



住宅熱傳送值的摘要匯表 RTTV Summary Sheet

請在適當的方格內填上「√」號。
Please tick in box as appropriate.

Notes:
ER = External Reflectance
SC = Shading Coefficient
VLT = Visible Light Transmittance
Window and skylight data should represent the major proportion of its use in the development.

註:
ER = 外部反射率
SC = 遮光係數
VLT = 可見光透光率
應以發展項目中使用比例最高的窗戶和天窗的資料為準。



電郵地址
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作認收電郵之用 (電子呈交適用)
For acknowledgement email (e-submission)

地址
Address: 45 PAU CHUNG STREET, KOWLOON

屋宇署檔號
BD Ref. No. 2/4073/14

建築物類型:
Building Type: 住宅
Residential

住宅熱傳送值計算者
RTTV calculated by

1. 註冊專業工程師
1. Registered Professional Engineers

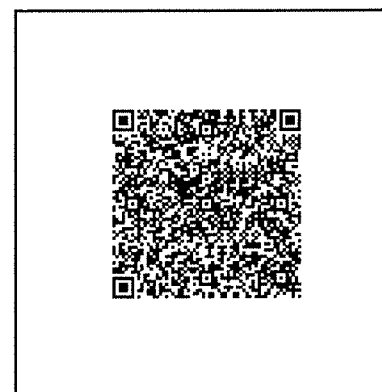
2. 建築師
2. Architect

3. 其他·請註明:
3. Others, please specify:

層數 (住宅單位)
No. of Storeys
(Residential Units) 19

表 1 Table 1

當作符合牆壁住宅熱傳送值 Deemed to Satisfy RTTV _{Wall}								
外牆朝向方位 Facade Orientation Facing	SW	W	NE	NW	SE			
平均吸收率值 Average Absorptivity	/	0.3	0.3	0.3	0.3			
窗戶與牆壁的平均比例 Average Window to Wall Ratio	0	1425:3584	38:1755	3330:8976	4590:8538			
玻璃遮光係數 Shading Coefficient of Glazing								
外牆的平均遮光係數 Average Shading Coefficient of Facade								
可見光透光率 Visible Light Transmittance	/ %	/ %	/ %	/ %	50.56 %	%	%	%
外部反射率 External Reflectance	/ %	5 %	5 %	5 %	7.8 %	%	%	%



wa 2.9.1
Not applicable

Table 2

牆壁住宅熱傳送值 RTTV_{Wall}

外牆朝向方位 Facade Orientation Facing		SW				W				NE				NW			
牆壁方位系數 Wall Orientation Factor		1.092				1.131				0.924				0.965			
外牆總面積 (住宅單位) Total External Wall Area (Residential Units)		678.46 平方米 m ²				71.68 平方米 m ²				702 平方米 m ²				897.61 平方米 m ²			
窗戶總面積 Total Window Area		0 m ²				28.5 m ²				15.2 m ²				33.3 m ²			
熱傳導 Heat Conduction	不透光牆 Opaque Wall	0.811 ✓ 瓦特/平方米 W/m ²				0.57 ✓ 瓦特/平方米 W/m ²				0.695 ✓ 瓦特/平方米 W/m ²				0.94 ✓ 瓦特/平方米 W/m ²			
	窗戶 Window	0.032 ✓ 瓦特/平方米 W/m ²				0.032 ✓ 瓦特/平方米 W/m ²				0.014 ✓ 瓦特/平方米 W/m ²				0.032 ✓ 瓦特/平方米 W/m ²			
窗戶 Window	玻璃類型 Glass Type	<input type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= %	VLT= ER= %	<input checked="" type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= %	VLT= ER= %	<input checked="" type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= %	VLT= ER= %	<input checked="" type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= %	VLT= ER= %
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	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= %	VLT= ER= %	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= %	VLT= ER= %	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= %	VLT= ER= %	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= %	VLT= ER= %	
雙層玻璃 Double Glazing	<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				<input checked="" type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				
外遮光物 External Shading	外懸伸建物 Overhang	<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				外懸伸建物 <input checked="" type="checkbox"/> 有 <input type="checkbox"/> 無 Overhang Yes No			
	側簷伸建物 Sidefin	<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				<input type="checkbox"/> 有 <input type="checkbox"/> 無 Yes No				側簷伸建物 <input checked="" type="checkbox"/> 有 <input type="checkbox"/> 無 Sidefin Yes No			
穿透玻璃的太陽輻射量 Solar Radiation through Glazing		瓦特/平方米 W/m ²				0.122 ✓ 瓦特/平方米 W/m ²				0.0531 ✓ 瓦特/平方米 W/m ²				0.121 ✓ 瓦特/平方米 W/m ²			
平均吸熱率值 Average Absorptivity		0.3				0.3				0.3				0.3			
各幅外牆的 牆壁住宅熱傳送值 RTTV _{Wall} at each facade		0.811 ✓ 瓦特/平方米 W/m ²				0.724 ✓ 瓦特/平方米 W/m ²				0.762 ✓ 瓦特/平方米 W/m ²				1.381 ✓ 瓦特/平方米 W/m ²			
總牆壁住宅熱傳送值 Overall RTTV _{Wall}		7.581 ✓ 瓦特/平方米 W/m ²				7.581 ✓ 瓦特/平方米 W/m ²				7.581 ✓ 瓦特/平方米 W/m ²				7.581 ✓ 瓦特/平方米 W/m ²			

