*W_5/R_5$	$*W_{5A}/R_{5A}$	*W /R
Location of Wall/Roof		Beams & Cols G/F & 1/F	Retaining Wall G/F	Ramp Wall 1/F	
External Finish Material		white mosaic tiles			
Conductivity	W/m°C	1.50	1.50	2.16	
Density	kg/m^3	2500	2500	2400	
Thickness	m	0.005	0.005	0.30	
Absorptivity	(α)	0.58	0.58	0.65	
Intermediate component		cement render			
Conductivity	W/m°C	0.72	0.72		
Density	kg/m^3	1860	1860		
Thickness	m	0.01	0.01		
Intermediate component		Reinforced concrete			
Conductivity	W/m°C	2.16	2.16		
Density	kg/m^3	2400	2400		
Thickness	m	0.60	0.30		
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white semi gloss paint			
Internal Finish Material		on gypsum plaster			
Conductivity	W/m°C	0.38	0.38	0.38	
Density	kg/m^3	1120	1120	1120	
Thickness	m	0.01	0.01	0.01	
Absorptivity	α	0.30	0.30	0.30	
'U' value of composite *Wall/Roof		1.51	1.91	1.97	
Area of *Wall/Roof	m^2	96.48	13.36	27.1	
Density of composite *Wall/Roof	kg/m^2	1482	762	731	
Equivalent temperature difference	(TD_{EQ})	2.40	2.40	2.40	

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 6 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing East (Podium) Solar Factor (SF) is 168

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight	G/F&1/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m^2	207.06			

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 6 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing East (Podium) .

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
W1	Beams & Col. G/F&1/F	96.48	1.51	0.58	2.40	202.79
W5	Panels G/F&1/F	13.36	1.91	0.58	2.40	35.52
W5	Ramp Wall 1/F	27.10	1.97	0.65	2.40	83.28
	Subtotals	136.94	(A)		Heat Gain	321.59 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
F1	G/F & 1/F	207.06	0.90	-	168	31,307.47
	Subtotals	207.06	(B)		Heat Gain	31,307.47 (D)

Gross Heat Gain (C + D) 31,629.06

Gross Area (A + B) 344.00

$$OTTV = \frac{C + D}{A + B} = 91.95 \text{ W/m}^2$$

* Delete as appropriate

First issue April 1995

North Elevation (Podium) Gross Wall Area 320.00 m²

Wall Composite Areas

Beam and Column Areas

G/F	0.6 x 40 + 0.6 x 3.4 x 8	=	40.32 m²	
1/F	0.6 x 40 + 0.6 x 3.4 x 8	=	40.32 m²	80.64 m²

100 mm Stair Wall

G/F Stair Wall	0.1 x 3.4	=	0.34 m²	

Glazing Areas

G/F	119.34	=	119.34 m²	
1/F	119.68	=	119.68 m²	239.02 m²

Panel Areas

G/F	160.00 - (40.32 + 119.34 + 0.34)	=	0	
1/F	160.00 - (40.32 + 119.68)	=	0	0

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 7 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing North (Podium) Solar Factor (SF) is 104

*Wall/Roof Code No.		*W_1/R_1	*W_7/R_7	*W_3/R_3	*W_4/R_4
Location of Wall/Roof		Beams & Cols G/F & 1/F	Stair Wall G/F		
External Finish Material		white mosaic tiles			
Conductivity	W/m°C	1.50	1.50		
Density	kg/m^3	2500	2500		
Thickness	m	0.005	0.005		
Absorptivity	(α)	0.58	0.58		
Intermediate component		cement render			
Conductivity	W/m°C	0.72	0.72		
Density	kg/m^3	1860	1860		
Thickness	m	0.01	0.01		
Intermediate component		Reinforced concrete			
Conductivity	W/m°C	2.16	2.16		
Density	kg/m^3	2400	2400		
Thickness	m	0.60	3.00		
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white semi gloss paint			
Internal Finish Material		on gypsum plaster			
Conductivity	W/m°C	0.38			
Density	kg/m^3	1120			
Thickness	m	0.01			
Absorptivity	α	0.30			
'U' value of composite *Wall/Roof		1.51	0.69		
Area of *Wall/Roof	m²	80.64	0.34		
Density of composite *Wall/Roof	kg/m²	1482	7231		
Equivalent temperature difference	(TD_{EQ})	1.70	1.70		

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 7 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing North (Podium) Solar Factor (SF) is 104

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight	G/F&1/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m^2	239.02			

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 7 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing North (Podium) .

