

Design and Construction Requirements for Energy Efficiency of Residential Buildings

Introduction

In Hong Kong, buildings accounted for some 90% of the total electricity consumption¹. Around 26% of the total electricity of the territory was consumed by residential buildings. Enhancing the energy performance of residential buildings forms an important part of the Government's overall strategy towards the achievement of a more environmentally friendly and sustainable built environment. In this connection, the Buildings Department (BD) commissioned a consultancy study on the design and construction requirements of residential buildings for energy efficiency (Consultancy Study) in 2010. This practice note promulgates the measures formulated in the Consultancy Study and sets out the procedures to implement the measures for improving the energy efficiency of residential buildings.

2. For avoidance of doubt, "residential building" in the context of this practice note means a domestic building as defined in section 2(1) of the Buildings Ordinance (BO) but does not include those premises having an air-conditioning operation profile not similar to that of a normal domestic household, such as hotel, guesthouse, residential care home for the elderly / persons with a disability.

Improvement of Energy Efficiency of Residential Buildings

3. Based on the Consultancy Study, a set of design and construction requirements is devised for improving the energy efficiency of residential buildings. These design and construction requirements are promulgated in the "Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings" (Guidelines) which has been issued and uploaded to the BD website at www.bd.gov.hk. The Guidelines set out the following key measures to enhance energy efficiency of residential buildings:-

- (a) controlling Residential Thermal Transfer Values (RTTV) of building envelopes, including visible light transmittance (VLT_{Glass}) and external reflectance (ER_{Glass}) of the glazed portions; and
- (b) promoting natural ventilation in window design for maintaining thermal comfort (NV_{TC}).

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¹ Hong Kong End-use Data 2012 published by the Electrical and Mechanical Services Department.

4. As the building fabric and air-conditioning profile of residents' recreational facilities (RRF) in residential developments share similar attributes with commercial buildings and hotels, the Consultancy Study recommended that the Overall Thermal Transfer Value (OTTV) of RRF ($OTTV_{RRF}$) should be subject to similar control as hotels and commercial buildings.

5. To improve the energy efficiency of residential buildings, the compliance with the following design and construction requirements is included as one of the pre-requisites for the granting of gross floor area (GFA) concessions for green / amenity features and non-mandatory / non-essential plant rooms and services in a residential building under Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (PNAP) APP-151:-

- (a) the RTTV of wall ($RTTV_{Wall}$) and roof ($RTTV_{Roof}$) should not exceed 14 Watt/m² and 4 Watt/m² respectively;
- (b) the $OTTV_{RRF}$ should not exceed 21 Watt/m² (in case of a building tower) or 50 Watt/m² (in case of a podium) as calculated in accordance with the Code of Practice for OTTV in Buildings 1995 (CoP);
- (c) the extent of compliance with NV_{TC} requirements (i.e. the percentage of area of habitable space complying with the Guidelines on NV_{TC}) should be submitted to the BD; and
- (d) glass forming part of the building envelope such as curtain wall, cladding, skylight, window and door of the residential building and RRF should have a VLT_{Glass} of not less than 50%² and an ER_{Glass} of not more than 20%.

Procedures

6. It is recognized that the design of the façade of a building may not have been finalised when the building plans are first submitted to the Building Authority (BA) for approval. Accordingly, the BA would accept that the first submission of building plans need not be accompanied by the information and calculations as required in paragraph 5 above. However, the plans should include a statement indicating that the proposed development should comply with the requirements of $RTTV_{Wall}$, $RTTV_{Roof}$, $OTTV_{RRF}$, VLT_{Glass} and ER_{Glass} under this practice note. The plans should also be accompanied by a letter from the developer or owner undertaking to submit to the BD a provisional energy efficiency report (EE report) and a final EE report, as described more fully in paragraphs 7 and 8 below.

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² The visible light transmittance requirement is only applicable to the glass installed in the prescribed windows referred to in regulations 30 and 31 of the Building (Planning) Regulations.

7. After the approval of general building plans and prior to the application for consent to the commencement of the building works, a provisional EE Report should be submitted to demonstrate compliance with paragraph 5(a), (b) and (d) above. The provisional EE Report should include the following information :-

- (a) RTTV calculations and information on the standard forms at Appendix III of the Guidelines; and
- (b) OTTV_{RRF} calculations, if applicable, with information on the standard forms (Forms OTTV 1 to 4) set out in the Schedule to the CoP.

8. Prior to the application for an occupation permit (OP), the finalised RTTV_{Wall}, RTTV_{Roof}, OTTV_{RRF}, VLT_{Glass}, and ER_{Glass} of the building and the shading coefficients of glass should be incorporated into the general building plans for record. Upon application for OP, the final EE Report containing the updated calculations, the record plans, test certificates or published specifications for the building materials used (such as glass used for fenestration and façade), Summary Sheets in Appendices A and B, and the extent of compliance with NV_{TC} requirements in Appendix VI of the Guidelines should be submitted.

9. A sample of the RTTV calculations for a residential building is provided in Appendix IV of the Guidelines and user-friendly computer spreadsheets are available at the BD website at www.bd.gov.hk to facilitate the calculation of RTTV for residential buildings.

Acceptance of Building Materials

10. If building materials other than those listed in the Guidelines and the CoP are used, their RTTV and OTTV related properties should be obtained from reliable sources. It would facilitate the processing of the consent or OP application if full background of the source of information and the suitability of the materials for use in local conditions are detailed in the submission.