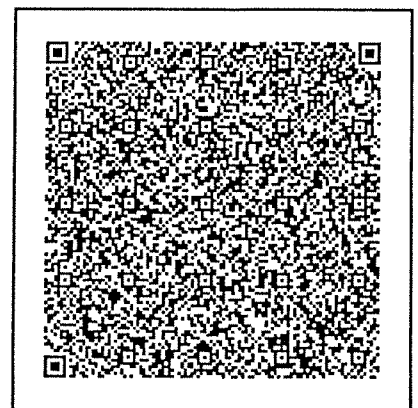


Table 2

牆壁住宅熱傳送值 RTTV_{Wall}

外牆朝向方位 Facade Orientation Facing		SE														
牆壁方位系數 Wall Orientation Factor		1.051														
外牆總面積 (住宅單位) Total External Wall Area (Residential Units)		858.81 平方米 m ²		窗戶與牆壁的比例 Window to Wall Ratio		平方米 m ²		窗戶與牆壁的比例 Window to Wall Ratio		平方米 m ²		窗戶與牆壁的比例 Window to Wall Ratio		平方米 m ²		
窗戶總面積 Total Window Area		459.8 m ²		45980:8588		m ²		m ²		m ²		m ²		m ²		
熱傳導 Heat Conduction	不透光牆 Opaque Wall	0.615		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		
	窗戶 Window	0.407		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		
窗戶 Window	玻璃類型 Glass Type	<input checked="" type="checkbox"/> 反射性 Reflective	面積 Area= 459.8 平方米 m ²	SC= VLT= 50.56 % ER= 7.8 %	<input type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 反射性 Reflective	面積 Area= 平方米 m ²	SC= VLT= ER=
		<input type="checkbox"/> 有色 Tinted	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 有色 Tinted	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 有色 Tinted	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 有色 Tinted	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 有色 Tinted	面積 Area= 平方米 m ²	SC= VLT= ER=
		<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= VLT= ER=	<input type="checkbox"/> 透明 Clear	面積 Area= 平方米 m ²	SC= VLT= ER=
		雙層玻璃 Double Glazing	<input checked="" type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No	
外遮光物 External Shading	外懸伸建物 Overhang	<input checked="" type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		外懸伸建物 Overhang <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		外懸伸建物 Overhang <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		外懸伸建物 Overhang <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		外懸伸建物 Overhang <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		外懸伸建物 Overhang <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		外懸伸建物 Overhang <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		
	側簷伸建物 Sidefin	<input checked="" type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		側簷伸建物 Sidefin <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		側簷伸建物 Sidefin <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		側簷伸建物 Sidefin <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		側簷伸建物 Sidefin <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		側簷伸建物 Sidefin <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		側簷伸建物 Sidefin <input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No		
穿透玻璃的太陽輻射量 Solar Radiation through Glazing		2.881		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		
平均吸熱率值 Average Absorptivity		0.3														
各幅外牆的 牆壁住宅熱傳送值 RTTV _{Wall} at each facade		3.903		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		
總牆壁住宅熱傳送值 Overall RTTV _{Wall}		7.581		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		瓦特/平方米 W/m ²		

7.581 W/m²

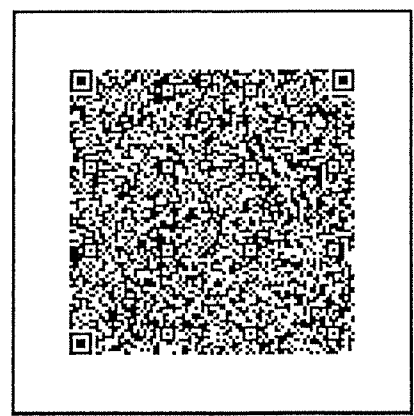


表 3 Table 3

屋頂住宅熱傳送值 RTTV _{Roof}						
屋頂方位系數 Roof Orientation Factor	2.16 ✓					
屋頂總面積 (住宅單位) Total Roof Area (Residential Units)	120		平方米 m ²			
天窗總面積 Total Skylight Area			平方米 m ²			
熱傳導 Heat Conduction	屋頂 Roof	2.79 ✓		瓦特/平方米 W/m ²		
	天窗 Skylight			瓦特/平方米 W/m ²		
天窗 Skylight	玻璃類型 Glass Type	<input type="checkbox"/> 反射性 Reflective	面積 = Area =	平方米 m ²	SC =	VLT = % ER = %
		<input type="checkbox"/> 有色 Tinted	面積 = Area =	平方米 m ²	SC =	VLT = % ER = %
		<input type="checkbox"/> 透明 Clear	面積 = Area =	平方米 m ²	SC =	VLT = % ER = %
	雙層玻璃 Double Glazing	<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No				
	外遮光物 External Shading	<input type="checkbox"/> 有 Yes <input type="checkbox"/> 無 No				
穿透玻璃的太陽輻射量 Solar Radiation through Glazing			瓦特/平方米 W/m ²			
平均吸熱率值 (屋頂) Average Absorptivity (roof)	0.7					
總屋頂住宅熱傳送值 Overall RTTV _{Roof}	2.79 ✓		瓦特/平方米 W/m ²			

簽署*
Signature*

< 3.5 W/m²

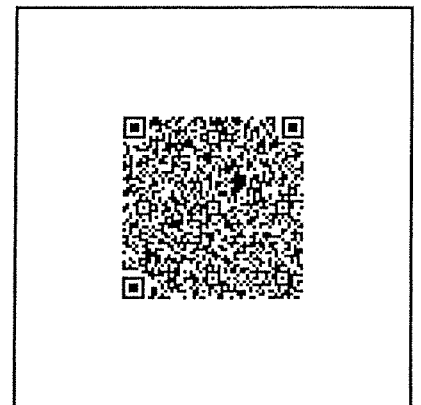

 Ir Lau Pak Kin
 Registered Professional Engineer
 (Mechanical & Building Services)
 Registration No. RP 0203025

任何失實核證或聲明可引致法律行動。##
Any false certification or declaration may be subject to legal action.##

日期 Date

3 | 1 | 0 | 3 | 2 | 0 | 2 | 3

日 dd 月 mm 年 yyyy



Content

1. Gross Wall Area (Opaque Walls + Glazing Areas) Calculation
2. “U” Value Calculation
3. Calculation of RTTV_{wall}
4. Calculation RTTV_{roof}

1.) Gross Wall Area (Opaque Wall Areas + Glazing Areas) Calculation

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

Storey heights (Residential Units):
 3/F - 22/F (4/F, 13/F & 14/F omitted) = 3.15m (17 storeys)
 23/F & 25/F = 3.15m (2 storeys)

1.1 SW Elevations

Opaque Wall Area

Floor	SW-W1	SW-W2	SW-W3
	150mm concrete wall	200mm concrete wall	300mm concrete wall
3/F	9.9x3.15x1 =15.435 m ²	2.8x3.15x1 =8.8 m ²	2.8x3.15x1 =8.8 m ²
5/F-25/F (4,13,14&24/F omitted)	15.435 m ² x 18 =277.83 m ²	8.8 m ² x 18 =158.4 m ²	8.8 m ² x 18 =158.4 m ²
Roof	-	1.4x3.1x1 =4.3 m ²	3.8x3.1x1 =11.78 m ²
Upper Roof	-	1.4x2.8x1 =3.92 m ²	4.8x2.8x1 =13.44 m ²
Top Roof	-	1.4x2.8x1 =3.92 m ²	4.8x2.8x1 =13.4 m ²
Total	293.265 m ²	179.38 m ²	205.82 m ²
Grand Total	678.465 m ² ✓		

Glazing Area : NIL

1.2 W Elevations

Opaque Wall Area

Floor	NE-W1
	150mm concrete wall
3/F	(1,198 x 3.15) - (1.5 x 1) =2.273 m ²
5/F-25/F (4,13,14&24/F omitted)	2.273 m ² x 18 =40.914 m ²
23/F & 25/F	3.2 x 3.15 x 2 =20.16 m ²
Total	43.18 m ²

Glazing Area : W-F1: (1.5m² x 1) x 19 = 28.5m²

1.3 NE Elevations

Opaque Wall Area

Floor	NE-W1	NE-W2	NE-W3
	150mm concrete wall	200mm concrete wall	300mm concrete wall
3/F	(4.9x3.15x1) -0.06 =15.375 m ²	(2.8x3.15x1) -0.06 =8.74 m ²	(2.8x3.15x1) -0.06 =8.74 m ²
5/F-25/F (4,13&14&24/F omitted)	15.375 m ² x 18 =276.75 m ²	8.74 m ² x 18 =157.32 m ²	8.74 m ² x 18 =157.32 m ²
Roof	-	1.4x3.1x1 =4.3 m ²	5.8x3.1x1 =17.98 m ²
Upper Roof	-	1.4x2.8x1 =3.92 m ²	6.8x2.8x1 =13.44 m ²
Top Roof	-	1.4x2.8x1 =3.92 m ²	6.8x2.8x1 =19 m ²
Total	292.125 m ²	178.2 m ²	216.48 m ²
Grand Total	686.805 m ²		

