Code of Practice on Wind Effects in Hong Kong

The Code of Practice on Wind Effects in Hong Kong 2019 (2019 Code) was promulgated in September 2019. The 2019 Code is a comprehensive code of practice on wind effects for building design in Hong Kong, taking into account the research on the latest development in wind engineering and technologies, and the available international codes of practices on wind loading. The Explanatory Notes to the 2019 Code (EN) provide further guidance on the use of the 2019 Code with theoretical background, assumptions, sources of reference and illustrative examples. The EN should **NOT** be construed as a part of the Code.

Implementation of 2019 Code

2. The 2019 Code has been effective since the issue of the circular letter on 30 September 2019. Submissions of plans for foundation or superstructure works designed to the Code of Practice on Wind Effects in Hong Kong 2004 were accepted during the grace period commencing on the date of the circular letter. After the expiry of the extended grace period on 31 March 2021, only submissions of plans for foundation or superstructure works designed to the 2019 Code are accepted. However, if the plans[1] for foundation or superstructure works had been submitted before the expiry of the extended grace period and were approved by the Building Authority (BA), the subsequent submissions of plans for foundation or superstructure works might continue to adopt the same code of practice on wind effects used in the original design.

3. For alteration and addition proposals submitted after the grace period, the design of new structural elements and/or checking of structural adequacy of the existing structure should follow the guidance given in the Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (PNAP) APP-117.

4. Notwithstanding the above arrangements, under section 16(3)(d) of the Buildings Ordinance, the BA may refuse to give his consent to the commencement of any building works when a period exceeding 2 years has elapsed since the approval of the prescribed plans in respect of the building works.

/5. ...

1 Including those plans for foundation or superstructure works designed with loading allowance for future structures.

5. After the promulgation of the 2019 Code, the Buildings Department (BD) has set up a Technical Committee (TC) to, among others, collect and consider the views and feedback from the building industry arising from the use of the 2019 Code and the EN. Taking into account the advice of the TC, the following amendments have been promulgated and uploaded to BD website www.bd.gov.hk:

(a) Amendments to the 2019 Code in Appendix A – December 2023; and

(b) Amendments to the EN in Appendix B – December 2023.

Wind Tunnel Test

6. Section 6 of the 2019 Code specifies the requirements for wind tunnel testing. If the wind tunnel test will not be carried out in accordance with these requirements, submission of the wind tunnel testing methodology proposal for prior acceptance by BD is required. BD will provide a determination on the wind tunnel testing methodology proposal normally within 45 days after receipt of the proposal. The registered structural engineer (RSE) may submit a pre-submission enquiry in accordance with PNAP ADM-19 with a preliminary test proposal to settle the design principles before formal submission of the wind tunnel testing methodology proposal. BD may hold pre-submission conferences with the RSE and representatives of the wind tunnel test laboratory to discuss and examine the principles and methodology involved. The essential information to be included in the wind tunnel testing methodology proposal is at Appendix C.

7. Quality assurance plan should be included in the wind tunnel testing methodology proposal. Reference can be made to relevant international standards/manuals such as "ASCE Manuals and Reports on Engineering Practice No. 67 - Wind Tunnel Studies of Buildings and Structures" published by the American Society of Civil Engineers or "Quality Assurance Manual: Wind Engineering Studies of Buildings" published by the Australasian Wind Engineering Society. The essential information to be included in the quality assurance plan is at Appendix D.

8. Wind tunnel test should be witnessed by RSE or an independent engineer who should not be a member of staff or employee of the wind tunnel test laboratory. The independent engineer, serving as RSE's representative, should be a Corporate Member of the Hong Kong Institution of Engineers or possess equivalent professional qualification, and has a minimum total relevant working experience of five years. RSE or the independent engineer should ensure that the quality assurance procedures have been properly followed.

9. The wind tunnel testing report should contain the testing procedures, whole set of test readings, structural and dynamic properties of the building structure adopted in the wind loads calculation together with a statement signed by RSE to confirm that proper supervision arrangement has been provided when conducting the wind tunnel test and the raw data and results of the wind tunnel test fully meet the requirements of the 2019 Code for the determination of wind loads for incorporation in structural submissions for the particular project.

(YU Po-mei, Clarice)
Building Authority

Ref. : BD GR/1-50/59/0

This PNAP is previously known as PNAP 219
First issue December 2004
This revision December 2023 (AD/NB2) (General revision)

Appendix A
(PNAP APP-139)

Amendments to the Code of Practice on Wind Effects in Hong Kong 2019

(December 2023)

Legends:

Amended

Deleted

(12/2023)

