21 4077/01 (Pt. VI) (54)

Appendix A
(PNAP APP-156)

RTTV Summary Sheet

Address: 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151	BD Ref. No.
Building Type:	Residential
RTTV calculated by	☐ 1. Registered Professional Engineers
	☑ 2. Architect
	☐ 3. Others, please specify :
No. of Storeys (Residential Units)	23

Table 1

Deemed to Satisfy $RTTV_{Wall}$								
Facade Orientation Facing								
Average Absorptivity								
Average Window to Wall Ratio								
Shading Coefficient of Glazing								
Average Shading Coefficient of Facade								
Visible Light Transmittance	%	%	%	%	%	%	%	%
External Reflectance	%	%	%	%	%	%	%	%

Table 2

$RTTV_{Wall}$																				
Facade Orientation Facing		N				E				S				W						
Wall Orientation Factor		0.79				1.072				0.975				1.131						
Total External Wall Area (Residential Units)		3514 m²	Window to Wall Ratio			2825.11 m²	Window to Wall Ratio			2682.23 m²	Window to Wall Ratio			2934.05 m²	Window to Wall Ratio					
Total Window Area		1651.94 m²	= 0.47			1161.95 m²	= 0.41			1285.87 m²	= 0.975			1180.82 m²	= 0.4					
Heat Conduction	Opaque Wall	3.25 W/m²				5.21 W/m²				4.24 W/m²				6.03 W/m²						
	Window	0.87 W/m²				0.88 W/m²				1.11 W/m²				1.08 W/m²						
Window	Glass Type	☑ Reflective	Area= 306.02 m²	SC= 0.33	VLT= 52 % ER= 16 %	☑ Reflective	Area= 727.64 m²	SC= 0.33	VLT= 52 % ER= 16 %	☑ Reflective	Area= 822.65 m²	SC= 0.33	VLT= 52 % ER= 16 %	☑ Reflective	Area= 565.11 m²	SC= 0.33	VLT= 52 % ER= 16 %			
		☑ Tinted	Area= 345.92 m²	SC= 0.66	VLT= 50 % ER= 6 %	☑ Tinted	Area= 434.31 m²	SC= 0.66	VLT= 50 % ER= 6 %	☑ Tinted	Area= 663.22 m²	SC= 0.66	VLT= 50 % ER= 6 %	☑ Tinted	Area= 615.71 m²	SC= 0.66	VLT= 50 % ER= 6 %			
		☐ Clear	Area= m²	SC=	VLT= % ER= %	☐ Clear	Area= m²	SC=	VLT= % ER= %	☐ Clear	Area= m²	SC=	VLT= % ER= %	☐ Clear	Area= m²	SC=	VLT= % ER= %			
	Double Glazing	☐ Yes ☑ No				☐ Yes ☑ No				☐ Yes ☑ No				☐ Yes ☑ No						
	External Shading	Overhang ☑ Yes ☐ No				Overhang ☑ Yes ☐ No				Overhang ☑ Yes ☐ No				Overhang ☑ Yes ☐ No						
		Sidefin ☑ Yes ☐ No				Sidefin ☑ Yes ☐ No				Sidefin ☑ Yes ☐ No				Sidefin ☑ Yes ☐ No						
Solar Radiation through Gazing		7.43 W/m²				7.16 W/m²				7.23 W/m²				7.81 W/m²						
Average Absorptivity		0.61				0.63				0.65				0.71						
$RTTV_{Wall}$ at each facade		11.55 W/m²				13.24 W/m²				12.58 W/m²				14.92 W/m²						
Overall $RTTV_{Wall}$		13.01 W/m²																		

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Table 3

$RTTV_{Roof}$						
Roof Orientation Factor						
Total Roof Area (Residential Units)		m²				
Total Skylight Area		m²				
Heat Conduction	Roof	W/m²				
	Skylight	W/m²				
Skylight	Glass Type	☐ Reflective	Area= m²	SC=	VLT= %	ER= %
		☐ Tinted	Area= m²	SC=	VLT= %	ER= %
		☐ Clear	Area= m²	SC=	VLT= %	ER= %
	Double Glazing	☐ Yes ☐ No				
	External Shading	☐ Yes ☐ No				
Solar Radiation through Glazing		W/m²				
Average Absorptivity (roof)						
Overall $RTTV_{Roof}$		W/m²				

ER = External Reflectance; SC = Shading Coefficient & VLT = Visible Light Transmittance

Notes :

1. Please tick in the box as appropriate
2. Window and skylight data should represent the major proportion of its use in the development.

Gross Wall Area (Opaque walls + Glazing Areas) Calculation

Storey heights (Residential Units) :

3/F	=	3.50 m	(1 storey)
5/F-16/F	=	3.50 m	(10 storeys)
18/F-30/F	=	3.50 m	(12 storeys)

North Gross Wall Area = Total Length of Opaque Walls & Glazing x Storey Height x No. of Storeys

3/F (0.575 + 0.200 + 0.165 + 0.100 + 0.700 + 0.100 + 2.085 + 0.450 + 0.100 + 0.305 + 0.150 + 0.080 + 0.875 + 0.075 + 0.875 + 0.437 + 0.700 + 0.100 + 36.428)x 3.50 x 1 = 44.50 x 3.50 x 1 = 155.75 m^2

5/F-16/F (0.575 + 0.200 + 0.165 + 0.100 + 0.700 + 0.100 + 2.085 + 0.450 + 0.100 + 0.305 + 0.150 + 0.080 + 0.875 + 0.075 + 0.875 + 0.437 + 0.700 + 0.100 + 36.428)x 3.50 x 10 = 44.50 x 3.50 x 10 = 1557.50 m^2

18/F-30/F (0.575 + 0.200 + 0.165 + 0.100 + 0.700 + 0.100 + 2.085 + 0.450 + 0.100 + 0.305 + 0.150 + 0.080 + 0.875 + 0.075 + 0.875 + 0.437 + 0.700 + 0.100 + 34.803)x 3.50 x 12 = 42.88 x 3.50 x 12 = 1800.75 m^2

Gross Wall Areas 3514.00 m^2

East Gross Wall Area = Total Length of Opaque Walls & Glazing x Storey Height x No. of Storeys

3/F (0.450 + 0.575 + 2.600 + 1.900 + 0.500 + 0.125 + 0.475 + 0.100 + 0.750 + 0.100 + 0.700 + 0.100 + 2.140 + 0.100 + 0.435 + 0.100 + 0.250 + 0.100 + 21.925)x 3.50 x 1 = 33.43 x 3.50 x 1 = 116.99 m^2

5/F-16/F (0.450 + 0.575 + 2.600 + 1.900 + 0.500 + 0.125 + 0.475 + 0.100 + 0.750 + 0.100 + 0.700 + 0.100 + 2.140 + 0.100 + 0.435 + 0.100 + 0.250 + 0.100 + 21.925)x 3.50 x 10 = 33.43 x 3.50 x 10 = 1169.88 m^2

18/F-30/F (0.575 + 2.600 + 1.900 + 0.200 + 0.875 + 0.100 + 0.700 + 0.100 + 0.700 + 0.100 + 0.928 + 0.100 + 0.700 + 0.437 + 0.887 + 0.075 + 0.887 + 0.080 + 24.681)x 3.50 x 12 = 36.63 x 3.50 x 12 = 1538.25 m^2

Gross Wall Areas 2825.11 m^2

South Gross Wall Area = Total Length of Opaque Walls & Glazing x Storey Height x No. of Storeys

3/F (0.575 + 0.200 + 0.080 + 0.837 + 0.075 + 0.837 + 0.140 + 0.150 + 0.330 + 0.100 + 0.200 + 0.300 + 0.140 + 0.850 + 0.075 + 0.850 + 0.080 + 0.125 + 28.226)x 3.50 x 1 = 34.17 x 3.50 x 1 = 119.60 m^2

5/F-16/F (0.575 + 0.200 + 0.080 + 0.837 + 0.075 + 0.837 + 0.140 + 0.150 + 0.330 + 0.100 + 0.200 + 0.300 + 0.140 + 0.850 + 0.075 + 0.850 + 0.080 + 0.125 + 28.226)x 3.50 x 10 = 34.17 x 3.50 x 10 = 1195.95 m^2

18/F-30/F (0.575 + 0.200 + 1.920 + 0.150 + 0.050 + 0.850 + 0.050 + 0.150 + 0.350 + 0.100 + 0.150 + 0.100 + 0.305 + 0.150 + 0.080 + 0.875 + 0.075 + 0.875 + 25.535)x 3.50 x 12 = 32.54 x 3.50 x 12 = 1366.68 m^2

Gross Wall Areas 2682.23 m^2

West Gross Wall Area = Total Length of Opaque Walls & Glazing x Storey Height x No. of Storeys

3/F (0.450 + 0.575 + 2.600 + 0.825 + 0.500 + 0.200 + 0.875 + 0.100 + 0.700 + 0.100 + 0.700 + 0.100 + 0.928 + 0.100 + 0.700 + 0.437 + 0.887 + 0.075 + 24.148)x 3.50 x 1 = 35.00 x 3.50 x 1 = 122.50 m^2

5/F-16/F (0.450 + 0.575 + 2.600 + 0.825 + 0.500 + 0.200 + 0.875 + 0.100 + 0.700 + 0.100 + 0.700 + 0.100 + 0.928 + 0.100 + 0.700 + 0.437 + 0.887 + 0.075 + 24.148)x 3.50 x 10 = 35.00 x 3.50 x 10 = 1225.00 m^2

18/F-30/F (1.900 + 0.575 + 2.600 + 0.825 + 1.825 + 0.200 + 0.875 + 0.100 + 0.700 + 0.100 + 0.700 + 0.100 + 0.928 + 0.100 + 0.700 + 0.437 + 0.887 + 0.075 + 24.148)x 3.50 x 12 = 37.78 x 3.50 x 12 = 1586.55 m^2

Gross Wall Areas 2934.05 m^2

Total Gross Wall Areas 11955.39 m^2

Total Glazing Area (Window + Balcony) Calculation

Sheet no. 7

Glazing heights (Residential Units) :

3/F (Window 1)	=	2.50 m	(1 storey)
3/F (Window 2)	=	0.35 m	(1 storey)
3/F (Window 3)	=	0.35 m	(1 storey)
3/F (Window 4)	=	1.40 m	(1 storey)
3/F (Balcony)	=	2.55 m	(1 storey)
5/F-16/F (Window 1)	=	2.50 m	(10 storeys)
5/F-16/F (Window 2)	=	0.35 m	(10 storeys)
5/F-16/F (Window 3)	=	0.35 m	(10 storeys)
5/F-16/F (Window 4)	=	1.40 m	(10 storeys)
5/F-16/F (Balcony)	=	2.55 m	(10 storeys)
18/F-30/F (Window 1)	=	2.50 m	(12 storeys)
18/F-30/F (Window 2)	=	0.35 m	(12 storeys)
18/F-30/F (Window 3)	=	0.35 m	(12 storeys)
18/F-30/F (Window 4)	=	1.40 m	(12 storeys)
18/F-30/F (Balcony)	=	2.55 m	(12 storeys)

North

Gross Glazing Area = Total Length of Glazing x Glazing Height x No. of Storeys

3/F (Window 1)	(0.165 + 1.238 + 1.238 + 1.238 + 1.238 + 1.238 + 1.238 + 1.278)x	2.50 x	1 =	8.871 x	2.50 x	1 =	22.18 m²
3/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700)x	0.35 x	1 =	5.600 x	0.35 x	1 =	1.96 m²
3/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	0.35 x	1 =	4.800 x	0.35 x	1 =	1.68 m²
3/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	1.40 x	1 =	4.800 x	1.40 x	1 =	6.72 m²
3/F (Balcony)	(0.875 + 0.875 + 0.888 + 0.888 + 0.888 + 0.888 + 0.888 + 0.888 + 0.887 + 0.887 + 0.875 + 0.875 + 0.887 + 4.263)x	2.55 x	1 =	15.752 x	2.55 x	1 =	40.17 m²
5/F-16/F (Window 1)	(0.165 + 1.238 + 1.238 + 1.238 + 1.238 + 1.238 + 1.238 + 1.278)x	2.50 x	10 =	8.871 x	2.50 x	10 =	221.78 m²
5/F-16/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700)x	0.35 x	10 =	5.600 x	0.35 x	10 =	19.60 m²
5/F-16/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	0.35 x	10 =	4.800 x	0.35 x	10 =	16.80 m²
5/F-16/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	1.40 x	10 =	4.800 x	1.40 x	10 =	67.20 m²
5/F-16/F (Balcony)	(0.875 + 0.875 + 0.888 + 0.888 + 0.888 + 0.888 + 0.888 + 0.888 + 0.887 + 0.887 + 0.875 + 0.875 + 0.887 + 4.263)x	2.55 x	10 =	15.752 x	2.55 x	10 =	401.68 m²
18/F-30/F (Window 1)	(0.165 + 1.238 + 1.238 + 1.238 + 1.238 + 1.238 + 1.238 + 1.278 + 1.925)x	2.50 x	12 =	10.796 x	2.50 x	12 =	323.88 m²
18/F-30/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700)x	0.35 x	12 =	5.600 x	0.35 x	12 =	23.52 m²
18/F-30/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	0.35 x	12 =	4.800 x	0.35 x	12 =	20.16 m²
18/F-30/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	1.40 x	12 =	4.800 x	1.40 x	12 =	80.64 m²
18/F-30/F (Balcony)	(0.875 + 0.875 + 0.888 + 0.888 + 0.888 + 0.888 + 0.888 + 0.888 + 0.887 + 0.887 + 0.875 + 0.875 + 0.875 + 1.725)x	2.55 x	12 =	13.202 x	2.55 x	12 =	403.98 m²
						Gross Glazing Areas	**1651.94** m²