Glazing Area : NE-F1: (0.8 x 1) x 19 = 15.2 m²

1.4 NW Elevations

Opaque Wall Area

Floor	NE-W1	NE-W2	NE-W3
	150mm concrete wall	200mm concrete wall	300mm concrete wall
3/F	(4.8x3.15x1)-0.1 =15 m ²	(8.6x3.15x1)-0.1 =26.00 m ²	-
5/F-25/F (4,13,14 & 24 / F omitted)	(1.5 m ² x18)-0.1 =269.9 m ²	(26.99 m ² x18)-0.1 =485.72 m ²	-
Roof	-	(6x2.8x1)-0.1 =16.7 m ²	-
Top Roof	-	(6x2.8x1)-0.1 =16.7 m ²	-
Total	284.9 m ²	546.11 m ²	-
Grand Total	864.31 m ²		

Glazing Area : NW-F1: (0.9 x 1) x 37 = 33.3 m²

1.5 SE Elevations

Gross Wall Areas (Opaque Walls + Glazing Area)

$$\begin{aligned}
 &= (14.935\text{m width} \times 3.15\text{m height} / \text{floor} \times 19 \text{ storeys}) + (7.42\text{m}^2 \times 8.75 \text{ height}) \\
 &= 893.85 \text{ m}^2 + 64.96\text{m}^2 \\
 &= \underline{958.81\text{m}^2}
 \end{aligned}$$

Glazing Area

Floor	SE-F1	SE-F2	SE-F2	SE-F2	SE-F2	SE-F2
	No shading	Shaded by Balcony OPF= 1800 = 0.76 2350 ESC over hang = 0.612 ESC right side fin=0.92 Total ESC =0.612x0.92=0.562	Shaded by Balcony OPF= 1010 = 0.429 2350 ESC over hang = 0.911 ESC right side fin =0.911 ESC Left side Fin =0.933 Total ESC = 0.911 x 0.911 x 0.933 = 0.773	Shaded by Balcony OPF= 1010 = 0.429 2350 ESC over hang = 0.911 ESC right side fin =0.969 ESC Left side Fin =0.933 Total ESC = 0.911 x 0.969 x 0.933 = 0.822	Shaded by Balcony OPF= 1800 = 0.76 2350 ESC over hang=0.612 ESC Left side fin=0.78 Total ESC = 0.477	No shading
3/F to 25/F (4,13,14 & 24/F omitted)	[(1x1.2)x2x19] + (4.5x1x19)=131.1 m ²	(1x2.8) x 19=53.2 m ²	2x2x19=76 m ²	2x2x19=76 m ²	1x2x19=38 m ²	4.5x1x19 =85.5 m ²
Grand Total	459.8 m ²					

Gross Wall Area (without Glazing) – 150 Concrete Wall (SE-W1)

$$\begin{aligned}
 &= 958.81 \text{ m}^2 - 459.8 \text{ m}^2 \\
 &= \underline{499 \text{ m}^2}
 \end{aligned}$$

1.6 Total Gross Wall Area (Ao)

$$\begin{aligned}
 \text{Ao} &= (678.465 \text{ m}^2) + (43.17\text{m}^2 + 28.5\text{m}^2) + (686.805 \text{ m}^2 + 15.2\text{m}^2) \\
 &\quad + (864.3\text{m}^2 + 33.3\text{m}^2) + (499\text{m}^2 + 459.8\text{m}^2) \\
 &= \underline{3308.54 \text{ m}^2}
 \end{aligned}$$

1.7 Total Glazing Area

$$\begin{aligned}
 &= 28.5\text{m}^2 + 15.2 \text{ m}^2 + 33.3 \text{ m}^2 + 459.8 \text{ m}^2 \\
 &= \underline{536.8 \text{ m}^2}
 \end{aligned}$$

1.7 Total Glazing Area

$$\begin{aligned}
 &= \frac{536.8}{3308.54} \\
 &= \underline{0.16}
 \end{aligned}$$

2. "U" value Calculation

2.1 SW Elevations

'U' value of Opaque Wall Areas

$U = 1/(R_i + x_1/k_1 + x_2/k_2 + \dots + x_n/k_n + R_a + R_o)$ where

R_i Surface film resistance of internal surface (Refer to Table 2)

R_o Surface film resistance of external surface (Refer to Table 2)

R_a Air space resistance (Refer to Table 3)

x Thickness of building materials

k Thermal conductivity of building materials (Refer to Table 1)

Wall Orientation Factor

$G_w = 1.092$ (Refer to Table 9)

Average Absorptivity (α) of the External Opaque Wall at

External Wall Material (Colour/Finish)	% of wall/roof area	α Absorptivity (Refer to Table 5)
white matt mosaic tiles	100%	0.3

Average Absorptivity = 0.3

150mm concrete wall

Description: RC Wall Areas

Wall Material			
External surface film resistance		$R_o =$	0.044
Air space resistance		$R_a =$	0
5mm mosaic tiles	0.005 / 1.5	$=$	0.003
10mm cement/ sand render	0.01 / 0.72	$=$	0.014
150mm concrete wall	0.15 / 2.16	$=$	0.069
10mm gypsum plaster	0.01 / 0.38	$=$	0.026
Internal surface film resistance		$R_i =$	0.12
Total			0.276

$$U_{w1} = \frac{1}{0.276} = 3.623 \text{ W/m}^2\text{K}$$

200mm concrete wall

Description: RC Column Areas

Wall Material			
external surface film		$R_o =$	0.044
Air space resistance		$R_a =$	0
5mm mosaic tiles	0.005 / 1.5	$=$	0.003
10mm cement/ sand render	0.01 / 0.72	$=$	0.014
200mm concrete column	0.2 / 2.16	$=$	0.092
10mm gypsum plaster	0.01 / 0.38	$=$	0.026
Internal surface film resistance		$R_i =$	0.12
Total			0.299

$$U_{w2} = \frac{1}{0.299} = 3.34 \text{ W/m}^2\text{K}$$

300mm concrete wall

Description: RC Column Areas

Wall Material			
external surface film		$R_o =$	0.044
Air space resistance		$R_a =$	0
5mm mosaic tiles	0.005 / 1.5	$=$	0.003
10mm cement/ sand render	0.01 / 0.72	$=$	0.014
300mm concrete column	0.3 / 2.16	$=$	0.138
10mm gypsum plaster	0.01 / 0.38	$=$	0.026
Internal surface film resistance		$R_i =$	0.12
Total			0.345

$$U_{w2} = \frac{1}{0.345} = 2.89 \text{ W/m}^2\text{K}$$

2. "U" value Calculation

2.2 W Elevations

'U' value of Opaque Wall Areas

$U = 1/(R_i + x_1/k_1 + x_2/k_2 + \dots + x_n/k_n + R_a + R_o)$ where

- R_i Surface film resistance of internal surface (Refer to Table 2)
- R_o Surface film resistance of external surface (Refer to Table 2)
- R_a Air space resistance (Refer to Table 3)
- x Thickness of building materials
- k Thermal conductivity of building materials (Refer to Table 1)