Sunshading and Innovative Designs

11. Genuine sunshades that are conducive to the reduction of RTTV and OTTV are not accountable for GFA and shall not be included in site coverage calculations. In case the sunshades project more than 750 mm from the external walls, quantitative assessment should be submitted to the BA for consideration. It is not envisaged that sunshades would project more than 1.5 m from the external walls.

12. In addition, sunshades with a projection of not more than 750 mm are regarded as not causing obstructions to prescribed windows.

13. Sunshades will not be allowed to project over streets under section 31(1) of the BO, but exemptions may be considered in individual cases if special circumstances so justify.

Disclosure for Public Information

14. To promote the adoption of the Guidelines for enhancing energy efficiency of residential buildings and increase the transparency of information to the public, the information on RTTV (including $RTTV_{Wall}$ and $RTTV_{Roof}$) together with $OTTV_{RRF}$ of individual residential developments will be uploaded onto the BD website after issuance of the OP.

15. The extent of compliance with the NV_{TC} requirements as set out in the Guidelines is collected for further research with a view to formulating a benchmark for NV_{TC} design in the long run. Such information will not be uploaded onto the BD website .

Implementation

16. This practice note does not apply to alteration and addition works or change in use not resulting in a new residential building.

Way Forward

17. Similar to the control on OTTV under the Building (Energy Efficiency) Regulation, the benchmark values for $RTTV_{Wall}$, $RTTV_{Roof}$ and $OTTV_{RRF}$ in this practice note will be subject to periodic review to keep pace with advancement in building design and technological development.

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RTTV Summary Sheet

Address:		BD Ref. No.
Building Type:	Residential	
RTTV calculated by	<input type="checkbox"/> 1. Registered Professional Engineers	
	<input type="checkbox"/> 2. Architect	
	<input type="checkbox"/> 3. Others, please specify :	
No. of Storeys (Residential Units)		

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																					
Wall Orientation Factor																					
Total External Wall Area (Residential Units)	m ²			Window to Wall Ratio			m ²			Window to Wall Ratio			m ²			Window to Wall Ratio					
Total Window Area	m ²			=			m ²			=			m ²			=					
Heat Conduction	Opaque Wall	W/m ²			W/m ²			W/m ²			W/m ²			W/m ²							
	Window	W/m ²			W/m ²			W/m ²			W/m ²			W/m ²							
Window	Glass Type	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %
	Double Glazing	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No							
External Shading	Overhang	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No							
	Sidefin	<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No			<input type="checkbox"/> Yes <input type="checkbox"/> No							
Solar Radiation through Glazing	W/m ²			W/m ²			W/m ²			W/m ²			W/m ²								
Average Absorptivity																					
RTTV _{Wall} at each facade	W/m ²			W/m ²			W/m ²			W/m ²			W/m ²								
Overall RTTV _{Wall}	W/m ²																				

Table 3

RTTV _{Roof}											
Roof Orientation Factor											
Total Roof Area (Residential Units)	m ²										
Total Skylight Area	m ²										
Heat Conduction	Roof	W/m ²									
	Skylight	W/m ²									
Skylight	Glass Type	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %	<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %
Double Glazing	<input type="checkbox"/> Yes <input type="checkbox"/> No										
External Shading	<input type="checkbox"/> Yes <input type="checkbox"/> No										
Solar Radiation through Glazing	W/m ²										
Average Absorptivity (roof)											
Overall RTTV _{Roof}	W/m ²										

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.

OTTV of Resident's Recreational Facilities Summary Sheet

Address:				BD Ref. No.		
Building Type / Use :		Resident's Recreational Facilities				
OTTV calculated by		<input type="checkbox"/> 1. Registered Professional Engineers				
		<input type="checkbox"/> 2. Architect				
		<input type="checkbox"/> 3. Others, please specify :				
Classification		<input type="checkbox"/> Podium / <input type="checkbox"/> Tower				
No. of Storeys (RRF)						
Gross Floor Area		m ²				
Usable Floor Area		m ²				
Total External Wall Area (including windows)		m ²		Window to Wall Ratio		
Total Window Area		m ²		=		
Total Skylight Area		m ²				
**Weighted Average U-value	Opaque Wall	W/m ²				
	Window	W/m ²				
	Opaque Roof	W/m ²				
	Skylight	W/m ²				
Window	Glass Type	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %
	Double Glazing	<input type="checkbox"/> Yes <input type="checkbox"/> No				
	External Shading	Overhang <input type="checkbox"/> Yes <input type="checkbox"/> No Sidefin <input type="checkbox"/> Yes <input type="checkbox"/> No				
Skylight	Glass Type	<input type="checkbox"/> Reflective	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Tinted	Area= m ²	SC=	VLT= %	ER= %
		<input type="checkbox"/> Clear	Area= m ²	SC=	VLT= %	ER= %
	Double Glazing	<input type="checkbox"/> Yes <input type="checkbox"/> No				
	External Shading	<input type="checkbox"/> Yes <input type="checkbox"/> No				
**Weighted Average Absorptivity	Wall					
	Roof					
**Weighted Average Density	Wall	kg/m ²				
	Roof	kg/m ²				
OTTV _{RRF}	Wall	W/m ²				
	Roof	W/m ²				
	Overall Average	W/m ²				

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

** Weighted by area

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.