East

Gross Glazing Area = Total Length of Glazing x Glazing Height x No. of Storeys

3/F (Window 1)	(0.875 + 0.928 + 1.238 + 1.238 + 0.475 + 1.990 + 0.435 + 0.435 + 2.140 + 0.475)x	2.50 x	1 =	10.229 x	2.50 x	1 =	25.57 m²
3/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700)x	0.35 x	1 =	4.200 x	0.35 x	1 =	1.47 m²
3/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	0.35 x	1 =	3.600 x	0.35 x	1 =	1.26 m²
3/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	1.40 x	1 =	3.600 x	1.40 x	1 =	5.04 m²
3/F (Balcony)	(0.887 + 0.887 + 0.887 + 0.887 + 1.003 + 1.003)x	2.55 x	1 =	5.554 x	2.55 x	1 =	14.16 m²
5/F-16/F (Window 1)	(0.875 + 0.928 + 1.238 + 1.238 + 0.475 + 1.990 + 0.435 + 0.435 + 2.140 + 0.475)x	2.50 x	10 =	10.229 x	2.50 x	10 =	255.73 m²
5/F-16/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700)x	0.35 x	10 =	4.200 x	0.35 x	10 =	14.70 m²
5/F-16/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	0.35 x	10 =	3.600 x	0.35 x	10 =	12.60 m²
5/F-16/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	1.40 x	10 =	3.600 x	1.40 x	10 =	50.40 m²
5/F-16/F (Balcony)	(0.887 + 0.887 + 0.887 + 0.887 + 1.003 + 1.003)x	2.55 x	10 =	5.554 x	2.55 x	10 =	141.63 m²
18/F-30/F (Window 1)	(0.875 + 0.928 + 1.238 + 1.238 + 0.875 + 0.928 + 0.928 + 0.875)x	2.50 x	12 =	7.885 x	2.50 x	12 =	236.55 m²
18/F-30/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700)x	0.35 x	12 =	5.600 x	0.35 x	12 =	23.52 m²
18/F-30/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	0.35 x	12 =	4.800 x	0.35 x	12 =	20.16 m²
18/F-30/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600)x	1.40 x	12 =	4.800 x	1.40 x	12 =	80.64 m²
18/F-30/F (Balcony)	(0.887 + 0.887 + 0.887 + 0.887 + 1.003 + 1.003 + 0.887 + 0.887 + 0.887 + 0.887)x	2.55 x	12 =	9.102 x	2.55 x	12 =	278.52 m²
						Gross Glazing Areas	**1161.95** m²

Total Glazing Area (Window + Balcony) Calculation

Sheet no. 7A

Glazing heights (Residential Units) :

3/F (Window 1)	=	2.50 m	(1 storey)
3/F (Window 2)	=	0.36 m	(1 storey)
3/F (Window 3)	=	1.94 m	(1 storey)
3/F (Window 4)	=	2.04 m	(1 storey)
3/F (Balcony)	=	2.55 m	(1 storey)
5/F-16/F (Window 1)	=	2.50 m	(10 storeys)
5/F-16/F (Window 2)	=	0.36 m	(10 storeys)
5/F-16/F (Window 3)	=	1.94 m	(10 storeys)
5/F-16/F (Window 4)	=	2.04 m	(10 storeys)
5/F-16/F (Balcony)	=	2.55 m	(10 storeys)
18/F-30/F (Window 1)	=	2.50 m	(12 storeys)
18/F-30/F (Window 2)	=	0.36 m	(12 storeys)
18/F-30/F (Window 3)	=	1.94 m	(12 storeys)
18/F-30/F (Window 4)	=	2.04 m	(12 storeys)
18/F-30/F (Balcony)	=	2.55 m	(12 storeys)

South

Gross Glazing Area = Total Length of Glazing x Glazing Height x No. of Storeys

3/F (Window 1)	(1.281 + 1.238 + 1.238 + 1.210 + 1.210	)x 2.50 x 1 =	6.177 x	2.50 x	1 =	15.44 m²
3/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700	)x 0.35 x 1 =	4.900 x	0.35 x	1 =	1.72 m²
3/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 0.35 x 1 =	4.200 x	0.35 x	1 =	1.47 m²
3/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 1.40 x 1 =	4.200 x	1.40 x	1 =	5.88 m²
3/F (Balcony)	(0.837 + 0.837 + 0.850 + 0.850 + 0.887 + 0.887 + 0.838 + 0.838 + 0.913 + 0.913 + 1.003 + 1.003 + 1.003 + 1.003	)x 2.55 x 1 =	12.662 x	2.55 x	1 =	32.29 m²
5/F-16/F (Window 1)	(1.281 + 1.238 + 1.238 + 1.210 + 1.210	)x 2.50 x 10	6.177 x	2.50 x	10 =	154.43 m²
5/F-16/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700	)x 0.35 x 10	4.900 x	0.35 x	10 =	17.15 m²
5/F-16/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 0.35 x 10 =	4.200 x	0.35 x	10 =	14.70 m²
5/F-16/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 1.40 x 10 =	4.200 x	1.40 x	10 =	58.80 m²
5/F-16/F (Balcony)	(0.837 + 0.837 + 0.850 + 0.850 + 0.887 + 0.887 + 0.838 + 0.838 + 0.913 + 0.913 + 1.003 + 1.003 + 1.003 + 1.003	)x 2.55 x 10 =	12.662 x	2.55 x	10 =	322.88 m²
18/F-30/F (Window 1)	(1.920 + 1.281 + 1.238 + 1.238 + 1.210 + 1.210	)x 2.50 x 12 =	8.097 x	2.50 x	12 =	242.91 m²
18/F-30/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700	)x 0.35 x 12 =	4.900 x	0.35 x	12 =	20.58 m²
18/F-30/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 0.35 x 12 =	4.200 x	0.35 x	12 =	17.64 m²
18/F-30/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 1.40 x 12 =	4.200 x	1.40 x	12 =	70.56 m²
18/F-30/F (Balcony)	(0.850 + 0.875 + 0.875 + 0.837 + 0.837 + 0.913 + 0.913 + 1.003 + 1.003 + 1.003 + 1.003	)x 2.55 x 12	10.112 x	2.55 x	12 =	309.43 m²
					Gross Glazing Areas	1285.87 m²

West

Gross Glazing Area = Total Length of Glazing x Glazing Height x No. of Storeys

3/F (Window 1)	(0.875 + 0.928 + 1.238 + 1.238 + 0.963 + 0.960	)x 2.50 x 1 =	6.202 x	2.50 x	1 =	15.51 m²
3/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700	)x 0.35 x 1 =	4.900 x	0.35 x	1 =	1.72 m²
3/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 0.35 x 1 =	4.200 x	0.35 x	1 =	1.47 m²
3/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 1.40 x 1 =	4.200 x	1.40 x	1 =	5.88 m²
3/F (Balcony)	(0.887 + 0.887 + 0.887 + 0.887 + 0.888 + 0.888 + 0.850 + 0.850 + 0.850 + 0.850 + 0.887 + 0.887	)x 2.55 x 1 =	10.498 x	2.55 x	1 =	26.77 m²
5/F-16/F (Window 1)	(0.875 + 0.928 + 1.238 + 1.238 + 0.963 + 0.960	)x 2.50 x 10 =	6.202 x	2.50 x	10 =	155.05 m²
5/F-16/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700	)x 0.35 x 10 =	4.900 x	0.35 x	10 =	17.15 m²
5/F-16/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 0.35 x 10 =	4.200 x	0.35 x	10 =	14.70 m²
5/F-16/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 1.40 x 10 =	4.200 x	1.40 x	10 =	58.80 m²
5/F-16/F (Balcony)	(0.887 + 0.887 + 0.887 + 0.887 + 0.888 + 0.888 + 0.850 + 0.850 + 0.850 + 0.850 + 0.887 + 0.887	)x 2.55 x 10 =	10.498 x	2.55 x	10 =	267.70 m²
18/F-30/F (Window 1)	(0.875 + 0.928 + 1.238 + 1.238 + 0.963 + 0.960	)x 2.50 x 12 =	6.202 x	2.50 x	12 =	186.06 m²
18/F-30/F (Window 2)	(0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700 + 0.700	)x 0.35 x 12 =	4.900 x	0.35 x	12 =	20.58 m²
18/F-30/F (Window 3)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 0.35 x 12 =	4.200 x	0.35 x	12 =	17.64 m²
18/F-30/F (Window 4)	(0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600 + 0.600	)x 1.40 x 12 =	4.200 x	1.40 x	12 =	70.56 m²
18/F-30/F (Balcony)	(0.887 + 0.887 + 0.887 + 0.887 + 0.888 + 0.888 + 0.850 + 0.850 + 0.850 + 0.850 + 0.887 + 0.887	)x 2.55 x 12 =	10.498 x	2.55 x	12 =	321.24 m²
					Gross Glazing Areas	1180.82 m²

Total Gross Glazing Areas 5280.57 m²

North

Gross Wall Areas = **3514.00** m²
(Opaque Walls + Glazing Areas) (Ao) at North

Glazing Areas at North = **1651.94** m²

Breakdown of Glazing Areas

Glazing Areas **Unshaded** (**N-F1**) = **709.0** m²

Glazing Areas **SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT)** (**N-F2**) = **149.65** m²

3/F	(	1.750	+	1.676	)x	2.55	x	1	=	8.74	m²	
5/F-16/F	(	1.750	+	1.676	)x	2.55	x	10	=	87.36	m²	
18/F-30/F	(	1.750			)x	2.55	x	12	=	53.55	m²	
OPF	=	0.88	/	2.55	=	0.35			**ECS1**	=	0.963	
SPF-L	=	0.50	/	1.905	=	0.26			**ECS2**	=	0.978	
ECS	=	0.963	x	0.978						=	0.942	

Glazing Areas **SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT)** (**N-F3**) = **156.19** m²

3/F	(	1.750			)x	2.55	x	1	=	4.46	m²	
5/F-16/F	(	1.750			)x	2.55	x	10	=	44.63	m²	
18/F-30/F	(	1.750	+	1.750	)x	2.55	x	12	=	107.10	m²	
OPF	=	0.88	/	2.55	=	0.35			**ECS1**	=	0.963	
SPF-R	=	0.50	/	1.905	=	0.26			**ECS2**	=	0.978	
ECS	=	0.963	x	0.978						=	0.942	

Opaque Wall Areas at North = **1862.06** m²

Breakdown of Opaque Wall Areas

Spandrel Curtain Wall Areas (**N-W1**) = **355.79** m²

Tiles Wall Areas (**N-W2**) = **108.06** m²

3/F	1.525	x	3.50	x	1 =	5.34	m²
5/F-16/F	1.525	x	3.50	x	10 =	53.38	m²
18/F-30/F	1.175	x	3.50	x	12 =	49.35	m²

Window to Wall Ratio (WWR) = 1651.94 / 3514.00 = **0.47**

Wall Orientation Factor Gw = 0.79 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at North

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	11%	1
Grey tiles	6%	0.9
Copper color metal	9%	0.4
Uncolored concrete	16%	0.7
Grey tinted glass	23%	0.55
Grey metal	35%	0.5
	Average Absorptivity =	**0.610636179**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+...+x_n/k_n+Ra+Ro)$ where

- Ri — Surface film resistance of internal surface (Refer to **Table 2**)
- Ro — Surface film resistance of external surface (Refer to **Table 2**)
- Ra — Air space resistance (Refer to **Table 3**)
- x — Thickness of building materials
- k — Thermal conductivity of building materials (Refer to **Table 1**)

N-W1 Description: Spandrel Curtain Wall Areas

Wall Material					
External surface film resistance			Ro	=	0.044
Air space resistanace			Ra	=	0.156
10mm glass	0.01	/	1.05	=	0.010
2mm aluminium	0.002	/	160	=	0.000013
50mm insulation	0.05	/	0.039	=	1.282
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistance			Ri	=	0.12
Total					**1.721**

$$Uw1 = \frac{1}{1.721} = 0.58 \text{ W/m}^2\text{K}$$

N-W2 Description: Tiles Wall Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
10mm artificial granite tiles	0.01	/	2.9	=	0.003
20mm cement/ sand render	0.02	/	0.72	=	0.028
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**0.304**

$$Uw2 = \frac{1}{0.304} = 3.29 \text{ W/m}^2\text{K}$$

North

Gross Wall Areas = **3514.00** m²
(Opaque Walls + Glazing Areas) (Ao) at North

Glazing Areas at North = **1651.94** m²

Breakdown of Glazing Areas

Glazing Areas **SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT)** (**N-F4**) = **255.78** m²

3/F	(	1.700	+	1.774	+	1.774	)x	2.55	x	1	=	13.38 m²
5/F-16/F	(	1.700	+	1.774	+	1.774	)x	2.55	x	10	=	133.82 m²
18/F-30/F	(	1.774	+	1.774			)x	2.55	x	12	=	108.58 m²

OPF = 0.88 / 2.55 = 0.35 **ECS1** = 0.963
SPF-L = 0.88 / 1.93 = 0.46 **ECS2** = 0.977
ECS = 0.963 x 0.977 = 0.941

Glazing Areas **SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT)** (**N-F5**) = **258.09** m²

3/F	(	1.774	+	1.776	+	1.776	)x	2.55	x	1	=	13.58 m²
5/F-16/F	(	1.774	+	1.776	+	1.776	)x	2.55	x	10	=	135.81 m²
18/F-30/F	(	1.776	+	1.776			)x	2.55	x	12	=	108.69 m²

OPF = 0.88 / 2.55 = 0.35 **ECS1** = 0.963
SPF-R = 0.88 / 1.93 = 0.46 **ECS2** = 0.977
ECS = 0.963 x 0.977 = 0.941

Opaque Wall Areas at North = **1862.06** m²

Breakdown of Opaque Wall Areas

Dark Grey Aluminum Cladding Areas (**N-W3**) = **119.95** m²

3/F	1.49	x	3.50	x	1 =	5.22	m²
5/F-16/F	1.49	x	3.50	x	10 =	52.15	m²
18/F-30/F	1.49	x	3.50	x	12 =	62.58	m²

Metal for Curtain Wall Areas (**N-W4**) = **427.57** m²

3/F	19.25	m²
5/F-16/F	192.54	m²
18/F-30/F	215.78	m²

Window to Wall Ratio (WWR) = 1651.94 / 3514.00 = **0.47**

Wall Orientation Factor Gw = 0.79 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at North

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	11%	1
Grey tiles	6%	0.9
Copper color metal	9%	0.4
Uncolored concrete	16%	0.7
Grey tinted glass	23%	0.55
Grey metal	35%	0.5
	Average Absorptivity =	**0.610636179**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$ where