Wall Orientation Factor

$$G_w = 1.131$$

(Refer to Table 9)

Average Absorptivity (α) of the External Opaque Wall at

External Wall Material (Colour/Finish)	% of wall/roof area	α Absorptivity (Refer to Table 5)
white matt mosaic tiles	100%	0.3

$$\text{Average Absorptivity} = 0.3$$

150mm concrete wall

Description: RC Wall Areas

Wall Material				
External surface film resistance		R _o	=	0.044
Air space resistance		R _a	=	0
5mm mosaic tiles	0.005 / 1.5		=	0.003
10mm cement/ sand render	0.01 / 0.72		=	0.014
150mm concrete wall	0.15 / 2.16		=	0.069
10mm gypsum plaster	0.01 / 0.38		=	0.026
Internal surface film resistance		R _i	=	0.12
Total				0.276

$$U_{w1} = \frac{1}{0.276} = 3.623 \text{ W/m}^2\text{K}$$

2.3 NE Elevations

'U' value of Opaque Wall Areas

$$U = 1/(R_i + x_1/k_1 + x_2/k_2 + \dots + x_n/k_n + R_a + R_o)$$

- where R_i Surface film resistance of internal surface (Refer to Table 2)
 R_o Surface film resistance of external surface (Refer to Table 2)
 R_a Air space resistance (Refer to Table 3)
 x Thickness of building materials
 k Thermal conductivity of building materials (Refer to Table 1)

Wall Orientation Factor

$$G_w = 0.924 \quad (\text{Refer to Table 9})$$

Average Absorptivity (α) of the External Opaque Wall at

External Wall Material (Colour/Finish)	% of wall/roof area	α Absorptivity (Refer to Table 5)
white matt mosaic tiles	100%	0.3

$$\text{Average Absorptivity} = 0.3$$

150mm concrete wall

Description: RC Wall Areas

Wall Material				
External surface film resistance		R_o	=	0.044
Air space resistance		R_a	=	0
5mm mosaic tiles	0.005 / 1.5		=	0.003
10mm cement/ sand render	0.01 / 0.72		=	0.014
150mm concrete wall	0.15 / 2.16		=	0.069
10mm gypsum plaster	0.01 / 0.38		=	0.026
Internal surface film resistance		R_i	=	0.12
Total				0.276

$$U_{w1} = \frac{1}{0.276} = 3.623 \quad \text{W/m}^2\text{K}$$

200mm concrete wall

Description: RC Column Areas

Wall Material				
external surface film		R_o	=	0.044
Air space resistance		R_a	=	0
5mm mosaic tiles	0.005 / 1.5		=	0.003
10mm cement/ sand render	0.01 / 0.72		=	0.014
200mm concrete column	0.2 / 2.16		=	0.092
10mm gypsum plaster	0.01 / 0.38		=	0.026
Internal surface film resistance		R_i	=	0.12
Total				0.299

$$U_{w2} = \frac{1}{0.299} = 3.34 \quad \text{W/m}^2\text{K}$$

300mm concrete wall

Description: RC Column Areas

Wall Material				
external surface film		R_o	=	0.044
Air space resistance		R_a	=	0
5mm mosaic tiles	0.005 / 1.5		=	0.003
10mm cement/ sand render	0.01 / 0.72		=	0.014
300mm concrete column	0.3 / 2.16		=	0.138
10mm gypsum plaster	0.01 / 0.38		=	0.026
Internal surface film resistance		R_i	=	0.12
Total				0.345

$$U_{w2} = \frac{1}{0.345} = 2.89 \quad \text{W/m}^2\text{K}$$

2. "U" value Calculation

2.4 NW Elevations

'U' value of Opaque Wall Areas

$U = 1/(R_i + x_1/k_1 + x_2/k_2 + \dots + x_n/k_n + R_a + R_o)$ where

- R_i Surface film resistance of internal surface (Refer to Table 2)
- R_o Surface film resistance of external surface (Refer to Table 2)
- R_a Air space resistance (Refer to Table 3)
- x Thickness of building materials
- k Thermal conductivity of building materials (Refer to Table 1)

Wall Orientation Factor

G_w = 0.965 (Refer to Table 9)

2.5 SE Elevations

'U' value of Opaque Wall Areas

$$U = 1/(R_i + x_1/k_1 + x_2/k_2 + \dots + x_n/k_n + R_a + R_o)$$

- where R_i Surface film resistance of internal surface (Refer to Table 2)
- R_o Surface film resistance of external surface (Refer to Table 2)
- R_a Air space resistance (Refer to Table 3)
- x Thickness of building materials
- k Thermal conductivity of building materials (Refer to Table 1)

Wall Orientation Factor $G_w = 1.051$ (Refer to Table 9)

Average Absorptivity (α) of the External Opaque Wall at

External Wall Material (Colour/Finish)	% of wall/roof area	α Absorptivity (Refer to Table 5)
white matt mosaic tiles	100%	0.3
Average Absorptivity =		0.3

150mm concrete wall	Description:	RC Wall Areas
Wall Material		
External surface film resistance		$R_o = 0.044$
Air space resistance		$R_a = 0$
5mm mosaic tiles	0.005 / 1.5	$= 0.003$
10mm cement/ sand render	0.01 / 0.72	$= 0.014$
150mm concrete wall	0.15 / 2.16	$= 0.069$
10mm gypsum plaster	0.01 / 0.38	$= 0.026$
Internal surface film resistance		$R_i = 0.12$
Total		0.276

$$U_{w1} = \frac{1}{0.276} = 3.623 \text{ W/m}^2\text{K}$$

3. Calculation of RTTV wall of Each Façade

$$\begin{aligned}
 \text{RTTV}_{\text{wall}} &= ((3.57(A_{w1}U_{w1} \alpha_{w1} + A_{w2}U_{w2} \alpha_{w2} + \dots + A_{wn}U_{wn} \alpha_{wn})A_o) + \\
 &= (0.64(A_{f1}U_{f1} + A_{f2}U_{f2} + \dots + A_{fn}U_{fn})A_o) + \\
 &\quad (41.75(A_{f1}SC_{f1}ESC_{f1} + A_{f2}SC_{f2}ESC_{f2} + \dots + A_{fn}SC_{fn}ESC_{fn})A_o))(G_w)
 \end{aligned}$$

Where :

A_o	= Total gross wall area (m ²)
A_{w1}, A_{w2}, A_{wn}	= Areas of different walls (m ²)
U_{w1}, U_{w2}, U_{wn}	= U-values of different walls (W/m ² K)
$\alpha_{w1}, \alpha_{w2}, \alpha_{wn}$	= Absorptivity of different walls
A_{f1}, A_{f2}, A_{fn}	= Areas of different fenestration (m ²)
U_{f1}, U_{f2}, U_{fn}	= U-values of different fenestration (W/m ² K)
$SC_{f1}, SC_{f2}, SC_{fn}$	= Shading Coefficient of different fenestration
$ESC_{f1}, ESC_{f2}, ESC_{fn}$	= Shading Coefficient of external shades of different fenestration