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
W1	Beams & Cols. G/F&1/F	80.64	1.51	0.58	1.70	120.06
W7	Stair Wall G/F	0.34	0.69	0.58	1.70	0.23
	Subtotals	80.98	(A)		Heat Gain	120.29 (C)

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
F1	G/F & 1/F	239.02	0.90	-	104	22,372.27
	Subtotals	239.02	(B)		Heat Gain	22,372.27 (D)

Gross Heat Gain (C + D) 22,492.56

Gross Area (A + B) 320.00

$$OTTV = \frac{C + D}{A + B} = 70.29 \text{ W/m}^2$$

* Delete as appropriate

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West Elevation (Podium) Gross Wall Area 366.00 m²
(With tiles = 112 m²)
(Party wall = 208 m²)

Wall Composite Areas

Beam and Column Areas (with tiles)

G/F	0.6 x 14 + 0.6 (3.4 x 3)	=	14.52 m²	
1/F	0.6 x 14 + 0.6 (3.4 x 3)	=	14.52 m²	29.04 m²

300 mm Ramp Wall

1/F	23 x 4 x 0.5 - 18.9	=	27.1 m²	

Glazing Areas

G/F	41.48	=	41.48 m²	
1/F	41.48	=	41.48 m²	82.96 m²

Beam and Column Areas (Party Wall and Ramp)

G/F	0.6 x 26 + 0.6 (3.4 x 5)	=	25.80 m²	
1/F	0.6 x 26 + 0.6 (3.4 x 5)	=	25.80 m²	
1/F Ramp	0.6 x 23 + 0.6 (3.4 x 5 x 0.5)	=	18.90 m²	70.50 m²

Panel Areas (with tiles)

G/F and 1/F	112.00 - (29.04 + 82.96)	=	-

Panel Areas in Party Wall

G/F and 1/F	208 - 51.60	=	156.40 m²	156.40 m²

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 8 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing West (Podium) Solar Factor (SF) is 175

*Wall/Roof Code No.		$*W_1/R_1$	$*W_{1A}/R_{1A}$	$*W_3/R_3$	$*W_5/R_5$
Location of Wall/Roof		Beams & Cols G/F & 1/F	Beams & Cols G/F & 1/F	Panels G/F & 1/F	Ramp Wall 1/F
External Finish Material		white mosaic tiles	Reinforced	Concrete	Reinforced Concrete
Conductivity	W/m°C	1.50	2.16	2.16	2.16
Density	kg/m^3	2500	2400	2400	2400
Thickness	m	0.005	0.60	0.10	0.30
Absorptivity	(α)	0.58	0.65	0.65	0.65
Intermediate component		cement render			
Conductivity	W/m°C	0.72			
Density	kg/m^3	1860			
Thickness	m	0.01			
Intermediate component		Reinforced concrete			
Conductivity	W/m°C	2.16			
Density	kg/m^3	2400			
Thickness	m	0.60			
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white semi gloss paint			
Internal Finish Material		on gypsum plaster			
Conductivity	W/m°C	0.38	0.38	0.38	0.38
Density	kg/m^3	1120	1120	1120	1120
Thickness	m	0.01	0.01	0.01	0.01
Absorptivity	α	0.30	0.30	0.30	0.30
'U' value of composite *Wall/Roof		1.51	1.55	2.41	1.97
Area of *Wall/Roof	m^2	29.04	70.50	156.40	27.1
Density of composite *Wall/Roof	kg/m^2	1482	1451	250	731
Equivalent temperature difference	(TD_{EQ})	2.10	2.10	4.35	2.10

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 8 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing West (Podium) Solar Factor (SF) is 175

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight	G/F&1/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m^2	82.96			

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	*F_1/RL_1	*F_2/RL_2	*F_3/RL_3	*F_4/RL_4
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 8 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing West (Podium) .

Opaque *Walls/Roofs

Code No.	Description	*A_w/A_r	U	α	TD_{EQ}	Sum
W1	Beams & Cols. G/F&1/F	29.04	1.51	0.58	2.10	53.41
W1A	Beams & Cols. G/F&1/F	70.50	1.55	0.65	2.10	149.16
W3	Panels G/F&1/F	156.40	2.41	0.65	4.35	1,065.75
W5	Ramp Wall 1/F	27.10	1.97	0.65	2.10	72.87
	Subtotals	283.04	(A)		Heat Gain	1,341.19 (C)

Fenestration

Code No.	Description	*Af_w/Af_r	SC	ESM	SF	Sum
F1	G/F & 1/F	82.96	0.90	-	175	13,066.20
	Subtotals	82.96	(B)		Heat Gain	13,066.20 (D)

Gross Heat Gain (C + D) 14,407.39

Gross Area (A + B) 366.00

$$OTTV = \frac{C + D}{A + B} = 39.36 \text{ W/m}^2$$

* Delete as appropriate

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South Elevation (Podium) Gross Wall Area 264.49 m²

Wall Composite Areas

Beam and Column Areas

G/F	-	=	-	
1/F	0.6 x 34.6 + 0.6 (3.4 x 8)	=	37.08 m²	37.08 m².
1/F Stair Wall	0.1 x 3.4	=	0.34 m²	0.34 m²

Glazing Areas

G/F	-	=	-	
1/F	100.98	=	100.98 m²	100.98 m²

Ramp

1/F	5.4 x 23.35	=	126.09 m²	126.09 m²
External wall at ramp omitted 5.4 x 40		=	21.60 m²	