- Ri — Surface film resistance of internal surface (Refer to **Table 2**)
- Ro — Surface film resistance of external surface (Refer to **Table 2**)
- Ra — Air space resistance (Refer to **Table 3**)
- x — Thickness of building materials
- k — Thermal conductivity of building materials (Refer to **Table 1**)

N-W3 Description: Dark Grey Aluminum Cladding Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
3mm aluminum	0.003 /	160	=	0.000019
20mm cement/ sand render	0.02 /	0.72	=	0.028
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.301**

$Uw3 = \frac{1}{0.301}$ = **3.33** W/m²K

N-W4 Description: Metal for Curtain Wall Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0.16
10mm aluminum	0.01 /	160	=	0.000063
10mm aluminum	0.01 /	160	=	0.000063
Internal surface film resistamce		Ri	=	0.12
Total				**0.324**

$Uw4 = \frac{1}{0.324}$ = **3.09** W/m²K

North

Gross Wall Areas
(Opaque Walls + Glazing Areas) (Ao) at North = **3514.00** m²

Glazing Areas at North = **1651.94** m²

Breakdown of Glazing Areas

Glazing Areas **SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT)** (**N-F6**) = **26.01** m²

18/F-30/F	(	0.85				)x	2.55	x	12	=	26.01 m²
	OPF	=	1.20	/	2.55	=	0.47		ECS1	=	0.960
	SPF-L	=	0.30	/	0.95	=	0.32		ECS2	=	0.977
	ECS	=	0.960	x	0.977					=	0.938

Glazing Areas **Unshaded** (**N-F7**) = **97.02** m²

3/F	(	0.700			)x	0.35	x	1	= 0.25 m²
3/F	(	0.600			)x	1.75	x	1	= 1.05 m²
3/F	(	0.165			)x	2.50	x	1	= 0.41 m²
5/F-16/F	(	0.700			)x	0.35	x	10	= 2.45 m²
5/F-16/F	(	0.600			)x	1.75	x	10	= 10.50 m²
5/F-16/F	(	0.165			)x	2.50	x	10	= 4.13 m²
18/F-30/F	(	0.700			)x	0.35	x	12	= 2.94 m²
18/F-30/F	(	0.600			)x	1.75	x	12	= 12.60 m²
18/F-30/F	(	0.165	+	1.925	)x	2.50	x	12	= 62.70 m²

Opaque Wall Areas at North = **1862.06** m²

Breakdown of Opaque Wall Areas

Black Concrete Areas (**N-W5**) = **196.68** m²

3/F	2.605	x	3.50	x	1 =	9.12 m²
5/F-16/F	2.605	x	3.50	x	10 =	91.18 m²
18/F-30/F	2.295	x	3.50	x	12 =	96.39 m²

Uncolored Concrete Areas (**N-W6**) = **297.88** m²

3/F	18.407	x	0.770	x	1 =	14.17 m²
5/F-16/F	18.407	x	0.770	x	10 =	141.73 m²
18/F-30/F	15.365	x	0.770	x	12 =	141.97 m²

Window to Wall Ratio (WWR) = 1651.94 / 3514.00 = **0.47**

Wall Orientation Factor Gw = 0.79 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at North

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	11%	1
Grey tiles	6%	0.9
Copper color metal	9%	0.4
Uncolored concrete	16%	0.7
Grey tinted glass	23%	0.55
Grey metal	35%	0.5
	Average Absorptivity =	**0.610636179**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$ where

- Ri — Surface film resistance of internal surface (Refer to **Table 2**)
- Ro — Surface film resistance of external surface (Refer to **Table 2**)
- Ra — Air space resistance (Refer to **Table 3**)
- x — Thickness of building materials
- k — Thermal conductivity of building materials (Refer to **Table 1**)

N-W5 Description: Black Concrete Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.273**

Uw5 = 1 / 0.273 = 3.66 W/m²K

N-W6 Description: Uncolored Concrete Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
250mm concrete	0.25 /	2.16	=	0.116
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.319**

Uw6 = 1 / 0.319 = 3.13 W/m²K

North

Gross Wall Areas
(Opaque Walls + Glazing Areas) (Ao) at North = **3514.00** m²

Glazing Areas at North = **1651.94** m²

Opaque Wall Areas at North = **1862.06** m²

Breakdown of Opaque Wall Areas

Glass Cladding Areas				(**N-W7**)	=	**0.00** m²
3/F	0 x	3.50 x	1 =	0.00	m²	
5/F-16/F	0 x	3.50 x	10 =	0.00	m²	
18/F-30/F	0 x	3.50 x	12 =	0.00	m²	
Copper Color Aluminum Cladding Areas				(**N-W8**)	=	**167.84** m²
3/F	2.085 x	3.50 x	1 =	7.30	m²	
5/F-16/F	2.085 x	3.50 x	10 =	72.98	m²	
18/F-30/F	2.085 x	3.50 x	12 =	87.57	m²	

Window to Wall Ratio (WWR) = 1651.94 / 3514.00 = **0.47**

Wall Orientation Factor Gw = 0.79 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at North

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	11%	1
Grey tiles	6%	0.9
Copper color metal	9%	0.4
Uncolored concrete	16%	0.7
Grey tinted glass	23%	0.55
Grey metal	35%	0.5
	Average Absorptivity =	**0.610636179**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+...+x_n/k_n+Ra+Ro)$ where

- Ri — Surface film resistance of internal surface (Refer to **Table 2**)
- Ro — Surface film resistance of external surface (Refer to **Table 2**)
- Ra — Air space resistance (Refer to **Table 3**)
- x — Thickness of building materials
- k — Thermal conductivity of building materials (Refer to **Table 1**)

N-W7 Description: Glass Cladding Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
10mm glass	0.01 /	1.05	=	0.010
2mm aluminium	0.002 /	160	=	0.000013
50mm insulation	0.05 /	0.039	=	1.282051
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**1.565**

$$Uw7 = \frac{1}{1.565} = 0.64 \text{ W/m}^2\text{K}$$

N-W8 Description: Copper Color Aluminum Cladding Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
3mm aluminum	0.003 /	160	=	0.000019
20mm cement/ sand render	0.02 /	0.72	=	0.028
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.301**

$$Uw8 = \frac{1}{0.301} = 3.33 \text{ W/m}^2\text{K}$$

North

Gross Wall Areas = **3514.00** m²
(Opaque Walls + Glazing Areas) (Ao) at North

Glazing Areas at North = **1651.94** m²

Opaque Wall Areas at North = **1862.06** m²

Breakdown of Opaque Wall Areas

Insulation Areas beside Mullions					(**N-W9**)	=	**19.32**	m²
3/F	0.24	x	3.50	x 1 =	0.84	m²		
5/F-16/F	0.24	x	3.50	x 10 =	8.40	m²		
18/F-30/F	0.24	x	3.50	x 12 =	10.08	m²		
Hollow Aluminum Cladding Areas					(**N-W10**)	=	**111.01**	m²
3/F	1.379	x	3.50	x 1 =	4.83	m²		
5/F-16/F	1.379	x	3.50	x 10 =	48.27	m²		
18/F-30/F	1.379	x	3.50	x 12 =	57.92	m²		

Window to Wall Ratio (WWR) = 1651.94 / 3514.00 = **0.47**

Wall Orientation Factor Gw = 0.79 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at North

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	11%	1
Grey tiles	6%	0.9
Copper color metal	9%	0.4
Uncolored concrete	16%	0.7
Grey tinted glass	23%	0.55
Grey metal	35%	0.5
	Average Absorptivity =	**0.610636179**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+...+x_n/k_n+Ra+Ro)$ where

- Ri — Surface film resistance of internal surface (Refer to **Table 2**)
- Ro — Surface film resistance of external surface (Refer to **Table 2**)
- Ra — Air space resistance (Refer to **Table 3**)
- x — Thickness of building materials
- k — Thermal conductivity of building materials (Refer to **Table 1**)

N-W9 Description: Insulation Areas beside Mullions

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
10mm glass	0.01	/	1.05	=	0.010
2mm aluminium	0.002	/	160	=	0.000013
160mm insulation	0.16	/	0.039	=	4.103
2mm aluminium	0.002	/	160	=	0.000013
Internal surface film resistamce			Ri	=	0.12
Total					**4.276**

$Uw9 = \frac{1}{4.276} = 0.23$ W/m²K

N-W10 Description: Hollow Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0.16
3mm aluminum	0.003	/	160	=	0.000019
25mm insulation	0.025	/	0.039	=	0.641
3mm aluminum	0.003	/	160	=	0.000019
Internal surface film resistamce			Ri	=	0.12
Total					**0.965**

$Uw10 = \frac{1}{0.965} = 1.04$ W/m²K

North

Gross Wall Areas = **3514.00** m²
(Opaque Walls + Glazing Areas) (Ao) at North

Glazing Areas at North = **1651.94** m²

Opaque Wall Areas at North = **1862.06** m²

Breakdown of Opaque Wall Areas

Frame Areas for Openable IGU					(**N-W11**)	=	**57.96** m²
3/F	0.315	x 8	x 1	=	2.52	m²	
5/F-16/F	0.315	x 8	x 10	=	25.20	m²	
18/F-30/F	0.315	x 8	x 12	=	30.24	m²	

Window to Wall Ratio (WWR) = 1651.94 / 3514.00 = **0.47**

Wall Orientation Factor Gw = 0.79 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at North

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	11%	1
Grey tiles	6%	0.9
Copper color metal	9%	0.4
Uncolored concrete	16%	0.7
Grey tinted glass	23%	0.55
Grey metal	35%	0.5
	Average Absorptivity =	**0.610636179**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$ where

- Ri — Surface film resistance of internal surface (Refer to **Table 2**)
- Ro — Surface film resistance of external surface (Refer to **Table 2**)
- Ra — Air space resistance (Refer to **Table 3**)
- x — Thickness of building materials
- k — Thermal conductivity of building materials (Refer to **Table 1**)

N-W11 Description: Frame Areas for Openable IGU

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0.153
20mm glass	0.02	/	1.05	=	0.019
5mm aluminum	0.005	/	160	=	0.000031
5mm aluminum	0.005	/	160	=	0.000031
Internal surface film resistamce			Ri	=	0.12
Total					**0.336**

$$Uw11 = \frac{1}{0.336} = 2.98 \text{ W/m}^2\text{K}$$

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	9	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	North	Gross Wall Area (Ao) =	3514.00
Window to Wall Ratio (WWR)	0.47	Wall Orientation Factor (Gw) =	0.79

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**N-W1**	**N-W2**	**N-W3**
External Finish Material		10mm glass	10mm artificial granite tiles	3mm aluminum
Conductivity	W/mK	1.05	2.90	160.00
Thickness	m	0.010	0.010	0.003
Average Absorptivity	(α)	0.61	0.61	0.61
Intermediate component		75mm air gap	20mm cement/ sand render	20mm cement/ sand render
Conductivity	W/mK	-	0.72	0.72
Thickness	m	0.075	0.02	0.02
Intermediate component		2mm aluminium	150mm concrete	150mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.002	0.15	0.15
Intermediate component		50mm insulation		
Conductivity	W/mK	0.039		
Thickness	m	0.05		
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.15		
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	0.38	0.38	0.38
Thickness	m	0.02	0.02	0.02
U-value of Opaque Area (Uwi)	W/m^2K	5.50	3.29	3.33
Opaque Wall Area (Awi)	m^2	355.79	108.06	119.95
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.96**	**0.17**	**0.20**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **3.25** W/m^2

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**N-F1**	**N-F2**	**N-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.01	0.01
Glazing Area (Afi)	m^2	709.00	149.65	156.19
U-value of Glazing (Ufi)	W/m^2K	1.59	5.67	5.67
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.162**	**0.122**	**0.127**

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **0.87**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**N-F1**	**N-F2**	**N-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.010	0.010
Glazing Area (Afi)	m^2	709.00	149.65	156.19
Shading Coefficient of Glazing (SCf)		0.33	0.66	0.66
Visible Light Transmittance (VLT)	%	52.00	50.00	50.00
External Reflectance (ER)	%	16.00	6.00	6.00
External Shading Multiplier (ESC)		1.00	0.94	0.94
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**2.20**	**0.87**	**0.91**

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.43** W/m^2

Summary of RTTV at North

= 3.25 + 0.87 + 7.43

= **11.55** W/m^2

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	9A	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	North	Gross Wall Area (Ao) =	3514.00
Window to Wall Ratio (WWR)	0.47	Wall Orientation Factor (Gw) =	0.79

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**N-W4**	**N-W5**	**N-W6**
External Finish Material		10mm aluminum	150mm concrete	250mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.010	0.150	0.250
Average Absorptivity	(α)	0.61	0.61	0.61
Intermediate component		100mm air gap		
Conductivity	W/mK	-		
Thickness	m	0.1		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		10mm aluminum	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	160.00	0.38	0.38
Thickness	m	0.01	0.02	0.015
U-value of Opaque Area (Uwi)	W/m²K	3.09	3.66	3.13
Opaque Wall Area (Awi)	m²	427.57	196.68	297.88
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.65**	**0.35**	**0.46**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **3.25** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**N-F4**	**N-F5**	**N-F6**
Glazing Type		Tinted Glass	Tinted Glass	Tinted Glass
Thickness	m	0.01	0.01	0.01
Glazing Area (Afi)	m²	255.78	258.09	26.01
U-value of Glazing (Ufi)	W/m²K	5.67	5.67	5.67
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.209**	**0.211**	**0.021**

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **0.87**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**N-F4**	**N-F5**	**N-F6**
Glazing Type		Tinted Glass	Tinted Glass	Tinted Glass
Thickness	m	0.01	0.010	0.010
Glazing Area (Afi)	m²	255.78	258.09	26.01
Shading Coefficient of Glazing (SCf)		0.66	0.66	0.66
Visible Light Transmittance (VLT)	%	50.00	50.00	50.00
External Reflectance (ER)	%	6.00	6.00	6.00
External Shading Multiplier (ESC)		0.94	0.94	0.94
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**1.49**	**1.50**	**0.15**

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.43** **W/m²**

Summary of RTTV at North

= 3.25 + 0.87 + 7.43

= **11.55** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	9B	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	North	Gross Wall Area (Ao) =	3514.00
Window to Wall Ratio (WWR)	0.47	Wall Orientation Factor (Gw) =	0.79

Part 1 - Calculation of Heat Conduction through Opaque Walls				
Components / Details		**Code No.**		
Description	**Units**	**N-W7**	**N-W8**	**N-W9**
External Finish Material		10mm glass	3mm aluminum	10mm glass
Conductivity	W/mK	1.05	160.00	1.05
Thickness	m	0.010	0.003	0.010
Average Absorptivity	(α)	0.61	0.61	0.61
Intermediate component		2mm aluminium	20mm cement/ sand render	2mm aluminium
Conductivity	W/mK	160	0.72	160
Thickness	m	0.002	0.02	0.002
Intermediate component		50mm insulation	150mm concrete	160mm insulation
Conductivity	W/mK	0.039	2.16	0.039
Thickness	m	0.05	0.15	0.16
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.150		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	2mm aluminium
Conductivity	W/mK	0.38	0.38	160.00
Thickness	m	0.02	0.02	0.002
U-value of Opaque Area (Uwi)	W/m^2K	0.64	3.33	5.50
Opaque Wall Area (Awi)	m^2	0.00	167.84	19.32
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.00**	**0.27**	**0.052**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **3.25** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing				
Components / Details		**Code No.**		
Description	**Units**	**N-F7**		
Glazing Type		IGU		
Thickness	m	0.028		
Glazing Area (Afi)	m^2	97.02		
U-value of Glazing (Ufi)	W/m^2K	1.59		
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.022**		

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **0.87**

Part 3 - Calculation of Solar Radiation through Glazing				
Components / Details		**Code No.**		
Description	**Units**	**N-F7**		
Glazing Type		IGU		
Thickness	m	0.028		
Glazing Area (Afi)	m^2	97.02		
Shading Coefficient of Glazing (SCf)		0.33		
Visible Light Transmittance (VLT)	%	52.00		
External Reflectance (ER)	%	16.00		
External Shading Multiplier (ESC)		1.00		
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**0.30**		

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.43** **W/m²**

Summary of RTTV at North

= 3.25 + 0.87 + 7.43

= **11.55** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No. 9C BD Ref No.