3.1 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.	1	BD Ref No.	2/4073/14
Building Address	Proposed Re-development in K.I.L. 1687 S.A.S.S.2 at 45 Pau Chung Street, Kowloon		
Facade Orientation Facing	SW	Gross Wall Area (Ao) =	605.25
Window to Wall Ratio (WWR)	No Glazing	Wall Orientation Factor (Gs) =	1.092

Part 1 - Calculation of Heat Conduction through Opaque Walls				
Components / Details		Code No.		
Description	Units	SW-W1	SW-W2	SW-W3
External Finish Material		5mm mosaic tiles	5mm mosaic tiles	5mm mosaic tiles
Conductivity	W/mK	1.50	1.50	1.50
Thickness	m	0.005	0.005	0.005
Average Absorptivity	(α)	0.3	0.3	0.3
Intermediate component		10mm cement/sand render	10mm cement/sand render	10mm cement/sand render
Conductivity	W/mK	0.72	0.72	0.72
Thickness	m	0.01	0.01	0.01
Intermediate component		150mm cement/sand render	200mm cement/sand render	300mm cement/sand render
Conductivity	W/mK	2.16	2.16	2.16
Thickness	m	0.15	0.20	0.30
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		10mm gypsum plaster	10mm gypsum plaster	
Conductivity	W/mK	0.38	0.38	0.38
Thickness	m	0.01	0.01	0.01
U-value Opaque Wall (Uwi)	W/m ² K	3.623	3.34	2.89
Opaque Wall Area (Awi)	m ²	146.68	132.26	101.43
Heat Conduction = 3.57(Awi/Ao) Uwi awi Gw		0.375	0.211	0.225
Total heat conduction	w/m ²		0.811	

Heat Conduction through Opaque Walls = $3.57 (A_{wi}/A_o) U_{wi} a_{wi} G_w$ where $l = 1, 2, \dots, n$

$$SW-W1 = 3.57 \times \frac{293.265}{3308.54} \times 3.623 \times 0.3 \times 1.092 = 0.375 \text{ w/m}^2$$

$$SW-W2 = 3.57 \times \frac{179.38}{3308.54} \times 3.34 \times 0.3 \times 1.092 = 0.211 \text{ w/m}^2$$

$$SW-W3 = 3.57 \times \frac{205.82}{3308.54} \times 3.105 \times 0.3 \times 1.092 = 0.225 \text{ w/m}^2$$

Total : 0.811 w/m² ✓

Sheet No.	2	BD Ref No.	2/4073/14
Building Address	Proposed Re-development in K.I.L. 1687 S.A.S.2 at 45 Pau Chung Street, Kowloon		
Façade Orientation Facing	W	Gross Wall Area (Ao) =	71.67m ²
Window to Wall Ratio (WWR)	0.39	Wall Orientation Factor (Gs) =	1.131

Part 1 - Calculation of Heat Conduction through Opaque Walls			
Components / Details		Code No.	
Description	Units	W-W1	
External Finish Material		5mm mosaic tiles	
Conductivity	W/mK	1.50	
Thickness	m	0.005	
Average Absorptivity	(α)	0.3	
Intermediate component		10mm cement/sand render	
Conductivity	W/mK	0.72	
Thickness	m	0.01	
Intermediate component		150mm cement/sand render	
Conductivity	W/mK	2.16	
Thickness	m	0.15	
Intermediate component			
Conductivity	W/mK		
Thickness	m		
Intermediate component			
Conductivity	W/mK		
Thickness	m		
Internal Finish Material		10mm gypsum plaster	
Conductivity	W/mK	0.38	
Thickness	m	0.01	
U-value of Opaque Wall (Uwi)	W/m ² K	3.623	
Opaque Wall Area (Awi)	m ²	43.18	
Heat Conduction = $3.57(Awi/Ao) Uwi \alpha_i Gw$		0.57	
Total heat conduction	w/m ²	0.57	

Heat Conduction through Opaque Walls = $3.57 (Awi/Ao) Uwi \alpha_i Gw$ where $i= 1, 2, \dots, n$

$$NE-W1 = \frac{3.57 \times 43.18}{3308.54} \times 3.623 \times 0.3 \times 1.131 = 0.57 \text{ w/m}^2$$

Part 2 - Calculation of Heat Conduction through Glazing	
Components / Details	Code No.

Part 2 - Calculation of Heat Conduction through Glazing		
Components / Details		Code No.
Description	Units	W-F3(item 6a)
Glazing Type		Fritted Tempered Glass
Thickness	mm	6mm+13mm+6mm
Glazing Area (Afi)	m ²	28.5
U-value of Glazing (Ufi)	W/m ² K	5.19
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		0.032

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

$$0.64 \times \frac{28.5}{3308.54} \times 5.19 \times 1.131 = 0.032 \text{ w/m}^2$$

Part 3 - Calculation of Solar Radiation through Glazing		
Components / Details		Code No.
Description	Units	W-F3 (item 6a)
Glazing Type		Fritted Tempered Glass
Thickness	mm	6mm+13mm+6mm
Glazing Area (Afi)	m ²	28.5
Shading Coefficient of Glazing (SCf)		0.3
Visible Light Transmittance (VLT) %		1
External Reflectance (ER) %		5
External Shading Multiplier (ESC)		1.00
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		0.122

Solar Radiation through Glazing = 41.750 (Afi/Ao) (SCfi)(ESCwi) GW where i = 1, 2, ..., n

$$\text{W-F3} = 41.75 \times \frac{28.5}{3308.54} \times 0.3 \times 1 \times 1.131 = 0.122 \text{ w/m}^2$$

3.3 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.	3	BD Ref No.	2/4073/14
Building Address	Proposed Re-development in K.I.L. 1687 S.A.S.2 at 45 Pau Chung Street, Kowloon		
Facade Orientation Facing	NE	Gross Wall Area (Ao) =	693.66 m ²
Window to Wall Ratio (WWR)	0.021	Wall Orientation Factor (Gs) =	0.924

Part 1 - Calculation of Heat Conduction through Opaque Walls				
Components / Details		Code No.		
Description	Units	NE-W1	NE-W2	NE-W3
External Finish Material		5mm mosaic tiles	5mm mosaic tiles	5mm mosaic tiles
Conductivity	W/mK	1.50	1.50	1.50
Thickness	m	0.005	0.005	0.005
Average Absorptivity	(α)	0.3	0.3	0.3
Intermediate component		10mm cement/sand render	10mm cement/sand render	
Conductivity	W/mK	0.72	0.72	0.72
Thickness	m	0.01	0.01	0.01
Intermediate component		150mm cement/sand render	200mm cement/sand render	300mm cement/sand render
Conductivity	W/mK	2.16	2.16	2.16
Thickness	m	0.15	0.20	0.30
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		10mm gypsum plaster	10mm gypsum plaster	
Conductivity	W/mK	0.38	0.38	0.38
Thickness	m	0.01	0.01	0.01
U-value of Opaque Wall (U _{wi})	W/m ² K	3.623	3.34	2.89
Opaque Wall Area (A _{wi})	m ²	292.125	178.2	216.48
Heat Conduction = 3.57(A _{wi} /A _o) U _{wi} α _{wi} G _w		0.316	0.178	0.201
Total heat conduction	w/m ²			0.695

