IEQ 6.6 Lighting Quality

6.6.1 Natural Lighting

Exclusions
None.

Objective
Encourage a holistic examination of site layout, building design, and fenestration design, such as to maximise access to daylight for the purposes of improved health and comfort.

Credits Attainable
3

Pre-requisites
None.

Credit Requirement
1 credit where the provision of daylight meets the levels specified in PNAP 278 for vertical daylight factor OR the average daylight factor (DF) is at least 0.5% for all normally occupied spaces.

2 credits where the average daylight factor in all normally occupied spaces is at least 1%.

3 credits where the average daylight factor in all normally occupied spaces is at least 2%.

Assessment
The Client shall submit evidence in the form of a report prepared by a suitably qualified person demonstrating compliance with the assessment criteria. Daylight availability, based on ‘worst case’ scenarios, i.e., the most obstructed windows, shall be demonstrated by either one of the following methods.

a) Measurement of VDF

On-site measurements for a selection of windows that are shown by design drawings to have the greatest external obstructions. The measurements should be carried out during stable overcast sky conditions.

To assess vertical daylight factor (VDF) an illuminance meter should be placed at the centre of the window and another illuminance meter on a horizontal plane under an unobstructed sky. In practice, a completely unobstructed horizontal plane may be difficult to achieve in the Hong Kong urban environment and the roof of the building may be a good approximation to an unobstructed horizontal plane. The two illuminance meters should be read simultaneously and the ratio of the illuminance on the window and the illuminance on the unobstructed horizontal plane is taken as the vertical daylight factor.

To qualify for credit the glazing visual transmittance, obtained from manufacturer's specification of the glazing product or by measurement, shall be equal or greater than 70%.

b) Measurement of DF

Measurement of average daylight factor (DF) shall be by the methods recommended by CIBSE [1], or equal equivalent.

Given that the specified sky condition can be difficult to obtain in practice the following modelling methods are acceptable alternatives.

c) Estimation of VDF

The CIE standard overcast sky shall be used in computer simulations.

Compliance with the VDF criteria can be demonstrated using the method

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1 The Chartered Institution of Building Services Engineers. Applications Manual – Window design.
given in PNAP 278 [2], provided application of the method takes account of the limitations stated in the Appendix A. The alternative is to use the HK-BEAM preferred method developed by Cheung and Chung [3] which can be applied without restrictions. (Details of this method with supporting calculation spreadsheet are available from the authors upon request).

d) Estimation of DF

The average daylight factor (DF) shall be estimated according to the preferred method [3], that given in the CIBSE design guide [4], or similar equivalent method. Alternatively, daylighting design software such as Radiance [5] can be used to calculate the average DF provided it can be demonstrated that the method of computation employed by the software used is not inconsistent with the preferred calculation method.

The report submitted shall identify the key parameters used in the computations/modelling, especially with regard to glazing transmittance, and the reflectance’s of external and internal surfaces. The values of the parameters shall reflect the nature and type of surfaces on the external vertical obstructions and horizontal surfaces, and likely internal finishes.

The room dimensions shall be taken to be a typical perimeter room for the building, be it a habitable room, office, classroom, etc.

BACKGROUND

Access to daylight is an important aspect of building design from the perspectives of comfort and health. Critical to providing sufficient daylight is the provision of a view of the sky. The amount of daylight available for specific rooms is related to:

- window and room geometry and room surface finishes;
- sky obstruction due to the form of the building and its overshadowing from neighbouring buildings;
- glazing transmittance.

In Hong Kong’s congested built form rooms on lower floors of buildings may be considerably overshadowed by the built form. This can result in significantly reductions in natural light, and will incur increased electricity consumption for artificial lighting, and degradation of internal comfort and health conditions. It is possible to take into account the overshadowing by adjacent buildings using appropriate design tools.

VERTICAL DAYLIGHT FACTOR

In Hong Kong, Building (Planning) Regulations CAP123 - Lighting and Ventilation sets out prescriptive requirements of a minimum window to floor area ratio of 10% and a maximum obstruction angle of 71.5° for habitable rooms. On a trial basis the Building Authority (BA) is prepared to accept an alternative performance standard on the provision of natural lighting in habitable rooms and domestic kitchens for the purpose of Building (Planning) Regulations (B(P)Reg.) 30, 31 and 32:

Vertical Daylight Factor (VDF) (measurement taken on the centre of the window pane):

- Habitable Room 8%  Kitchen 4%

To assist designers in adopting the above performance-based approach in design, guidelines with a simplified assessment method are given in

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3 Cheung H D, Chung T M. Calculation fo Mean Daylight Factor in a Building Interior Within a Dense Urban Environment. Department of Building Services Engineering, Hong Kong Polytechnic University.
4 The Chartered Institution of Building Services Engineers. Lighting Guide LG10. daylighting and window design. CIBSE.
5 Ward Larson, G. and Shakespeare, R. Rendering with RADIANCE. Morgan Kaufmann. San Francisco.
Appendix A of PNAP 278.

The Practice Note recommends the use of the "Unobstructed Vision Area" (UVA) method as a reliable tool to demonstrate compliance with the performance requirements. However, the correlation between VDF and UVA is not entirely convincing. In fact, VDF assesses only one factor determining the indoor daylight environment, namely the external daylight availability. The internal daylight levels depend also on the window size and configuration and the transmission property of the window glazing. The total daylight environment of a room depends also on the depth of the room. Daylight penetration in side lit rooms is limited to a shallow perimeter area adjacent to the window. For deep rooms, the back of the room looks gloomy unless some advanced daylight redistribution systems such as light shelves exist in the room. For these reasons, HK-BEAM gives credit for building designs that provide for the use of sufficient daylight.

A typical overcast sky condition in Hong Kong provides 5000 to 10000 lux, so a 1% average DF is an average of 50 to 100 lux in the space.