Building Address Proposed Composite Building Development at 63 Ma Tau Wai Road,
Kowloon - K.I.L. 1151

Facade Orientation Facing North Gross Wall Area (Ao) = 3514.00

Window to Wall Ratio (WWR) 0.47 Wall Orientation Factor (Gw) = 0.79

Part 1 - Calculation of Heat Conduction through Opaque Walls				
Components / Details		**Code No.**		
Description	**Units**	**N-W10**	**N-W11**	
External Finish Material		3mm aluminum	20mm glass	
Conductivity	W/mK	160.00	1.05	
Thickness	m	0.003	0.020	
Average Absorptivity	(α)	0.61	0.61	
Intermediate component		25mm insulation	5mm aluminum	
Conductivity	W/mK	0.039	160	
Thickness	m	0.025	0.005	
Intermediate component		300mm air gap	50mm air gap	
Conductivity	W/mK	-	-	
Thickness	m	0.3	0.05	
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		3mm aluminum	5mm aluminum	
Conductivity	W/mK	160.00	160.00	
Thickness	m	0.003	0.005	
U-value of Opaque Area (Uwi)	W/m^2K	1.04	2.98	
Opaque Wall Area (Awi)	m^2	111.01	57.96	
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.06**	**0.08**	

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **3.25** W/m^2

Part 2 - Calculation of Heat Conduction through Glazing				
Components / Details		**Code No.**		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
U-value of Glazing (Ufi)	W/m^2K			
Heat Conduction = 0.64 (Afi/Ao) Uf Gw				

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **0.87**

Part 3 - Calculation of Solar Radiation through Glazing				
Components / Details		**Code No.**		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
Shading Coefficient of Glazing (SCf)				
Visible Light Transmittance (VLT)	%			
External Reflectance (ER)	%			
External Shading Multiplier (ESC)				
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw				

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.43** W/m^2

Summary of RTTV at North

= 3.25 + 0.87 + 7.43

= **11.55** W/m^2

East

Gross Wall Areas = **2825.11** m²
(Opaque Walls + Glazing Areas) (Ao) at East

Glazing Areas at East = **1161.95** m²

Breakdown of Glazing Areas

Glazing Areas Unshaded (E-F1) = **394.06** m²

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT) (E-F2) = **117.65** m²

3/F	(	2.006			)x	2.55	x	1	=	5.12	m²
5/F-16/F	(	2.006			)x	2.55	x	10	=	51.15	m²
18/F-30/F	(	2.006			)x	2.55	x	12	=	61.38	m²

OPF	=	0.88	/	2.55	=	0.35	ECS1	= 0.780
SPF-L	=	3.55	/	2.16	=	1.65	ECS2	= 0.955
ECS	=	0.780	x	0.955				= 0.745

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT) (E-F3) = **158.33** m²

3/F	(	1.774			)x	2.55	x	1	=	4.52	m²
5/F-16/F	(	1.774			)x	2.55	x	10	=	45.24	m²
18/F-30/F	(	1.774	+	1.77	)x	2.55	x	12	=	108.57	m²

OPF	=	0.88	/	2.55	=	0.35	ECS1	= 0.780
SPF-R	=	0.88	/	1.93	=	0.46	ECS2	= 0.901
ECS	=	0.780	x	0.901				= 0.703

Opaque Wall Areas at East = **1663.16** m²

Breakdown of Opaque Wall Areas

Spandrel Curtain Wall Areas (E-W1) = **320.63** m²

Tiles Wall Areas (E-W2) = **376.69** m²

3/F	5.175	x	3.50	x	1 =	18.11	m²
5/F-16/F	5.175	x	3.50	x	10 =	181.13	m²
18/F-30/F	4.225	x	3.50	x	12 =	177.45	m²

Window to Wall Ratio (WWR) = 1161.95 / 2825.11 = **0.41**

Wall Orientation Factor Gw = 1.072 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at East

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	4%	1
Grey tiles	23%	0.9
Copper color metal	12%	0.4
Uncolored concrete	9%	0.7
Grey tinted glass	26%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.630115522**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

E-W1 Description: Spandrel Curtain Wall Areas

Wall Material					
External surface film resistance			Ro	=	0.044
Air space resistanace			Ra	=	0.156
10mm glass	0.01	/	1.05	=	0.010
2mm aluminium	0.002	/	160	=	0.000013
50mm insulation	0.05	/	0.039	=	1.282
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistance			Ri	=	0.12
Total					1.721

$$Uw1 = \frac{1}{1.721} = 0.58 \text{ W/m}^2\text{K}$$

E-W2 Description: Tiles Wall Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
10mm artificial granite tiles	0.01	/	2.9	=	0.003
20mm cement/ sand render	0.02	/	0.72	=	0.028
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					0.304

$$Uw2 = \frac{1}{0.304} = 3.29 \text{ W/m}^2\text{K}$$

East

Sheet no. 10A

Gross Wall Areas = **2825.11** m²
(Opaque Walls + Glazing Areas) (Ao) at East

Glazing Areas at East = **1161.95** m²

Breakdown of Glazing Areas

Glazing Areas	**SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT)**			(E-F4)	=	**158.33** m²
3/F	(1.774)x	2.55 x 1	=	4.52 m²		
5/F-16/F	(1.774)x	2.55 x 10	=	45.24 m²		
18/F-30/F	(1.774 + 1.774)x	2.55 x 12	=	108.57 m²		
OPF =	0.88 / 2.55 = 0.35	ECS1	=	0.780		
SPF-L =	0.88 / 2.00 = 0.44	ECS2	=	0.986		
ECS =	0.780 x 0.986		=	0.769		

Glazing Areas	**Unshaded**			(E-F5)	=	**333.58** m²
3/F	(0.700 + 0.700)x	0.35 x 1	=	0.49 m²		
3/F	(0.600 + 0.600)x	1.75 x 1	=	2.10 m²		
3/F	(0.928 + 0.875)x	2.50 x 1	=	4.51 m²		
5/F-16/F	(0.700 + 0.700)x	0.35 x 10	=	4.90 m²		
5/F-16/F	(0.600 + 0.600)x	1.75 x 10	=	21.00 m²		
5/F-16/F	(0.928 + 0.875)x	2.50 x 10	=	45.08 m²		
18/F-30/F	(0.700 + 0.700 + 2.80)x	0.35 x 12	=	17.64 m²		
18/F-30/F	(0.600 + 0.600 + 2.40)x	1.75 x 12	=	75.60 m²		
18/F-30/F	(0.928 + 0.875 + 3.606)x	2.50 x 12	=	162.27 m²		

Opaque Wall Areas at East = **1663.16** m²

Breakdown of Opaque Wall Areas

Dark Grey Aluminum Cladding Areas		(E-W3)		=	**40.29** m²
3/F	0.5 x 3.50 x 1 =	1.75	m²		
5/F-16/F	0.5 x 3.50 x 10 =	17.50	m²		
18/F-30/F	0.501 x 3.50 x 12 =	21.04	m²		
Metal for Curtain Wall Areas		(E-W4)		=	**331.76** m²
3/F		12.83	m²		
5/F-16/F		128.31	m²		
18/F-30/F		190.62	m²		

Window to Wall Ratio (WWR) = 1161.95 / 2825.11 = **0.41**

Wall Orientation Factor Gw = 1.072 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at East

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	4%	1
Grey tiles	23%	0.9
Copper color metal	12%	0.4
Uncolored concrete	9%	0.7
Grey tinted glass	26%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.630115522**

'U' value of Opaque Wall Areas

$U = 1/(Ri + x_1/k_1 + x_2/k_2 + \ldots + x_n/k_n + Ra + Ro)$

where
- Ri — Surface film resistance of internal surface (Refer to **Table 2**)
- Ro — Surface film resistance of external surface (Refer to **Table 2**)
- Ra — Air space resistance (Refer to **Table 3**)
- x — Thickness of building materials
- k — Thermal conductivity of building materials (Refer to **Table 1**)

E-W3 Description: Dark Grey Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
3mm aluminum	0.003	/	160	=	0.000019
20mm cement/ sand render	0.02	/	0.72	=	0.028
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**0.301**

$Uw3 = \frac{1}{0.301} = 3.33$ W/m²K

E-W4 Description: Metal for Curtain Wall Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0.16
10mm aluminum	0.01	/	160	=	0.000063
10mm aluminum	0.01	/	160	=	0.000063
Internal surface film resistamce			Ri	=	0.12
Total					**0.324**

$Uw4 = \frac{1}{0.324} = 3.09$ W/m²K

East

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at East = **2825.11** m²

Glazing Areas at East = **1161.95** m²

Opaque Wall Areas at East = **1663.16** m²

Breakdown of Opaque Wall Areas

Black Concrete Areas				(**E-W5**)	=	**66.50**	m²
3/F	0.56	x 3.50	x 1 =	1.96	m²		
5/F-16/F	0.56	x 3.50	x 10 =	19.60	m²		
18/F-30/F	1.07	x 3.50	x 12 =	44.94	m²		
Uncolored Concrete Areas				(**E-W6**)	=	**152.31**	m²
3/F	6.440	x 0.770	x 1 =	4.96	m²		
5/F-16/F	6.440	x 0.770	x 10 =	49.59	m²		
18/F-30/F	10.58	x 0.770	x 12 =	97.76	m²		

Window to Wall Ratio (WWR) = 1161.95 / 2825.11 = **0.41**

Wall Orientation Factor Gw = 1.072 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at East

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	4%	1
Grey tiles	23%	0.9
Copper color metal	12%	0.4
Uncolored concrete	9%	0.7
Grey tinted glass	26%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.630115522**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

E-W5 Description: Black Concrete Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.273**

$Uw5 = \frac{1}{0.273} = 3.66$ W/m²K

E-W6 Description: Uncolored Concrete Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
250mm concrete	0.25 /	2.16	=	0.116
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.319**

$Uw6 = \frac{1}{0.319} = 3.13$ W/m²K

East

Gross Wall Areas
(Opaque Walls + Glazing Areas) (Ao) at East = **2825.11** m²

Glazing Areas at East = **1161.95** m²

Opaque Wall Areas at East = **1663.16** m²

Breakdown of Opaque Wall Areas

Glass Cladding Areas				(**E-W7**)	=	**56.35** m²
3/F	0.7 x	3.50 x	1 =	2.45	m²	
5/F-16/F	0.7 x	3.50 x	10 =	24.50	m²	
18/F-30/F	0.7 x	3.50 x	12 =	29.40	m²	
Copper Color Aluminum Cladding Areas				(**E-W8**)	=	**197.05** m²
3/F	2.5 x	3.50 x	1 =	8.75	m²	
5/F-16/F	2.5 x	3.50 x	10 =	87.50	m²	
18/F-30/F	2.4 x	3.50 x	12 =	100.80	m²	

Window to Wall Ratio (WWR) = 1161.95 / 2825.11 = **0.41**

Wall Orientation Factor Gw = 1.072 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at East

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	4%	1
Grey tiles	23%	0.9
Copper color metal	12%	0.4
Uncolored concrete	9%	0.7
Grey tinted glass	26%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.630115522**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

E-W7 Description: Glass Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
10mm glass	0.01	/ 1.05		=	0.010
2mm aluminium	0.002	/ 160		=	0.000013
50mm insulation	0.05	/ 0.039		=	1.282051
150mm concrete	0.15	/ 2.16		=	0.069
15mm gypsum plaster	0.015	/ 0.38		=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**1.565**

$Uw7 = \frac{1}{1.565} = 0.64$ W/m²K

E-W8 Description: Copper Color Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
3mm aluminum	0.003	/ 160		=	0.000019
20mm cement/ sand render	0.02	/ 0.72		=	0.028
150mm concrete	0.15	/ 2.16		=	0.069
15mm gypsum plaster	0.015	/ 0.38		=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**0.301**

$Uw8 = \frac{1}{0.301} = 3.33$ W/m²K

East

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at East = **2825.11** m²

Glazing Areas at East = **1161.95** m²

Opaque Wall Areas at East = **1663.16** m²

Breakdown of Opaque Wall Areas

Insulation Areas beside Mullions (**E-W9**) = **6.44** m²

3/F	0.08	x 3.50	x 1 =	0.28	m²	
5/F-16/F	0.08	x 3.50	x 10 =	2.80	m²	
18/F-30/F	0.08	x 3.50	x 12 =	3.36	m²	