Heat Conduction through Opaque Walls = $3.57 (A_{wi}/A_o) U_{wi} \alpha_{wi} G_w$ where $i=1, 2, \dots, n$

$$NE-W1 = 3.57 \times \frac{292.125}{3308.54} \times 3.623 \times 0.3 \times 0.924 = 0.316 \text{ w/m}^2$$

$$NE-W2 = 3.57 \times \frac{178.2}{3308.54} \times 3.34 \times 0.3 \times 0.924 = 0.178 \text{ w/m}^2$$

$$NE-W3 = 3.57 \times \frac{216.48}{3308.54} \times 3.105 \times 0.3 \times 0.924 = 0.201 \text{ w/m}^2$$

Total 0.695 w/m²

Part 2 - Calculation of Heat Conduction through Glazing		
Components / Details		Code No.
Description	Units	NE - F3 (item 6a)
Glazing Type		Fritted tempered glass
Thickness	mm	6mm +13mm +6mm
Glazing Area (Afi)	m ²	15.2
U-value of Glazing (Ufi)	W/m ² K	5.19
Heat Conduction = 0.64 (Afi/Ao) Uf Gw		0.014

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

$$0.64 \times \frac{15.2}{3308.54} \times 5.19 \times 0.924 = 0.014 \text{ w/m}^2$$

Part 3 - Calculation of Solar Radiation through Glazing		
Components / Details		Code No.
Description	Units	NE-F3(item 6a)
Glazing Type		<i>Fritted Tempered Glass</i>
Thickness	mm	<i>6mm + 13mm + 6mm</i>
Glazing Area (Afi)	m ²	15.2
Shading Coefficient of Glazing (SCf)		0.3
Visible Light Transmittance (VLT)	%	1
External Reflectance (ER)	%	5
External Shading Multiplier (ESC)		1.00
Solar Radiation = 41.75 (Afi/Ao)(SCfi)(ESCwi)Gw		0.0531

Solar Radiation through Glazing = 41.750 (Afi/Ao) (SCfi)(ESCwi) GW where i = 1, 2, ..., n

$$W-F3 = 41.75 \times \frac{15.2}{3308.54} \times 0.3 \times 1 \times 0.924 = 0.0531 \text{ w/m}^2$$

3.4 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.	4	BD Ref No.	2/4073/14
Building Address	Proposed Re-development in K.I.L. 1687 S.A.S.S.2 at 45 Pau Chung Street, Kowloon		
Façade Orientation Facing	NW	Gross Wall Area (Ao) =	720.105 m ²
Window to Wall Ratio (WWR)	0.037	Wall Orientation Factor (Gs) =	0.965

Part 1 - Calculation of Heat Conduction through Opaque Walls			
Components / Details		Code No.	
Description	Units	NW-W1	NW-W2
External Finish Material		5mm mosaic tiles	5mm mosaic tiles
Conductivity	W/mK	1.50	1.50
Thickness	m	0.005	0.005
Average Absorptivity (α)		0.3	0.3
Intermediate component			
Conductivity	W/mK	0.72	0.72
Thickness	m	0.01	0.01
Intermediate component		150mm cement/sand render	200mm cement/sand render
Conductivity	W/mK	2.16	2.16
Thickness	m	0.15	0.2
Intermediate component			
Conductivity	W/mK		
Thickness	m		
Intermediate component			
Conductivity	W/mK		
Thickness	m		
Internal Finish Material		10mm gypsum plaster	10mm gypsum plaster
Conductivity	W/mK	0.38	0.38
Thickness	m	0.01	0.01
U-value of Opaque Wall (U _{wi})	W/m ² K	3.623	3.34
Opaque Wall Area (A _{wi})	m ²	284.9	546.11
Heat Conduction = 3.57(A _{wi} /A _o) U _{wi} α _{wi} G _w		0.322	0.618
Total heat conduction	w/m ²	0.94	

Heat Conduction through Opaque Walls = $3.57 (A_{wi}/A_o) U_{wi} \alpha_{wi} G_w$ where $i=1, 2, \dots, n$

$$NE-W1 = 3.57 \times \frac{284.9}{3308.54} \times 3.623 \times 0.3 \times 0.965 = 0.322 \text{ w/m}^2$$

$$NE-W2 = 3.57 \times \frac{546.11}{3308.54} \times 3.623 \times 0.3 \times 0.965 = 0.618 \text{ w/m}^2$$

Total : 0.94 w/m²

Part 2 - Calculation of Heat Conduction through Glazing			
Components / Details		Code No.	
Description	Units	NW - F3	
Glazing Type		Single Reflected Glass	
Thickness	mm	6mm+13mm+6mm	
Glazing Area (Afi)	m ²	33.3	
U-value of Glazing (Ufi)	W/m ² K	5.19	
Heat Conduction = 0.64 (Afi/Ao) Uf Gw	W/m ²	0.032	

Heat Conduction through Glazing = $0.64 (A_{fi}/A_o) U_{fi} G_w$ where $i=1, 2, \dots, n$

$$0.64 \times \frac{33.3}{3308.54} \times 5.19 \times 0.965 = 0.032 \text{ w/m}^2$$

Part 3 - Calculation of Solar Radiation through Glazing			
Components / Details		Code No.	
Description	Units	NW-F3	
Glazing Type		Fritted tempered glass (item 6a)	Single reflected glass (with FRR (-/60/60 enclosure) (item 6)
Thickness	mm	6mm+13mm+6mm	8mm
Glazing Area (Afi)	m ²	33.3	33.3
Shading Coefficient of Glazing (SCf)		0.3	0.3
Visible Light Transmittance (VLT)	%	1	1
External Reflectance (ER)	%	5	5
External Shading Multiplier (ESC)		1.00	1.00
Solar Radiation = $41.75 (A_{fi}/A_o)(SC_{fi})(ESC_{wi})G_w$	m ²	0.121	

Solar Radiation through Glazing = $41.75 (A_{fi}/A_o) (SC_{fi})(ESC_{wi}) G_w$

where $i = 1, 2, \dots, n$

$$W-F3 = 41.75 \times \frac{33.3}{3308.54} \times 0.3 \times 1 \times 0.965$$

$$= 0.121 \text{ w/m}^2$$

3.5 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.	5	BD Ref No.	2/4073/14
Building Address	Proposed Re-development in K.I.L. 1687 S.A.S.S.2 at 45 Pau Chung Street, Kowloon		
Façade Orientation Facing	SE	Gross Wall Area (Ao) =	958.81
Window to Wall Ratio (WWR)	0.51	Wall Orientation Factor (Gs) =	1.051

Part 1 - Calculation of Heat Conduction through Opaque Walls		
Components / Details		Code No.
Description	Units	SE-W1
External Finish Material		5mm mosaic tiles
Conductivity	W/mK	1.50
Thickness	m	0.005
Average Absorptivity	(α)	0.3
Intermediate component		
Conductivity	W/mK	0.72
Thickness	m	0.01
Intermediate component		150mm cement/sand render
Conductivity	W/mK	2.16
Thickness	m	0.15
Intermediate component		
Conductivity	W/mK	
Thickness	m	
Intermediate component		
Conductivity	W/mK	
Thickness	m	
Internal Finish Material		10mm gypsum plaster
Conductivity	W/mK	0.38
Thickness	m	0.01
U-value of Opaque Wall (U _{wi})	W/m ² K	3.623
Opaque Wall Area (A _{wi})	m ²	499
Heat Conduction = $3.57(A_{wi}/A_o) U_{wi} \alpha_{wi} G_w(w/m^2)$		0.615