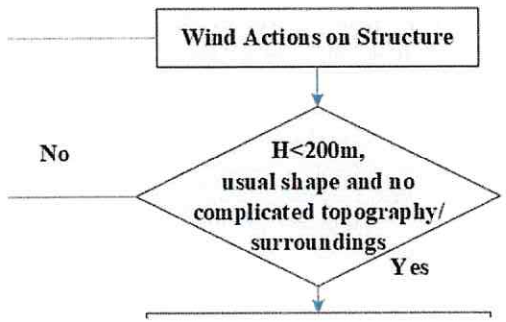
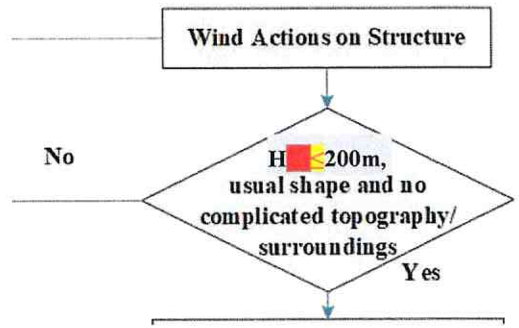
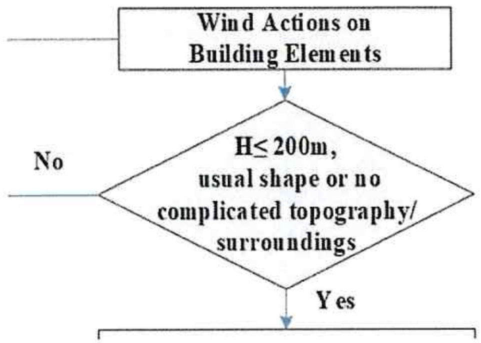
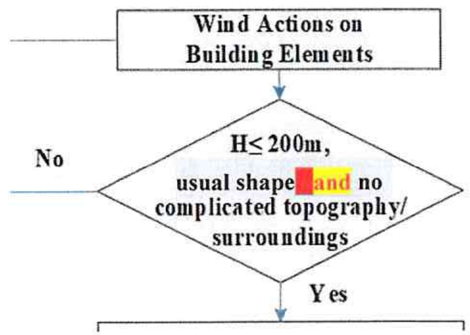
Amendments to the Code of Practice on Wind Effects in Hong Kong 2019 in December 2023 included:

(a) Figures 2-1 and 2-2 – Revision on the condition required to carry out wind tunnel test;

(b) Table 4-1, Appendix A2 and Figure B3-1 – Textual refinement; and

(c) Figure 5-2 and Appendix C1 – Elaboration on calculation of size factor.

Amendments to the Code of Practice on Wind Effects in Hong Kong 2019

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>1. Figure 2-1</td><td>
</td><td>
</td></tr>
<tr><td>2. Figure 2-2</td><td>
</td><td>
</td></tr>
<tr><td>3. Table 4-1</td><td>(d) Where there are significant steps in building form, i.e. podiums, the height rules for tower and podium in Figure 4.6(a) and Figure 4.6(b) should be followed.</td><td>(d) Where there are significant steps in building form, i.e. podiums, the height rules for tower and podium in Figure 4.5(a) and Figure 4.5(b) should be followed.</td></tr>
</table>

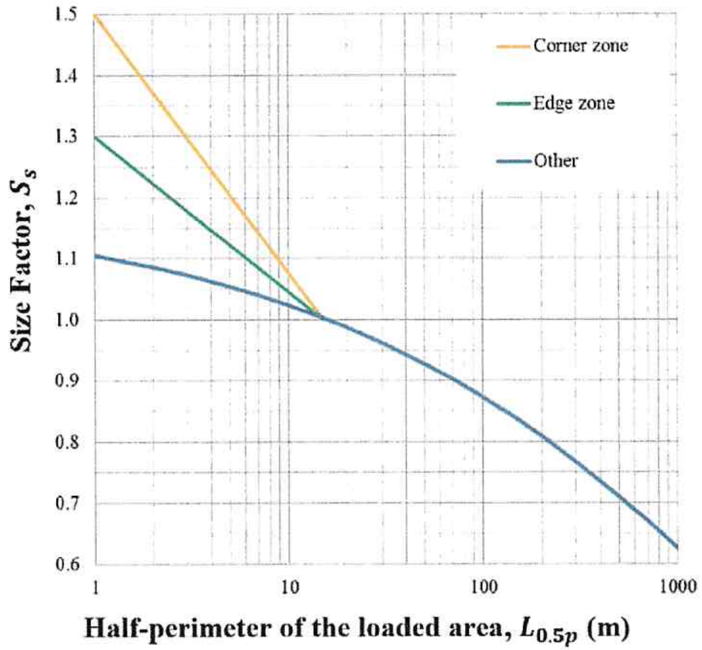
<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>4. Figure 5-2</td><td>