Hollow Aluminum Cladding Areas (**E-W10**) = **64.12** m²

3/F	0.591	x 3.50	x 1 =	2.07	m²	
5/F-16/F	0.591	x 3.50	x 10 =	20.69	m²	
18/F-30/F	0.985	x 3.50	x 12 =	41.37	m²	

Window to Wall Ratio (WWR) = 1161.95 / 2825.11 = **0.41**

Wall Orientation Factor Gw = 1.072 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at East

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	4%	100%
Grey tiles	23%	90%
Copper color metal	12%	40%
Uncolored concrete	9%	70%
Grey tinted glass	26%	55%
Grey metal	26%	50%
	Average Absorptivity =	**0.630115522**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

E-W9 Description: Insulation Areas beside Mullions

Wall Material				
external surface film			Ro =	0.044
Air space resistanace			Ra =	0
10mm glass	0.01	/ 1.05	=	0.010
2mm aluminium	0.002	/ 160	=	0.000013
160mm insulation	0.16	/ 0.039	=	4.103
2mm aluminium	0.002	/ 160	=	0.000013
Internal surface film resistamce			Ri =	0.12
Total				**4.276**

$Uw9 = \frac{1}{4.276} = 0.23$ W/m²K

E-W10 Description: Hollow Aluminum Cladding Areas

Wall Material				
external surface film			Ro =	0.044
Air space resistanace			Ra =	0.16
3mm aluminum	0.003	/ 160	=	0.000019
25mm insulation	0.025	/ 0.039	=	0.641
3mm aluminum	0.003	/ 160	=	0.000019
Internal surface film resistamce			Ri =	0.12
Total				**0.965**

$Uw10 = \frac{1}{0.965} = 1.04$ W/m²K

East

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at East = **2825.11** m²

Glazing Areas at East = **1161.95** m²

Opaque Wall Areas at East = **1663.16** m²

Breakdown of Opaque Wall Areas

Frame Areas for Openable IGU (**E-W11**) = **51.03** m²

3/F	0.315	x 6	x 1 =	1.89	m²	
5/F-16/F	0.315	x 6	x 10 =	18.90	m²	
18/F-30/F	0.315	x 8	x 12 =	30.24	m²	

Window to Wall Ratio (WWR) = 1161.95 / 2825.11 = **0.41**

Wall Orientation Factor Gw = 1.072 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at East

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	4%	100%
Grey tiles	23%	90%
Copper color metal	12%	40%
Uncolored concrete	9%	70%
Grey tinted glass	26%	55%
Grey metal	26%	50%
	Average Absorptivity =	**0.630115522**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

E-W11 Description: Frame Areas for Openable IGU

Wall Material						
external surface film				Ro	=	0.044
Air space resistanace				Ra	=	0.153
20mm glass	0.02	/	1.05	=		0.019
5mm aluminum	0.005	/	160	=		0.000031
5mm aluminum	0.005	/	160	=		0.000031
Internal surface film resistamce				Ri	=	0.12
Total						**0.336**

$Uw11 = \frac{1}{0.336}$ = **2.98** W/m²K

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No. 11 BD Ref No. _____

Building Address: Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151

Facade Orientation Facing: East Gross Wall Area (Ao) = 2825.11

Window to Wall Ratio (WWR): 0.41 Wall Orientation Factor (Gw) = 1.072

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**E-W1**	**E-W2**	**E-W3**
External Finish Material		10mm glass	10mm artificial granite tiles	3mm aluminum
Conductivity	W/mK	1.05	2.90	160.00
Thickness	m	0.010	0.010	0.003
Average Absorptivity	(α)	0.63	0.63	0.63
Intermediate component		75mm air gap	20mm cement/ sand render	20mm cement/ sand render
Conductivity	W/mK	-	0.72	0.72
Thickness	m	0.075	0.02	0.02
Intermediate component		2mm aluminium	150mm concrete	150mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.002	0.15	0.15
Intermediate component		50mm insulation		
Conductivity	W/mK	0.039		
Thickness	m	0.05		
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.15		
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	0.38	0.38	0.38
Thickness	m	0.02	0.02	0.02
U-value of Opaque Area (Uwi)	W/m^2K	5.50	3.29	3.33
Opaque Wall Area (Awi)	m^2	320.63	376.69	40.29
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**1.51**	**1.06**	**0.11**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **5.21** W/m^2

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**E-F1**	**E-F2**	**E-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.01	0.01
Glazing Area (Afi)	m^2	394.06	117.65	158.33
U-value of Glazing (Ufi)	W/m^2K	1.59	5.67	5.67
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.15**	**0.16**	**0.22**

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **0.88**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**E-F1**	**E-F2**	**E-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.01	0.01
Glazing Area (Afi)	m^2	394.06	117.65	158.33
Shading Coefficient of Glazing (SCf)		0.33	0.66	0.66
Visible Light Transmittance (VLT)	%	52.00	50.00	50.00
External Reflectance (ER)	%	16.00	6.00	6.00
External Shading Multiplier (ESC)		1.00	0.74	0.70
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**2.06**	**0.92**	**1.16**

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.16** W/m^2

Summary of RTTV at East

= 5.21 + 0.88 + 7.16

= **13.24** W/m^2

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	11A	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	East	Gross Wall Area (Ao) =	2825.11
Window to Wall Ratio (WWR)	0.41	Wall Orientation Factor (Gw) =	1.072

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**E-W4**	**E-W5**	**E-W6**
External Finish Material		10mm aluminum	150mm concrete	250mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.010	0.150	0.250
Average Absorptivity	(α)	0.63	0.63	0.63
Intermediate component		100mm air gap		
Conductivity	W/mK	-		
Thickness	m	0.1		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		10mm aluminum	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	160.00	0.38	0.38
Thickness	m	0.01	0.02	0.02
U-value of Opaque Area (Uwi)	W/m^2K	3.09	3.66	3.13
Opaque Wall Area (Awi)	m^2	331.76	66.50	152.31
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.87**	**0.21**	**0.41**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n
= **5.21** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**E-F4**	**E-F5**	
Glazing Type		Tinted Glass	IGU	
Thickness	m	0.01	0.028	
Glazing Area (Afi)	m^2	158.33	333.58	
U-value of Glazing (Ufi)	W/m^2K	5.67	1.59	
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.22**	**0.13**	

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n
= **0.88**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**E-F4**	**E-F5**	
Glazing Type		Tinted Glass	IGU	
Thickness	m	0.01	0.028	
Glazing Area (Afi)	m^2	158.33	333.58	
Shading Coefficient of Glazing (SCf)		0.66	0.33	
Visible Light Transmittance (VLT)	%	50.00	52.00	
External Reflectance (ER)	%	6.00	16.00	
External Shading Multiplier (ESC)		0.77	1.00	
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**1.27**	**1.74**	

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n
= **7.16** **W/m²**

Summary of RTTV at East
= 5.21 + 0.88 + 7.16
= **13.24** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	11B	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	East	Gross Wall Area (Ao) =	2825.11
Window to Wall Ratio (WWR)	0.41	Wall Orientation Factor (Gw) =	1.072

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**E-W7**	**E-W8**	**E-W9**
External Finish Material		10mm glass	3mm aluminum	10mm glass
Conductivity	W/mK	1.05	160.00	1.05
Thickness	m	0.010	0.003	0.010
Average Absorptivity	(α)	0.63	0.63	0.63
Intermediate component		2mm aluminium	20mm cement/ sand render	2mm aluminium
Conductivity	W/mK	160	0.72	160.00
Thickness	m	0.002	0.02	0.002
Intermediate component		50mm insulation	150mm concrete	160mm insulation
Conductivity	W/mK	0.039	2.16	0.039
Thickness	m	0.05	0.15	0.16
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.150		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	2mm aluminium
Conductivity	W/mK	0.38	0.38	160.00
Thickness	m	0.02	0.02	0.002
U-value of Opaque Area (Uwi)	W/m^2K	5.50	3.33	5.50
Opaque Wall Area (Awi)	m^2	56.35	197.05	6.44
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.26**	**0.56**	**0.030**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n
= **5.21** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
U-value of Glazing (Ufi)	W/m^2K			
Heat Conduction = 0.64 (Afi/Ao) Uf Gw				

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n
= **0.88**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
Shading Coefficient of Glazing (SCf)				
Visible Light Transmittance (VLT)	%			
External Reflectance (ER)	%			
External Shading Multiplier (ESC)				
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw				

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n
= **7.16** **W/m²**

Summary of RTTV at East

= 5.21 + 0.88 + 7.16
= **13.24** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No. 11C BD Ref No.

Building Address Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151

Facade Orientation Facing East Gross Wall Area (Ao) = 2825.11

Window to Wall Ratio (WWR) 0.41 Wall Orientation Factor (Gw) = 1.072

Part 1 - Calculation of Heat Conduction through Opaque Walls				
Components / Details		**Code No.**		
Description	**Units**	**E-W10**	**E-W11**	
External Finish Material		3mm aluminum	20mm glass	
Conductivity	W/mK	160.00	1.05	
Thickness	m	0.003	0.020	
Average Absorptivity	(α)	0.63	0.63	
Intermediate component		25mm insulation	5mm aluminum	
Conductivity	W/mK	0.039	160	
Thickness	m	0.025	0.005	
Intermediate component		300mm air gap	50mm air gap	
Conductivity	W/mK	-	-	
Thickness	m	0.3	0.05	
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		3mm aluminum	5mm aluminum	
Conductivity	W/mK	160.00	160.00	
Thickness	m	0.003	0.005	
U-value of Opaque Area (Uwi)	W/m^2K	1.04	2.98	
Opaque Wall Area (Awi)	m^2	64.12	51.03	
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.06**	**0.13**	

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **5.21** W/m^2

Part 2 - Calculation of Heat Conduction through Glazing				
Components / Details		**Code No.**		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
U-value of Glazing (Ufi)	W/m^2K			
Heat Conduction = 0.64 (Afi/Ao) Uf Gw				

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **0.88**

Part 3 - Calculation of Solar Radiation through Glazing				
Components / Details		**Code No.**		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
Shading Coefficient of Glazing (SCf)				
Visible Light Transmittance (VLT)	%			
External Reflectance (ER)	%			
External Shading Multiplier (ESC)				
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw				

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.16** W/m^2

Summary of RTTV at East

= 5.21 + 0.88 + 7.16

= **13.24** W/m^2

South

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at South = **2682.23** m²

Glazing Areas at South = **1285.87** m²

Breakdown of Glazing Areas

Glazing Areas Unshaded (S-F1) = **306.76** m²

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT) (S-F2) = **49.76** m²

3/F	(1.774	)x	2.55	x 1	=	4.52	m²
5/F-16/F	(1.774	)x	2.55	x 10	=	45.24	m²

OPF = 0.88 / 2.55 = 0.35 ECS1 = 0.711
SPF-L = 0.88 / 1.93 = 0.46 ECS2 = 0.885
ECS = 0.711 x 0.885 = 0.629

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT) (S-F3) = **117.65** m²

3/F	(2.006	)x	2.55	x 1	=	5.12	m²
5/F-16/F	(2.006	)x	2.55	x 10	=	51.15	m²
18/F-30/F	(2.006	)x	2.55	x 12	=	61.38	m²

OPF = 0.88 / 2.55 = 0.35 ECS1 = 0.711
SPF-L = 1.22 / 2.16 = 0.56 ECS2 = 0.872
ECS = 0.711 x 0.872 = 0.620

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT) (S-F4) = **52.17** m²

18/F-30/F	(1.705	)x	2.55	x 12	=	52.17	m²

OPF = 0.88 / 2.55 = 0.35 ECS1 = 0.711
SPF-L = 0.50 / 1.905 = 0.26 ECS2 = 0.920
ECS = 0.711 x 0.920 = 0.654

Opaque Wall Areas at South = **1396.36** m²

Breakdown of Opaque Wall Areas

Spandrel Curtain Wall Areas (S-W1) = **277.64** m²

Tiles Wall Areas (S-W2) = **257.39** m²

3/F	3.38	x 3.50	x 1	=	11.83	m²
5/F-16/F	3.38	x 3.50	x 10	=	118.30	m²
18/F-30/F	3.03	x 3.50	x 12	=	127.26	m²

Window to Wall Ratio (WWR) = 1285.87 / 2682.23 = **0.48**

Wall Orientation Factor Gw = 0.975 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at South

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	7%	1
Grey tiles	18%	0.9
Copper color metal	0%	0.4
Uncolored concrete	17%	0.7
Grey tinted glass	24%	0.55
Grey metal	34%	0.5
	Average Absorptivity =	**0.653882586**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

S-W1 Description: Spandrel Curtain Wall Areas

Wall Material				
External surface film resistance		Ro	=	0.044
Air space resistanace		Ra	=	0.156
10mm glass	0.01 /	1.05	=	0.010
2mm aluminium	0.002 /	160	=	0.000013
50mm insulation	0.05 /	0.039	=	1.282
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistance		Ri	=	0.12
Total				**1.721**

$Uw1 = \frac{1}{1.721} = 0.58$ W/m²K

S-W2 Description: Tiles Wall Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
10mm artificial granite tiles	0.01 /	2.9	=	0.003
20mm cement/ sand render	0.02 /	0.72	=	0.028
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.304**

$Uw2 = \frac{1}{0.304} = 3.29$ W/m²K

South

Gross Wall Areas = **2682.23** m²
(Opaque Walls + Glazing Areas) (Ao) at South

Glazing Areas at South = **1285.87** m²

Breakdown of Glazing Areas

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT) (**S-F5**) = **145.19** m²

3/F	(	1.674	+	1.676	)x	2.55	x	1	=	8.54	m²	
5/F-16/F	(	1.674	+	1.676	)x	2.55	x	10	=	85.43	m²	
18/F-30/F	(	1.674			)x	2.55	x	12	=	51.22	m²	
	OPF	=	0.88	/	2.55	=	0.35		ECS1	=	0.711	
	SPF-R	=	0.50	/	1.89	=	0.26		ECS2	=	0.920	
	ECS	=	0.711	x	0.920					=	0.654	

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT) (**S-F6**) = **107.09** m²