Heat Conduction through Opaque Walls = $3.57 (A_{wi}/A_o) U_{wi} \alpha_{wi} G_w$ where $i=1, 2, \dots, n$

$$NE-W1 = 3.57 \times \frac{499}{3308.54} \times 3.623 \times 0.3 \times 1.051 = 0.615 \text{ W/m}^2$$

Part 2 - Calculation of Heat Conduction through Glazing			
Components / Details		Code No.	
Description	Units	SE-F1 (item 1)	SE-F2 (item 2)
Glazing Type		Double Glazing	Double Glazing
Thickness	mm	8mm+12A+8mm	6mm+12A+6mm
Glazing Area (A _{fi})	m ²	131.1m ²	328.7
U-value of Glazing (U _{fi})	W/m ² K	2.66	2.85
Heat Conduction = 0.64 (A _{fi} /A _o) U _{fi} G _w	w/m ²	0.129	0.348
Total heat conduction	w/m ²	0.407	

Heat Conduction through Glazing = $0.64 (A_{fi}/A_o) U_{fi} G_w$ where $i= 1, 2, \dots, n$

$$SE-F1 = \frac{131.1}{3308.54} \times 2.66 \times 1.051 = 0.11 \text{ w/m}^2$$

$$SE-F2 = \frac{328.7}{3308.54} \times 2.85 \times 1.051 = 0.297 \text{ w/m}^2$$

$$\text{Total : } 0.407 \text{ w/m}^2$$

Part 3 - Calculation of Solar Radiation through Glazing

Components / Details		Code No.					
Description	Units	SE-F1 (item 1)	SE-F2 (item 2)	SE-F2 (item 2)	SE-F2 (item 2)	SE-F2 (item 2)	SE-F1 (item 1)
		No shading	Shaded by Balcony OPF= $\frac{1800}{2350} = 0.76$ ESC over hang = 0.612 ESC right side fin=0.92 Total ESC = $0.612 \times 0.92 = 0.563$	Shaded by Balcony OPF= $\frac{1010}{2350} = 0.429$ ESC over hang = 0.71 ESC right side fin = 0.911 ESC Left side Fin = 0.933 Total ESC = $0.71 \times 0.911 \times 0.933 = 0.603$	Shaded by Balcony OPF= $\frac{1010}{2350} = 0.429$ ESC over hang = 0.71 ESC right side fin = 0.969 ESC Left side Fin = 0.933 Total ESC = $0.71 \times 0.969 \times 0.933 = 0.641$	Shaded by Balcony OPF= $\frac{1800}{2350} = 0.76$ ESC over hang = 0.612 ESC Left side fin = 0.78 Total ESC = 0.477	No shading
Glazing Type		Single Glazing					
Thickness	mm	$\frac{1}{2} \times 12A + \frac{1}{2} \times 6mm$	$6mm + 12A + 6mm$				$\frac{1}{2} \times 12A + \frac{1}{2} \times 6mm$
Glazing Area (Afi)	m ²	131.1	53.2	76	76	38	85.5
Shading Coefficient of Glazing (SCf)		0.56	0.65	0.65	0.65	0.65	0.56
Visible Light Transmittance (VLT)	%	50	56	56	56	56	50
External Reflectance (ER)	%	7	7	7	7	7	7
External Shading Multiplier (ESC)		1	0.563	0.603	0.71	0.477	1
Solar Radiation = $41.75 (Afi/Ao)(SCfi)(ESCwi)Gw$		0.973	0.257	0.395	0.465	0.156	0.633
Total Solar Radiation(w/m ²)		2.881					

Solar Radiation through Glazing = $41.750 (Afi/Ao) (SCfi)(ESCwi) GW$ where I = 1, 2, ..., n

$$SE-F1(\text{No shading}) = 41.750 \times \frac{131.1}{3308.54} \times 0.56 \times 1.051 = 0.973 \text{ w/m}^2$$

$$SE-F2(\text{OPF}=0.76) = 41.750 \times \frac{53.2}{3308.54} \times 0.65 \times 0.563 \times 1.051 = 0.257 \text{ w/m}^2$$

$$SE-F2(\text{OPF}=0.429) = 41.750 \times \frac{76}{3308.54} \times 0.65 \times 0.603 \times 1.051 = 0.395 \text{ w/m}^2$$

$$SE-F2(\text{OPF}=0.429) = 41.750 \times \frac{76}{3308.54} \times 0.65 \times 0.71 \times 1.051 = 0.465 \text{ w/m}^2$$

$$SE-F2(\text{OPF}=0.76) = 41.750 \times \frac{38}{3308.54} \times 0.65 \times 0.477 \times 1.051 = 0.156 \text{ w/m}^2$$

$$SE-F2(\text{No shading}) = 41.750 \times \frac{85.5}{3308.54} \times 0.56 \times 1 \times 1.051 = 0.633 \text{ w/m}^2$$

Total : 2.881 w/m²

3.6 Summary of Overall $RTTV_{wall}$ of Building

Overall Gross Wall Area [a] 3308.54 m²

Façade Orientation Facing	Gross Wall Area (m ²)	Heat Conduction through Opaque Walls (w/m ²)	Heat Conduction through Glazing (w/m ²)	Heat Conduction through Glazing (w/m ²)	$RTTV_{wall}$ at Each Façade (w/m ²)	Area-weighted $RTTV_{wall}$ (w/m ²)
SW	678.465	0.0811	-	-	0.811	0.166
W	71.67	0.57	0.032	0.122	0.724	0.015
NE	702.005	0.695	0.014	0.0531	0.762	0.161
NW	897.6	0.94	0.32	0.121	1.381	0.374
SE	958.8	0.615	0.407	2.881	3.903	1.138

Overall $RTTV_{wall}$ = $\frac{7.581}{14}$ w/m²

< 14 w/m² ✓

4. Calculation RTTV at Roof

$$RTTV_{\text{roof}} = 3.47(1-SRR)U_r \alpha_r G_s + 0.40(SRR)$$

Where :

- U_r = U-values of the roof (W/m²K)
- α_r = Absorptivity of the roof
- G_s = Roof orientation factor
- SRR = Skylight to Roof Ratio
- U_{sl} = U-values of the skylight glazing (W/m²K)
- SC_r = Shading Coefficient of the skylight glazing

4.1 "U" value of Roof

Gross Roof Areas = 120 m² ✓
 (Opaque Walls+Skylight Areas)(Aro)at Roof = 0.00m²
 Skylight Areas st Roof

Breakdown of Skylight Areas
 Skylight Areas Unshaded (S1) = 0.00m²

Roof Orientation Factor Gs = 2.16 ✓ (Refer to Table 9)

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

External Roof Material(Colour/Finish)	% of roof area	α Absorptivity (Refer to Table 5)
Uncoloured Concrete tiles	100%	0.7