Panel Areas

G/F	-	=	-	
1/F	160.00 - (37.08 + 0.34 + 100.98 + 21.60)	=	-	-

Building (Energy Efficiency) Regulation
Form OTTV 1

Calculation of 'U' Value of Composite Wall/Roof
and Details of Other Values

Sheet No. A 9 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data of Opaque *Wall/Roof

Facade Orientation facing South (Podium) Solar Factor (SF) is 191

*Wall/Roof Code No.		*W_1/R_1	*W_5/R_5	*W_7/R_7	*W /R
Location of Wall/Roof		Beams & Cols 1/F	Ramp 1/F	Stair Wall 1/F	
External Finish Material		white mosaic tiles	r. concrete	white mosaic tiles	
Conductivity	W/m°C	1.50	2.16	1.50	
Density	kg/m^3	2500	2400	2500	
Thickness	m	0.005	0.30	0.005	
Absorptivity	(α)	0.58	0.65	0.58	
Intermediate component		cement render		cement render	
Conductivity	W/m°C	0.72		0.72	
Density	kg/m^3	1860		1860	
Thickness	m	0.01		0.01	
Intermediate component		Reinforced Concrete		Reinforced Concrete	
Conductivity	W/m°C	2.16		2.16	
Density	kg/m^3	2400		2400	
Thickness	m	0.60		3.00	
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m				
Intermediate component					
Conductivity	W/m°C				
Density	kg/m^3				
Thickness	m	white semi gloss paint			
Internal Finish Material		on gypsum plaster			
Conductivity	W/m°C	0.38	0.38		
Density	kg/m^3	1120	1120		
Thickness	m	0.01	0.01		
Absorptivity	α	0.30	0.30		
'U' value of composite *Wall/Roof		1.51	1.97	0.69	
Area of *Wall/Roof	m^2	37.08	126.09	0.34	
Density of composite *Wall/Roof	kg/m^2	1482	731	7231	
Equivalent temperature difference	(TD_{EQ})	1.40	4.10	1.40	

*Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 2

Window/Rooflight Schedule

Sheet No. B 9 BD Ref 2/___/___/___

Building address Typical Commercial Building

Physical data on *window/rooflight

Facade Orientation facing South (Podium) Solar Factor (SF) is 191

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight	1/F unshaded			
Glazing type	plain			
Thickness m	0.012			
Shading Coefficient (SC)	0.90			
Type of shading device	-			
External Shading Multiplier (ESM)	-			
Area of glazing m^2	100.98			

Physical data on *window/rooflight

Facade Orientation facing _____ Solar Factor is _____

Window/Rooflight Code No.	$*F_1/RL_1$	$*F_2/RL_2$	$*F_3/RL_3$	$*F_4/RL_4$
Location of *Window/ Rooflight				
Glazing type				
Thickness m				
Shading Coefficient (SC)				
Type of shading device				
External Shading Multiplier (ESM)				
Area of glazing m^2				

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 3

Calculation of OTTV of Individual Facade in Building Envelope

Sheet No. C 9 BD Ref 2/___/___/___

Building address Typical Commercial Building

Facade Orientation facing South (Podium) .

Opaque *Walls/Roofs

Code No.	Description	$*A_w/A_r$	U	α	TD_{EQ}	Sum
W1	Beams and Cols G/F&1/F	37.08	1.51	0.58	1.40	45.46
W2	Stair Wall 1/F	0.34	0.69	0.58	1.40	0.19
W3	Ramp 1/F	126.09	1.97	0.65	4.10*	611.98
	Subtotals	163.51	(A)		Heat Gain	657.63 (C)

* Value interpolated from vert. and horizontal components.

Fenestration

Code No.	Description	$*Af_w/Af_r$	SC	ESM	SF	Sum
F1	1/F	100.98	0.90	-	191	17,358.46
	Subtotals	100.98	(B)		Heat Gain	17,358.46 (D)

Gross Heat Gain (C + D) 18,016.09

Gross Area (A + B) 264.49

$$OTTV = \frac{C + D}{A + B} = 68.12 \text{ W/m}^2$$

* Delete as appropriate

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Building (Energy Efficiency) Regulation
Form OTTV 4

Summary of OTTV of Building Envelope

Sheet No. D 1 BD Ref. 2/___/___/___

Building address Typical Commercial Building

Total Envelope Heat Gain (*Tower/Podium)

Facade Orientation	Gross Area from Form OTTV3	Gross Heat Gain from Form OTTV3
a. East	344.00	31,629.06
b. North	320.00	22,492.56
c. West	366.00	14,407.39
d. South	264.49	18,016.09
e.		
f.		
Subtotal	1,294.49 (E)	86,545.10 (G)
Roof	Carpark under - non accountable	
a. Main		
b. 15/F		
Subtotal	(F)	(H)

*Tower/Podium Walls OTTV = $\frac{G}{E}$ = 66.86 W/m²

*Tower/Podium Roofs OTTV = $\frac{H}{F}$ = _____ W/m²

*Tower/Podium OTTV = $\frac{G + H}{E + F}$ = _____ W/m²

* Delete as appropriate