3/F	(	1.826			)x	2.55	x	1	=	4.66	m²	
5/F-16/F	(	1.826			)x	2.55	x	10	=	46.56	m²	
18/F-30/F	(	1.826			)x	2.55	x	12	=	55.88	m²	
	OPF	=	0.88	/	2.55	=	0.35		ECS1	=	0.711	
	SPF-R	=	1.98	/	1.98	=	1.00		ECS2	=	0.837	
	ECS	=	0.711	x	0.837					=	0.595	

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT) (**S-F7**) = **117.65** m²

3/F	(	2.006			)x	2.55	x	1	=	5.12	m²	
5/F-16/F	(	2.006			)x	2.55	x	10	=	51.15	m²	
18/F-30/F	(	2.006			)x	2.55	x	12	=	61.38	m²	
	OPF	=	0.88	/	2.55	=	0.35		ECS1	=	0.711	
	SPF-R	=	2.98	/	2.16	=	1.38		ECS2	=	0.820	
	ECS	=	0.711	x	0.820					=	0.583	

Opaque Wall Areas at South = **1396.36** m²

Breakdown of Opaque Wall Areas

Dark Grey Aluminum Cladding Areas (**S-W3**) = **60.38** m²

3/F	0.75	x	3.50	x	1 =	2.63	m²
5/F-16/F	0.75	x	3.50	x	10 =	26.25	m²
18/F-30/F	0.75	x	3.50	x	12 =	31.50	m²

Metal for Curtain Wall Areas (**S-W4**) = **350.36** m²

3/F	15.90	m²
5/F-16/F	158.97	m²
18/F-30/F	175.50	m²

Window to Wall Ratio (WWR) = 1285.87 / 2682.23 = **0.48**

Wall Orientation Factor Gw = 0.975 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at South

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	7%	1
Grey tiles	18%	0.9
Copper color metal	0%	0.4
Uncolored concrete	17%	0.7
Grey tinted glass	24%	0.55
Grey metal	34%	0.5
	Average Absorptivity =	**0.653882586**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

S-W3 Description: Dark Grey Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
3mm aluminum	0.003	/	160	=	0.000019
20mm cement/ sand render	0.02	/	0.72	=	0.028
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					0.301

$Uw3 = \frac{1}{0.301} = 3.33$ W/m²K

S-W4 Description: Metal for Curtain Wall Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0.16
10mm aluminum	0.01	/	160	=	0.000063
10mm aluminum	0.01	/	160	=	0.000063
Internal surface film resistamce			Ri	=	0.12
Total					0.324

$Uw4 = \frac{1}{0.324} = 3.09$ W/m²K

South

Gross Wall Areas = **2682.23** m²
(Opaque Walls + Glazing Areas) (Ao) at South

Glazing Areas at South = **1285.87** m²

Breakdown of Glazing Areas

Glazing Areas	SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT)									(S-F8)	=	**47.69** m²
3/F	(1.700							)x	2.55 x 1	=	4.34 m²	
5/F-16/F	(1.700							)x	2.55 x 10	=	43.35 m²	
	OPF =	0.88	/	2.55	=	0.35		ECS1 =			0.711	
	SPF-R =	0.88	/	1.855	=	0.47		ECS2 =			0.885	
	ECS =	0.711	x	0.885				=			0.629	

Glazing Areas	SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT)									(S-F9)	=	**26.01** m²
18/F-30/F	(0.85							)x	2.55 x 12	=	26.01 m²	
	OPF =	1.20	/	2.55	=	0.47		ECS1 =			0.651	
	SPF-R =	0.34	/	0.95	=	0.36		ECS2 =			0.901	
	ECS =	0.651	x	0.901				=			0.587	

Glazing Areas	Unshaded							(S-F10)	=	**315.89** m²
3/F	(0.700 +	0.700 +	1.400	)x	0.35 x 1	=	0.98 m²			
3/F	(0.600 +	0.600 +	1.200	)x	1.75 x 1	=	4.20 m²			
3/F	(1.210 +	1.210		)x	2.50 x 1	=	6.05 m²			
5/F-16/F	(0.700 +	0.700 +	1.400	)x	0.35 x 10	=	9.80 m²			
5/F-16/F	(0.600 +	0.600 +	1.200	)x	1.75 x 10	=	42.00 m²			
5/F-16/F	(1.210 +	1.210		)x	2.50 x 10	=	60.50 m²			
18/F-30/F	(0.700 +	0.700 +	1.400	)x	0.35 x 12	=	11.76 m²			
18/F-30/F	(0.600 +	0.600 +	1.200	)x	1.75 x 12	=	50.40 m²			
18/F-30/F	(1.210 +	1.210 +	1.920	)x	2.50 x 12	=	130.20 m²			

Opaque Wall Areas at South = **1396.36** m²

Breakdown of Opaque Wall Areas

Black Concrete Areas					(S-W5)	=	**97.27** m²
3/F	1.37 x	3.50 x	1 =	4.80	m²		
5/F-16/F	1.37 x	3.50 x	10 =	47.95	m²		
18/F-30/F	1.06 x	3.50 x	12 =	44.52	m²		

Uncolored Concrete Areas					(S-W6)	=	**232.73** m²
3/F	14.73 x	0.770 x	1 =	11.34	m²		
5/F-16/F	14.73 x	0.770 x	10 =	113.42	m²		
18/F-30/F	11.69 x	0.770 x	12 =	107.97	m²		

Window to Wall Ratio (WWR) = 1285.87 / 2682.23 = **0.48**

Wall Orientation Factor Gw = 0.975 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at South

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	7%	1
Grey tiles	18%	0.9
Copper color metal	0%	0.4
Uncolored concrete	17%	0.7
Grey tinted glass	24%	0.55
Grey metal	34%	0.5
	Average Absorptivity =	**0.653882586**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

S-W5 Description: Black Concrete Areas

Wall Material					
external surface film			Ro =	0.044	
Air space resistanace			Ra =	0	
150mm concrete	0.15	/ 2.16	=	0.069	
15mm gypsum plaster	0.015	/ 0.38	=	0.039	
Internal surface film resistamce			Ri =	0.12	
Total				**0.273**	

$Uw5 = \frac{1}{0.273} = 3.66$ W/m²K

S-W6 Description: Uncolored Concrete Areas

Wall Material					
external surface film			Ro =	0.044	
Air space resistanace			Ra =	0	
250mm concrete	0.25	/ 2.16	=	0.116	
15mm gypsum plaster	0.015	/ 0.38	=	0.039	
Internal surface film resistamce			Ri =	0.12	
Total				**0.319**	

$Uw6 = \frac{1}{0.319} = 3.13$ W/m²K

South

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at South = **2682.23** m²

Glazing Areas at South = **1285.87** m²

Opaque Wall Areas at South = **1396.36** m²

Breakdown of Opaque Wall Areas

Glass Cladding Areas				(	**S-W7**	)	= **0.00** m²
3/F	0	x 3.50	x 1	=	0.00	m²	
5/F-16/F	0	x 3.50	x 10	=	0.00	m²	
18/F-30/F	0	x 3.50	x 12	=	0.00	m²	
Copper Color Aluminum Cladding Areas				(	**S-W8**	)	= **0.00** m²
3/F	0	x 3.50	x 1	=	0.00	m²	
5/F-16/F	0	x 3.50	x 10	=	0.00	m²	
18/F-30/F	0	x 3.50	x 12	=	0.00	m²	

Window to Wall Ratio (WWR) = 1285.87 / 2682.23 = **0.48**

Wall Orientation Factor Gw = 0.975 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at South

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	7%	1
Grey tiles	18%	0.9
Copper color metal	0%	0.4
Uncolored concrete	17%	0.7
Grey tinted glass	24%	0.55
Grey metal	34%	0.5
	Average Absorptivity =	**0.653882586**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri — Surface film resistance of internal surface (Refer to **Table 2**)
Ro — Surface film resistance of external surface (Refer to **Table 2**)
Ra — Air space resistance (Refer to **Table 3**)
x — Thickness of building materials
k — Thermal conductivity of building materials (Refer to **Table 1**)

S-W7 Description: Glass Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
10mm glass	0.01	/	1.05	=	0.010
2mm aluminium	0.002	/	160	=	0.000013
50mm insulation	0.05	/	0.039	=	1.282051
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**1.565**

$Uw7 = \frac{1}{1.565}$ = **0.64** W/m²K

S-W8 Description: Copper Color Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
3mm aluminum	0.003	/	160	=	0.000019
20mm cement/ sand render	0.02	/	0.72	=	0.028
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**0.301**

$Uw8 = \frac{1}{0.301}$ = **3.33** W/m²K

South

Gross Wall Areas = **2682.23** m²
(Opaque Walls + Glazing Areas) (Ao) at South

Glazing Areas at South = **1285.87** m²

Opaque Wall Areas at South = **1396.36** m²

Breakdown of Opaque Wall Areas

Insulation Areas beside Mullions				(**S-W9**)	=	**6.44**	m²
3/F	0.08	x	3.50	x 1 =	0.28	m²	
5/F-16/F	0.08	x	3.50	x 10 =	2.80	m²	
18/F-30/F	0.08	x	3.50	x 12 =	3.36	m²	
Hollow Aluminum Cladding Areas				(**S-W10**)	=	**63.43**	m²
3/F	0.788	x	3.50	x 1 =	2.76	m²	
5/F-16/F	0.788	x	3.50	x 10 =	27.58	m²	
18/F-30/F	0.788	x	3.50	x 12 =	33.10	m²	

Window to Wall Ratio (WWR) = 1285.87 / 2682.23 = **0.48**

Wall Orientation Factor Gw = 0.975 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at South

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	7%	1
Grey tiles	18%	0.9
Copper color metal	0%	0.4
Uncolored concrete	17%	0.7
Grey tinted glass	24%	0.55
Grey metal	34%	0.5
	Average Absorptivity =	**0.653882586**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri — Surface film resistance of internal surface (Refer to **Table 2**)
Ro — Surface film resistance of external surface (Refer to **Table 2**)
Ra — Air space resistance (Refer to **Table 3**)
x — Thickness of building materials
k — Thermal conductivity of building materials (Refer to **Table 1**)

S-W9 Description: Insulation Areas beside Mullions

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
10mm glass	0.01	/	1.05	=	0.010
2mm aluminium	0.002	/	160	=	0.000013
160mm insulation	0.16	/	0.039	=	4.103
2mm aluminium	0.002	/	160	=	0.000013
Internal surface film resistamce			Ri	=	0.12
Total					**4.276**

$Uw9 = \frac{1}{4.276}$ = **0.23** W/m²K

S-W10 Description: Hollow Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0.16
3mm aluminum	0.003	/	160	=	0.000019
25mm insulation	0.025	/	0.039	=	0.641
3mm aluminum	0.003	/	160	=	0.000019
Internal surface film resistamce			Ri	=	0.12
Total					**0.965**

$Uw10 = \frac{1}{0.965}$ = **1.04** W/m²K

South

Gross Wall Areas
(Opaque Walls + Glazing Areas) (Ao) at South = **2682.23** m²

Glazing Areas at South = **1285.87** m²

Opaque Wall Areas at South = **1396.36** m²

Breakdown of Opaque Wall Areas

Frame Areas for Openable IGU					(S-W11)		= **50.72** m²
3/F	0.315	x 7	x 1	=	2.21	m²	
5/F-16/F	0.315	x 7	x 10	=	22.05	m²	
18/F-30/F	0.315	x 7	x 12	=	26.46	m²	

Window to Wall Ratio (WWR) = 1285.87 / 2682.23 = **0.48**

Wall Orientation Factor Gw = 0.975 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at South

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	7%	1
Grey tiles	18%	0.9
Copper color metal	0%	0.4
Uncolored concrete	17%	0.7
Grey tinted glass	24%	0.55
Grey metal	34%	0.5

Average Absorptivity = 0.653882586

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

S-W11 Description: Frame Areas for Openable IGU

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0.153
20mm glass	0.02	/ 1.05		=	0.019
5mm aluminum	0.005	/ 160		=	0.000031
5mm aluminum	0.005	/ 160		=	0.000031
Internal surface film resistamce			Ri	=	0.12
Total					**0.336**

$Uw11 = \frac{1}{0.336} = 2.98$ W/m²K

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	13	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	South	Gross Wall Area (Ao) =	2682.23
Window to Wall Ratio (WWR)	0.48	Wall Orientation Factor (Gw) =	0.975

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**S-W1**	**S-W2**	**S-W3**
External Finish Material		10mm glass	10mm artificial granite tiles	3mm aluminum
Conductivity	W/mK	1.05	2.90	160.00
Thickness	m	0.010	0.010	0.003
Average Absorptivity	(α)	0.65	0.65	0.65
Intermediate component		75mm air gap	20mm cement/ sand render	20mm cement/ sand render
Conductivity	W/mK	-	0.72	0.72
Thickness	m	0.075	0.02	0.02
Intermediate component		2mm aluminium	150mm concrete	150mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.002	0.15	0.15
Intermediate component		50mm insulation		
Conductivity	W/mK	0.039		
Thickness	m	0.05		
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.15		
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	0.38	0.38	0.38
Thickness	m	0.02	0.02	0.02
U-value of Opaque Area (Uwi)	W/m^2K	5.50	3.29	3.33
Opaque Wall Area (Awi)	m^2	277.64	257.39	60.38
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**1.30**	**0.72**	**0.17**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **4.24** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F1**	**S-F2**	**S-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.01	0.01
Glazing Area (Afi)	m^2	306.76	49.76	117.65
U-value of Glazing (Ufi)	W/m^2K	1.59	5.67	5.67
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.11**	**0.07**	**0.16**

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.11** **W/m²**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F1**	**S-F2**	**S-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.010	0.010
Glazing Area (Afi)	m^2	306.76	49.76	117.65
Shading Coefficient of Glazing (SCf)		0.33	0.66	0.66
Visible Light Transmittance (VLT)	%	52.00	50.00	50.00
External Reflectance (ER)	%	16.00	6.00	6.00
External Shading Multiplier (ESC)		1.00	0.63	0.62
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**1.54**	**0.31**	**0.73**

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.23** **W/m²**

Summary of RTTV at South

= 4.24 + 1.11 + 7.23

= **12.58** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No. 13A BD Ref No.