Average Absorptivity = 0.7

"U" value of Opaque Roof Area

$U = 1/(R_i + X_1/K_1 + X_2/K_2 + \dots + X_n/K_n + R_a + R_o)$

Where R_i Surface film resistance of internal surface (Refer to Table 2)

R_o Surface film resistance of external surface (Refer to Table 2)

R_a Air space resistance (Refer to Table 3)

X Thickness of building materials

K Thermal Conductivity of building materials (Refer to Table 1)

Table 1)

R1	Description:	Roof Area
Roof Material		
External surface film resistance		$R_o = 0.055$
Air space resistance		$R_a = 0$
25mm concrete tiles	0.025 / 1.1	= 0.023
50mm cement/ sand render	0.05 / 0.72	= 0.069
50mm expanded polystyrene	0.05 / 0.034	= 1.471
150mm concrete slab	0.15 / 2.16	= 0.069
10mm gypsum plaster	0.01 / 0.38	= 0.026
Internal surface film resistance		$R_i = 0.162$
Total		1.875

$$U_{w1} = \frac{1}{1.875} = 0.523 \text{ w/m}^2\text{K}$$

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014

4.2 Form RTTV (Roof) 1 - Calculation of RTTV_{roof}

Sheet No.	1	BD Ref No.	2/4073/14
Building Address	Proposed Re-development in K.I.L. 1687 S.A.S.2 at 41-45 Pau Chung Street, Kowloon		
Roof Orientation Facing	Flat	Gross Roof Area (A _o) =	120
Skylight to Roof Ratio (SRR)	0	Roof Orientation Factor (G _s) =	2.16

Part 1 - Calculation of Heat Conduction through Opaque Roof				
Components / Details		Code No.		
Description	Units	R1		
External Finish Material		25mm concrete tile		
Conductivity	W/mK	1.10		
Thickness	m	0.025		
Average Absorptivity	(α)	0.7		
Intermediate component		50mm cement/ sand screed		
Conductivity	W/mK	0.72		
Thickness	m	0.050		
Intermediate component		50mm expanded polystyrene		
Conductivity	W/mK	0.034		
Thickness	m	0.05		
Intermediate component		150mm concrete slab		
Conductivity	W/mK	2.16		
Thickness	m	0.15		
Intermediate component				
Conductivity	W/mK			
Thickness	m			
Internal Finish Material		10mm gypsum plaster		
Conductivity	W/mK	0.38		
Thickness	m	0.01		
U-value of the Roof (U _{ri})	W/m ² K	0.533		
Opaque Roof Area (A _{ri})	m ²	120		
Heat Conduction = 3.47(A _{ri} /A _{ro}) U _{ri} a _{ri} G _s		2.89		

$$\begin{aligned}
 \text{Heat Conduction through Opaque Roof} &= 3.47(A_{ri}/A_{ro}) U_{ri} a_{ri} G_s \quad \text{where } i= 1, 2, \dots, n \\
 &= 3.47 \times \frac{120}{120} \times 0.533 \times 0.7 \times 2.16 \\
 &= 2.79 \text{ w/m}^2
 \end{aligned}$$

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014

4.2 Form RTTV (Roof) 1 - Calculation of RTTVroof

Sheet No.	1	BD Ref No.	2/4073/14
Building Address	Proposed Re-development in K.I.L. 1687 S.A.S.2 at 41-45 Pau Chung Street, Kowloon		
Roof Orientation Facing	Flat	Gross Roof Area (Ao) =	120
Skylight to Roof Ratio (SRR)	0	Roof Orientation Factor (Gs) =	2.16

Part 1 - Calculation of Heat Conduction through Opaque Roof			
Components / Details		Code No.	
Description	Units	R1	
External Finish Material		25mm concrete tile	
Conductivity	W/mK	1.10	
Thickness	m	0.025	
Average Absorptivity	(α)	0.7	
Intermediate component		50mm cement/ sand screed	
Conductivity	W/mK	0.72	
Thickness	m	0.050	
Intermediate component		50mm expanded polystyrene	
Conductivity	W/mK	0.034	
Thickness	m	0.05	
Intermediate component		150mm concrete slab	
Conductivity	W/mK	2.16	
Thickness	m	0.15	
Intermediate component			
Conductivity	W/mK		
Thickness	m		
Internal Finish Material		10mm gypsum plaster	
Conductivity	W/mK	0.38	
Thickness	m	0.01	
U-value of the Roof (Uri)	W/m²K	0.533	
Opaque Roof Area (Ari)	m²	120	
Heat Conduction = 3.47(Ari/Aro) Uri ari Gs		2.89	

Heat Conduction through Opaque Roof = $3.47(Ari/Aro) \sum_{i=1}^n U_i A_i G_i$ where $i=1, 2, \dots, n$

= $3.47 \times \frac{120}{120} \times 0.533 \times 0.7 \times 2.16$

= 2.89 w/m²

2.79

Part 2 - Calculation of Heat Conduction through Skylight		
Components / Details		Code No.
Description	Units	S1
Skylight Glazing Type		-
Thickness	m	-
Skylight Area (Asi)	m ²	0.00
U-value of Skylight Glazing (Usi)	W/m ² K	-
Heat Conduction = 0.40 (Asi/Aro) Usi Gs		0.00

$$\begin{aligned} \text{Heat Conduction through Skylight} &= 0.40 \text{ (Asi/Aro) Usi Gs} && \text{where } i = 1, 2, \dots, n \\ &= 0.00 \text{ w/m}^2 \end{aligned}$$

Part 3 - Calculation of Solar Radiation through Skylight		
Components / Details		Code No.
Description	Units	S1
Skylight Glazing Type		-
Thickness	m	-
Skylight Area (Asi)	m ²	0.00
Shading Coefficient of Skylight Glazing (SCr)		-
Visible Light Transmittance (VLT)		-
External Reflectance (ER)		-
Solar Radiation = 41.10 (Asi/Aro) (SCri) Gs		0.00

$$\begin{aligned} \text{Solar Radiation through Skylight} &= 41.10 \text{ (Asi/Aro) (SCri) Gs} && \text{where } i = 1, 2, \dots, n \\ &= 0.00 \text{ w/m}^2 \end{aligned}$$

$$\begin{aligned} \text{Summary of RTTV at Roof} &= 2.79 + 0.00 + 0.00 \\ &= 2.79 \text{ w/m}^2 \end{aligned}$$

Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings 2014

4.3 Form RTTV (Roof) 2 – Summary of RTTV roof of Building Envelopes

Sheet No. 2 BD Ref No. 2/4073/14
 Building Address Proposed Re-development in K.I.L. 1687 S.A.S.S.2 at 41-45 Pau Chung Street, Kowloon
 Overall Gross Wall Area [a] 120 m²

Roof	Gross Roof Area	Heat Conduction through Opaque Roof	Heat Conduction through Glazing	Solar Radiation through Glazing	RTTVroof at Each Type of Roof	Area-weighted RTTVroof
	(m ²)	(W/m ²)	(W/m ²)	(W/m ²)	(W/m ²)	(W/m ²)
	[b]	[c]	[d]	[e]	[f]=[c]+[d]+[e]	[g]=[f]x[b]/[a]
Roof	120	2.79	0.00	0.00	2.79	2.79

Overall RTTV roof = 2.79w/m²
 $\leq 4w/m^2$