Building Address Proposed Composite Building Development at 63 Ma Tau Wai Road,
Kowloon - K.I.L. 1151

Facade Orientation Facing South Gross Wall Area (Ao) = 2682.23

Window to Wall Ratio (WWR) 0.48 Wall Orientation Factor (Gw) = 0.975

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**S-W4**	**S-W5**	**S-W6**
External Finish Material		10mm aluminum	150mm concrete	250mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.010	0.150	0.250
Average Absorptivity	(α)	0.65	0.65	0.65
Intermediate component		100mm air gap		
Conductivity	W/mK	-		
Thickness	m	0.1		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		10mm aluminum	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	160.00	0.38	0.38
Thickness	m	0.01	0.02	0.02
U-value of Opaque Area (Uwi)	W/m^2K	3.09	3.66	3.13
Opaque Wall Area (Awi)	m^2	350.36	97.27	232.73
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.92**	**0.30**	**0.62**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **4.24** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F4**	**S-F5**	**S-F6**
Glazing Type		Tinted Glass	Tinted Glass	Tinted Glass
Thickness	m	0.01	0.01	0.01
Glazing Area (Afi)	m^2	52.17	145.19	107.09
U-value of Glazing (Ufi)	W/m^2K	5.67	5.67	5.67
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.07**	**0.19**	**0.14**

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.11** **W/m²**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F4**	**S-F5**	**S-F6**
Glazing Type		Tinted Glass	Tinted Glass	Tinted Glass
Thickness	m	0.010	0.010	0.010
Glazing Area (Afi)	m^2	52.17	145.19	107.09
Shading Coefficient of Glazing (SCf)		0.66	0.66	0.66
Visible Light Transmittance (VLT)	%	50.00	50.00	50.00
External Reflectance (ER)	%	6.00	6.00	6.00
External Shading Multiplier (ESC)		0.65	0.65	0.60
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**0.34**	**0.95**	**0.64**

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.23** **W/m²**

Summary of RTTV at South

= 4.24 + 1.11 + 7.23

= **12.58** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No. 13B BD Ref No.

Building Address Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151

Facade Orientation Facing South Gross Wall Area (Ao) = 2682.23

Window to Wall Ratio (WWR) 0.48 Wall Orientation Factor (Gw) = 0.975

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**S-W7**	**S-W8**	**S-W9**
External Finish Material		10mm glass	3mm aluminum	10mm glass
Conductivity	W/mK	1.05	160.00	1.05
Thickness	m	0.010	0.003	0.010
Average Absorptivity	(α)	0.65	0.65	0.65
Intermediate component		2mm aluminium	20mm cement/ sand render	2mm aluminium
Conductivity	W/mK	160	0.72	160.00
Thickness	m	0.002	0.02	0.002
Intermediate component		50mm insulation	150mm concrete	160mm insulation
Conductivity	W/mK	0.039	2.16	0.039
Thickness	m	0.05	0.15	0.16
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.15		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	2mm aluminium
Conductivity	W/mK	0.38	0.38	160.00
Thickness	m	0.02	0.02	0.002
U-value of Opaque Area (Uwi)	W/m^2K	5.50	3.33	5.50
Opaque Wall Area (Awi)	m^2	0.00	0.00	6.44
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.00**	**0.00**	**0.030**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **4.24** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F7**	**S-F8**	**S-F9**
Glazing Type		Tinted Glass	Tinted Glass	Tinted Glass
Thickness	m	0.01	0.01	0.01
Glazing Area (Afi)	m^2	117.65	47.69	26.01
U-value of Glazing (Ufi)	W/m^2K	5.67	5.67	5.67
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.16**	**0.06**	**0.03**

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.11** **W/m²**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F7**	**S-F8**	**S-F9**
Glazing Type		Tinted Glass	Tinted Glass	Tinted Glass
Thickness	m	0.010	0.010	0.010
Glazing Area (Afi)	m^2	117.65	47.69	26.01
Shading Coefficient of Glazing (SCf)		0.66	0.66	0.66
Visible Light Transmittance (VLT)	%	50.00	50.00	50.00
External Reflectance (ER)	%	6.00	6.00	6.00
External Shading Multiplier (ESC)		0.58	0.63	0.59
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**0.69**	**0.30**	**0.15**

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.23** **W/m²**

Summary of RTTV at South

= 4.24 + 1.11 + 7.23

= **12.58** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	13C	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	South	Gross Wall Area (Ao) =	2682.23
Window to Wall Ratio (WWR)	0.48	Wall Orientation Factor (Gw) =	0.975

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**S-W10**	**S-W11**	
External Finish Material		3mm aluminum	20mm glass	
Conductivity	W/mK	160.00	1.05	
Thickness	m	0.003	0.020	
Average Absorptivity	(α)	0.65	0.65	
Intermediate component		25mm insulation	5mm aluminum	
Conductivity	W/mK	0.039	160	
Thickness	m	0.025	0.005	
Intermediate component		300mm air gap	50mm air gap	
Conductivity	W/mK	-	-	
Thickness	m	0.3	0.05	
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		3mm aluminum	5mm aluminum	
Conductivity	W/mK	160.00	160.00	
Thickness	m	0.003	0.005	
U-value of Opaque Area (Uwi)	W/m^2K	1.04	2.98	
Opaque Wall Area (Awi)	m^2	63.43	50.72	
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.06**	**0.13**	

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **4.24** W/m^2

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F10**		
Glazing Type		IGU		
Thickness	m	0.028		
Glazing Area (Afi)	m^2	315.89		
U-value of Glazing (Ufi)	W/m^2K	1.59		
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.12**		

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.11** W/m^2

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**S-F10**		
Glazing Type		IGU		
Thickness	m	0.028		
Glazing Area (Afi)	m^2	315.89		
Shading Coefficient of Glazing (SCf)		0.33		
Visible Light Transmittance (VLT)	%	52.00		
External Reflectance (ER)	%	16.00		
External Shading Multiplier (ESC)		1.00		
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**1.58**		

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.23** W/m^2

Summary of RTTV at South

= 4.24 + 1.11 + 7.23

= **12.58** W/m^2

West

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at West = **2934.05** m²

Glazing Areas at West = **1180.82** m²

Breakdown of Glazing Areas

Glazing Areas Unshaded (**W-F1**) = **201.94** m²

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON RIGHT) (**W-F2**) = **307.91** m²

3/F	(	1.77 +	1.776 +	1.700)x	2.55	x 1	=	13.39	m²	
5/F-16/F	(	1.77 +	1.776 +	1.700)x	2.55	x 10	=	133.88	m²	
18/F-30/F	(	1.77 +	1.776 +	1.700)x	2.55	x 12	=	160.65	m²	
	OPF	=	0.88 /	2.55	=	0.35	**ECS1**	=	0.780	
	SPF-R	=	0.88 /	1.93	=	0.46	**ECS2**	=	0.985	
	ECS	=	0.780	x	0.985			=	0.768	

Glazing Areas SHADED BY BALCONY & BUILD-FIN (PROJECTION ON LEFT) (**W-F3**) = **307.80** m²

3/F	(	1.77 +	1.700 +	1.774)x	2.55	x 1	=	13.38	m²	
5/F-16/F	(	1.77 +	1.700 +	1.774)x	2.55	x 10	=	133.82	m²	
18/F-30/F	(	1.77 +	1.700 +	1.774)x	2.55	x 12	=	160.59	m²	
	OPF	=	0.88 /	2.55	=	0.35	**ECS1**	=	0.780	
	SPF-L	=	0.88 /	1.93	=	0.46	**ECS2**	=	0.901	
	ECS	=	0.780	x	0.901			=	0.703	

Opaque Wall Areas at West = **1753.23** m²

Breakdown of Opaque Wall Areas

Spandrel Curtain Wall Areas (**W-W1**) = **255.47** m²

Tiles Wall Areas (**W-W2**) = **559.30** m²

3/F	5.5	x	3.50	x	1 =	19.25	m²
5/F-16/F	5.5	x	3.50	x	10 =	192.50	m²
18/F-30/F	8.275	x	3.50	x	12 =	347.55	m²

Window to Wall Ratio (WWR) = 1180.82 / 2934.05 = **0.40**

Wall Orientation Factor Gw = 1.131 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at West

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	8%	1
Grey tiles	32%	0.9
Copper color metal	0%	0.4
Uncolored concrete	12%	0.7
Grey tinted glass	21%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.705111821**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+...+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

W-W1 Description: Spandrel Curtain Wall Areas

Wall Material				
External surface film resistance		Ro	=	0.044
Air space resistanace		Ra	=	0.156
10mm glass	0.01 /	1.05	=	0.010
2mm aluminium	0.002 /	160	=	0.000013
50mm insulation	0.05 /	0.039	=	1.282
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistance		Ri	=	0.12
Total				**1.721**

$Uw1 = \frac{1}{1.721} = 0.58$ W/m²K

W-W2 Description: Tiles Wall Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
10mm artificial granite tiles	0.01 /	2.9	=	0.003
20mm cement/ sand render	0.02 /	0.72	=	0.028
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.304**

$Uw2 = \frac{1}{0.304} = 3.29$ W/m²K

West

Gross Wall Areas = **2934.05** m²
(Opaque Walls + Glazing Areas) (Ao) at West

Glazing Areas at West = **1180.82** m²

Breakdown of Glazing Areas

Glazing Areas	**Unshaded**											
										(	**W-F4**	)
3/F	(	0.700	+	0.700	+	2.100	)x	0.35	x 1	=	1.23	m²
3/F	(	0.600	+	0.600	+	1.800	)x	1.75	x 1	=	5.25	m²
3/F	(	0.875	+	0.928	+	1.923	)x	2.50	x 1	=	9.32	m²
5/F-16/F	(	0.700	+	0.700	+	2.100	)x	0.35	x 10	=	12.25	m²
5/F-16/F	(	0.600	+	0.600	+	1.800	)x	1.75	x 10	=	52.50	m²
5/F-16/F	(	0.875	+	0.928	+	1.923	)x	2.50	x 10	=	93.15	m²
18/F-30/F	(	0.700	+	0.700	+	2.100	)x	0.35	x 12	=	14.70	m²
18/F-30/F	(	0.600	+	0.600	+	1.800	)x	1.75	x 12	=	63.00	m²
18/F-30/F	(	0.875	+	0.928	+	1.923	)x	2.50	x 12	=	111.78	m²

Opaque Wall Areas at West = **1753.23** m²

Breakdown of Opaque Wall Areas

Dark Grey Aluminum Cladding Areas (**W-W3**) = **60.38** m²

3/F	0.75	x	3.50	x	1 =	2.63	m²
5/F-16/F	0.75	x	3.50	x	10 =	26.25	m²
18/F-30/F	0.75	x	3.50	x	12 =	31.50	m²

Metal for Curtain Wall Areas (**W-W4**) = **330.09** m²

3/F	14.35	m²
5/F-16/F	143.52	m²
18/F-30/F	172.22	m²

Window to Wall Ratio (WWR) = 1180.82 / 2934.05 = **0.40**

Wall Orientation Factor Gw = 1.131 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at West

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	8%	1
Grey tiles	32%	0.9
Copper color metal	0%	0.4
Uncolored concrete	12%	0.7
Grey tinted glass	21%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.705111821**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

W-W3 Description: Dark Grey Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
3mm aluminum	0.003	/	160	=	0.000019
20mm cement/ sand render	0.02	/	0.72	=	0.028
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**0.301**

$Uw3 = \frac{1}{0.301}$ = **3.33** W/m²K

W-W4 Description: Metal for Curtain Wall Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0.16
10mm aluminum	0.01	/	160	=	0.000063
10mm aluminum	0.01	/	160	=	0.000063
Internal surface film resistamce			Ri	=	0.12
Total					**0.324**

$Uw4 = \frac{1}{0.324}$ = **3.09** W/m²K

West

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at West = **2934.05** m²

Glazing Areas at West = **1180.82** m²

Opaque Wall Areas at West = **1753.23** m²

Breakdown of Opaque Wall Areas

Black Concrete Areas (**W-W5**) = **147.32** m²

3/F	1.83	x 3.50	x 1 =	6.41	m²	
5/F-16/F	1.83	x 3.50	x 10 =	64.05	m²	
18/F-30/F	1.83	x 3.50	x 12 =	76.86	m²	

Uncolored Concrete Areas (**W-W6**) = **217.30** m²

3/F	12.27	x 0.770	x 1 =	9.45	m²	
5/F-16/F	12.27	x 0.770	x 10 =	94.48	m²	
18/F-30/F	12.27	x 0.770	x 12 =	113.37	m²	

Window to Wall Ratio (WWR) = 1180.82 / 2934.05 = **0.40**

Wall Orientation Factor Gw = 1.131 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at West

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	8%	1
Grey tiles	32%	0.9
Copper color metal	0%	0.4
Uncolored concrete	12%	0.7
Grey tinted glass	21%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.705111821**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

W-W5 Description: Black Concrete Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
150mm concrete	0.15 /	2.16	=	0.069
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.273**

Uw5 = $\frac{1}{0.273}$ = **3.66** W/m²K

W-W6 Description: Uncolored Concrete Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
250mm concrete	0.25 /	2.16	=	0.116
15mm gypsum plaster	0.015 /	0.38	=	0.039
Internal surface film resistamce		Ri	=	0.12
Total				**0.319**

Uw6 = $\frac{1}{0.319}$ = **3.13** W/m²K

West

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at West = **2934.05** m²

Glazing Areas at West = **1180.82** m²

Opaque Wall Areas at West = **1753.23** m²

Breakdown of Opaque Wall Areas

Glass Cladding Areas					(	**W-W7**	)	= **56.35** m²
3/F	0.7	x	3.50	x	1 =	2.45	m²	
5/F-16/F	0.7	x	3.50	x	10 =	24.50	m²	
18/F-30/F	0.7	x	3.50	x	12 =	29.40	m²	
Copper Color Aluminum Cladding Areas					(	**W-W8**	)	= **0.00** m²
3/F	0	x	3.50	x	1 =	0.00	m²	
5/F-16/F	0	x	3.50	x	10 =	0.00	m²	
18/F-30/F	0	x	3.50	x	12 =	0.00	m²	

Window to Wall Ratio (WWR) = 1180.82 / 2934.05 = **0.40**

Wall Orientation Factor Gw = 1.131 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at West

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	8%	1
Grey tiles	32%	0.9
Copper color metal	0%	0.4
Uncolored concrete	12%	0.7
Grey tinted glass	21%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.705111821**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+...+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

W-W7 Description: Glass Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
10mm glass	0.01	/	1.05	=	0.010
2mm aluminium	0.002	/	160	=	0.000013
50mm insulation	0.05	/	0.039	=	1.282
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**1.565**

$Uw7 = \frac{1}{1.565}$ = **0.64** W/m²K

W-W8 Description: Copper Color Aluminum Cladding Areas

Wall Material					
external surface film			Ro	=	0.044
Air space resistanace			Ra	=	0
3mm aluminum	0.003	/	160	=	0.000019
20mm cement/ sand render	0.02	/	0.72	=	0.028
150mm concrete	0.15	/	2.16	=	0.069
15mm gypsum plaster	0.015	/	0.38	=	0.039
Internal surface film resistamce			Ri	=	0.12
Total					**0.301**

$Uw8 = \frac{1}{0.301}$ = **3.33** W/m²K

West

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at West = **2934.05** m²

Glazing Areas at West = **1180.82** m²

Opaque Wall Areas at West = **1753.23** m²

Breakdown of Opaque Wall Areas

Insulation Areas beside Mullions (**W-W9**) = **12.88** m²

3/F	0.16	x 3.50	x 1 =	0.56	m²	
5/F-16/F	0.16	x 3.50	x 10 =	5.60	m²	
18/F-30/F	0.16	x 3.50	x 12 =	6.72	m²	

Hollow Aluminum Cladding Areas (**W-W10**) = **63.43** m²

3/F	0.788	x 3.50	x 1 =	2.76	m²	
5/F-16/F	0.788	x 3.50	x 10 =	27.58	m²	
18/F-30/F	0.788	x 3.50	x 12 =	33.10	m²	

Window to Wall Ratio (WWR) = 1180.82 / 2934.05 = **0.40**

Wall Orientation Factor Gw = 1.131 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at West

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	8%	1
Grey tiles	32%	0.9
Copper color metal	0%	0.4
Uncolored concrete	12%	0.7
Grey tinted glass	21%	0.55
Grey metal	26%	0.5
	Average Absorptivity =	**0.705111821**

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

W-W9 Description: Insulation Areas beside Mullions

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0
10mm glass	0.01 /	1.05	=	0.010
2mm aluminium	0.002 /	160	=	0.000013
160mm insulation	0.16 /	0.039	=	4.103
2mm aluminium	0.002 /	160	=	0.000013
Internal surface film resistamce		Ri	=	0.12
Total				**4.276**

$Uw9 = \frac{1}{4.276} = 0.23$ W/m²K

W-W10 Description: Hollow Aluminum Cladding Areas

Wall Material				
external surface film		Ro	=	0.044
Air space resistanace		Ra	=	0.16
3mm aluminum	0.003 /	160	=	0.000019
25mm insulation	0.025 /	0.039	=	0.641
3mm aluminum	0.003 /	160	=	0.000019
Internal surface film resistamce		Ri	=	0.12
Total				**0.965**

$Uw10 = \frac{1}{0.965} = 1.04$ W/m²K

West

Gross Wall Areas (Opaque Walls + Glazing Areas) (Ao) at West = **2934.05** m²

Glazing Areas at West = **1180.82** m²

Opaque Wall Areas at West = **1753.23** m²

Breakdown of Opaque Wall Areas

Frame Areas for Openable IGU (**W-W11**) = **50.72** m²

3/F	0.315	x 7	x 1 =	2.21	m²	
5/F-16/F	0.315	x 7	x 10 =	22.05	m²	
18/F-30/F	0.315	x 7	x 12 =	26.46	m²	

Window to Wall Ratio (WWR) = 1180.82 / 2934.05 = **0.40**

Wall Orientation Factor Gw = 1.131 (Refer to **Table 9**)

Average Absorptivity (α) of the External Opaque Wall at West

External Wall Material (Colour/Finish)	% of wall area	α Absorptivity
Black concrete	8%	1
Grey tiles	32%	0.9
Copper color metal	0%	0.4
Uncolored concrete	12%	0.7
Grey tinted glass	21%	0.55
Grey metal	26%	0.5

Average Absorptivity = 0.705111821

'U' value of Opaque Wall Areas

$U = 1/(Ri+x_1/k_1+x_2/k_2+\ldots+x_n/k_n+Ra+Ro)$

where Ri Surface film resistance of internal surface (Refer to **Table 2**)
Ro Surface film resistance of external surface (Refer to **Table 2**)
Ra Air space resistance (Refer to **Table 3**)
x Thickness of building materials
k Thermal conductivity of building materials (Refer to **Table 1**)

W-W11 Description: Frame Areas for Openable IGU

Wall Material				
external surface film			Ro =	0.044
Air space resistanace			Ra =	0.153
20mm glass	0.02	/ 1.05	=	0.019
5mm aluminum	0.005	/ 160	=	0.000031
5mm aluminum	0.005	/ 160	=	0.000
Internal surface film resistamce			Ri =	0.12
Total				**0.336**

$Uw11 = \frac{1}{0.336} = 2.98$ W/m²K

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	15	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	West	Gross Wall Area (Ao) =	2934.05
Window to Wall Ratio (WWR)	0.40	Wall Orientation Factor (Gw) =	1.131

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**W-W1**	**W-W2**	**W-W3**
External Finish Material		10mm glass	10mm artificial granite tiles	3mm aluminum
Conductivity	W/mK	1.05	2.90	160.00
Thickness	m	0.010	0.010	0.003
Average Absorptivity	(α)	0.71	0.71	0.71
Intermediate component		75mm air gap	20mm cement/ sand render	20mm cement/ sand render
Conductivity	W/mK	-	0.72	0.72
Thickness	m	0.075	0.020	0.020
Intermediate component		2mm aluminium	150mm concrete	150mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.002	0.15	0.15
Intermediate component		50mm insulation		
Conductivity	W/mK	0.039		
Thickness	m	0.05		
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.15		
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	0.38	0.38	0.38
Thickness	m	0.02	0.02	0.02
U-value of Opaque Area (Uwi)	W/m^2K	5.50	3.29	3.33
Opaque Wall Area (Awi)	m^2	255.47	559.30	60.38
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**1.36**	**1.78**	**0.19**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **6.03** W/m^2

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**W-F1**	**W-F2**	**W-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.01	0.01
Glazing Area (Afi)	m^2	201.94	307.91	307.80
U-value of Glazing (Ufi)	W/m^2K	1.59	5.67	5.67
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.08**	**0.43**	**0.43**

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.08** W/m^2

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**W-F1**	**W-F2**	**W-F3**
Glazing Type		IGU	Tinted Glass	Tinted Glass
Thickness	m	0.028	0.01	0.01
Glazing Area (Afi)	m^2	201.94	307.91	307.80
Shading Coefficient of Glazing (SCf)		0.33	0.66	0.66
Visible Light Transmittance (VLT)	%	52.00	50.00	50.00
External Reflectance (ER)	%	16.00	6.00	6.00
External Shading Multiplier (ESC)		1.00	0.77	0.70
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**1.07**	**2.51**	**2.30**

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.81** W/m^2

Summary of RTTV at West

= 6.03 + 1.08 + 7.81

= **14.92** W/m^2

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	15A	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road,		
	Kowloon - K.I.L. 1151		
Facade Orientation Facing	West	Gross Wall Area (Ao) =	2934.05
Window to Wall Ratio (WWR)	0.40	Wall Orientation Factor (Gw) =	1.131

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**W-W4**	**W-W5**	**W-W6**
External Finish Material		10mm aluminum	150mm concrete	250mm concrete
Conductivity	W/mK	160.00	2.16	2.16
Thickness	m	0.010	0.150	0.250
Average Absorptivity	(α)	0.71	0.71	0.71
Intermediate component		100mm air gap		
Conductivity	W/mK	-		
Thickness	m	0.1		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		10mm aluminum	15mm gypsum plaster	15mm gypsum plaster
Conductivity	W/mK	160.00	0.38	0.38
Thickness	m	0.01	0.02	0.02
U-value of Opaque Area (Uwi)	W/m^2K	3.09	3.66	3.13
Opaque Wall Area (Awi)	m^2	330.09	147.32	217.30
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.99**	**0.52**	**0.66**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **6.03** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**	**W-F4**		
Glazing Type		IGU		
Thickness	m	0.028		
Glazing Area (Afi)	m^2	363.17		
U-value of Glazing (Ufi)	W/m^2K	1.59		
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		**0.14**		

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.08** **W/m²**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**	**W-F4**		
Glazing Type		IGU		
Thickness	m	0.028		
Glazing Area (Afi)	m^2	363.17		
Shading Coefficient of Glazing (SCf)		0.33		
Visible Light Transmittance (VLT)	%	52.00		
External Reflectance (ER)	%	16.00		
External Shading Multiplier (ESC)		1.00		
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		**1.93**		

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.81** **W/m²**

Summary of RTTV at West

= 6.03 + 1.08 + 7.81

= **14.92** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	15B	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road,		
	Kowloon - K.I.L. 1151		
Facade Orientation Facing	West	Gross Wall Area (Ao) =	2934.05
Window to Wall Ratio (WWR)	0.40	Wall Orientation Factor (Gw) =	1.131

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**W-W7**	**W-W8**	**W-W9**
External Finish Material		10mm glass	3mm aluminum	10mm glass
Conductivity	W/mK	1.05	160.00	1.05
Thickness	m	0.010	0.003	0.010
Average Absorptivity	(α)	0.71	0.71	0.71
Intermediate component		2mm aluminium	20mm cement/ sand render	2mm aluminium
Conductivity	W/mK	160	0.72	160.00
Thickness	m	0.002	0.020	0.002
Intermediate component		50mm insulation	150mm concrete	160mm insulation
Conductivity	W/mK	0.039	2.16	0.039
Thickness	m	0.05	0.15	0.16
Intermediate component		150mm concrete		
Conductivity	W/mK	2.16		
Thickness	m	0.150		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		15mm gypsum plaster	15mm gypsum plaster	2mm aluminium
Conductivity	W/mK	0.38	0.38	160.00
Thickness	m	0.02	0.02	0.002
U-value of Opaque Area (Uwi)	W/m^2K	5.50	3.33	0.23
Opaque Wall Area (Awi)	m^2	56.35	0.00	12.88
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.30**	**0.00**	**0.003**

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **6.03** **W/m²**

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
U-value of Glazing (Ufi)	W/m^2K			
Heat Conduction = 0.64 (Afi/Ao) Uf Gw				

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.08** **W/m²**

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
Shading Coefficient of Glazing (SCf)				
Visible Light Transmittance (VLT)	%			
External Reflectance (ER)	%			
External Shading Multiplier (ESC)				
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw				

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.81** **W/m²**

Summary of RTTV at West

= 6.03 + 1.08 + 7.81

= **14.92** **W/m²**

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 1 - Calculation of $RTTV_{wall}$ of Each Facade

Sheet No.	15C	BD Ref No.	
Building Address	Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151		
Facade Orientation Facing	West	Gross Wall Area (Ao) =	2934.05
Window to Wall Ratio (WWR)	0.40	Wall Orientation Factor (Gw) =	1.131

Part 1 - Calculation of Heat Conduction through Opaque Walls

Components / Details		Code No.		
Description	**Units**	**W-W10**	**W-W11**	
External Finish Material		3mm aluminum	20mm glass	
Conductivity	W/mK	160.00	1.05	
Thickness	m	0.003	0.020	
Average Absorptivity	(α)	0.71	0.71	
Intermediate component		25mm insulation	5mm aluminum	
Conductivity	W/mK	0.039	160	
Thickness	m	0.025	0.005	
Intermediate component		300mm air gap	50mm air gap	
Conductivity	W/mK	-	-	
Thickness	m	0.3	0.05	
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		3mm aluminum	5mm aluminum	
Conductivity	W/mK	160.00	160.00	
Thickness	m	0.003	0.005	
U-value of Opaque Area (Uwi)	W/m^2K	1.04	2.98	
Opaque Wall Area (Awi)	m^2	63.43	50.72	
Heat Conduction = 3.57(Awi/Ao) Uwi αwi Gw		**0.06**	**0.15**	

Heat Conduction through Opaque Walls = 3.57(Awi/Ao) Uwi αwi Gw where i= 1, 2, ..., n

= **6.03** W/m^2

Part 2 - Calculation of Heat Conduction through Glazing

Components / Details		Code No.		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
U-value of Glazing (Ufi)	W/m^2K			
Heat Conduction = 0.64 (Afi/Ao) Uf Gw				

Heat Conduction through Glazing = 0.64 (Afi/Ao) Ufi Gw where i= 1, 2, ..., n

= **1.08** W/m^2

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.		
Description	**Units**			
Glazing Type				
Thickness	m			
Glazing Area (Afi)	m^2			
Shading Coefficient of Glazing (SCf)				
Visible Light Transmittance (VLT)	%			
External Reflectance (ER)	%			
External Shading Multiplier (ESC)				
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw				

Solar Radiation through Glazing = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw where i= 1, 2, ..., n

= **7.81** W/m^2

Summary of RTTV at West

= 6.03 + 1.08 + 7.81

= **14.92** W/m^2

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014
Form RTTV (Wall) 2 - Summary of Overall $RTTV_{wall}$ of Building

Sheet No. 16 BD Ref No. 2/4077/09

Building Address Proposed Composite Building Development at 63 Ma Tau Wai Road, Kowloon - K.I.L. 1151

Overall Gross Wall Area [a] 11955.39 m^2

Facade Orientation Facing	Gross Wall Area (m^2) [b]	Heat Conduction through Opaque Walls (W/m^2) [c]	Heat Conduction through Glazing (W/m^2) [d]	Solar Radiation through Glazing (W/m^2) [e]	RTTVwall at Each Facade (W/m^2) [f]=[c]+[d]+[e]	Area-weighted RTTVwall (W/m^2) [g]=[f]x[b]/[a]
North	3514.00	3.25	0.87	7.43	11.55	3.40
East	2825.11	5.21	0.88	7.16	13.24	3.13
South	2682.23	4.24	1.11	7.23	12.58	2.82
West	2934.05	6.03	1.08	7.81	14.92	3.66

Overall RTTVwall = 13.01 W/m^2

< 14 W/m^2 Pass