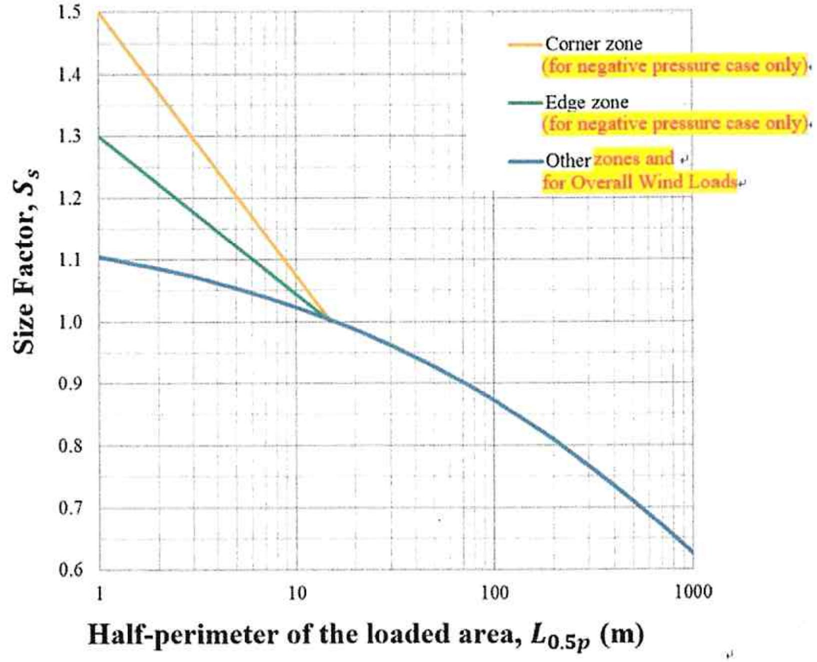
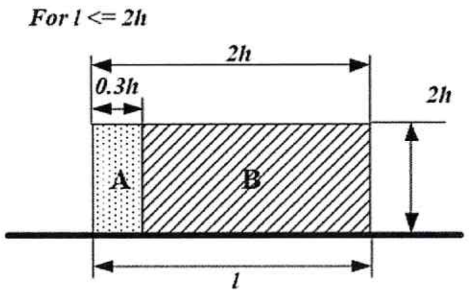
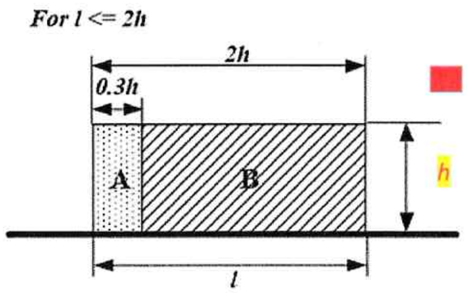
Figure 5-2 Size factor, S_s</td><td>

Figure 5-2 Size factor, S_s</td></tr>
<tr><td>5. Appendix A2</td><td>Figure A2-3 can be used to determine the most and the second most obstructing buildings. The largest and the second largest H_d. Z_e are taken as the following:</td><td>Figure A2-3 can be used to determine the most and the second most obstructing buildings (i.e. the largest and the second largest H_d). Z_e are taken as the following:</td></tr>
</table>

Item	Current version	Amendments
6. Figure B3-1		
7. Appendix C1	**C1 Equations for Calculation of Size Factor** The size factor, S_s, depends on the loaded area and is defined by the half-perimeter of the area, $L_{0.5p}$ as shown in Figure 5-2. Alternatively, S_s, may be calculated using the formulas below: **Other zones and for Overall Wind Loads** $S_{s=L_{0.5p}} = Exp(0.17 - 0.07\ L_{0.5p}{}^{0.32})$ - Equation C1-1a **Edge** zones if $L_{0.5p} < 15\text{m}$ $S_{s=L_{0.5p}} = 1.3 - \log_n(L_{0.5p})\ /9.0 > 1.0$ - Equation C1-1b **Corner** zones if $L_{0.5p} < 15\text{m}$ $S_{s=L_{0.5p}} = 1.5 - \log_n(L_{0.5p})\ /5.4 > 1.0$ - Equation C1-1c	**C1 Equations for Calculation of Size Factor** The size factor, S_s, depends on the loaded area and is defined by the half-perimeter of the area, $L_{0.5p}$ as shown in Figure 5-2. Alternatively, S_s, may be calculated using the formulas below: **Edge zones if $L_{0.5p} \geq 15\text{m}$, Corner zones if $L_{0.5p} \geq 15\text{m}$, Other zones and for Overall Wind Loads** $S_{s=L_{0.5p}} = Exp(0.17 - 0.07\ L_{0.5p}{}^{0.32})$ - Equation C1-1a **Edge** zones if $L_{0.5p} < 15\text{m}$ $S_{s=L_{0.5p}} = 1.3 - \log_n(L_{0.5p})\ /9.0 > 1.0$ - Equation C1-1b **Corner** zones if $L_{0.5p} < 15\text{m}$ $S_{s=L_{0.5p}} = 1.5 - \log_n(L_{0.5p})\ /5.4 > 1.0$ - Equation C1-1c

Amendments to the Explanatory Notes to the Code of Practice on Wind Effects in Hong Kong 2019 (December 2023)

Legends:

Amended

Deleted

(12/2023)

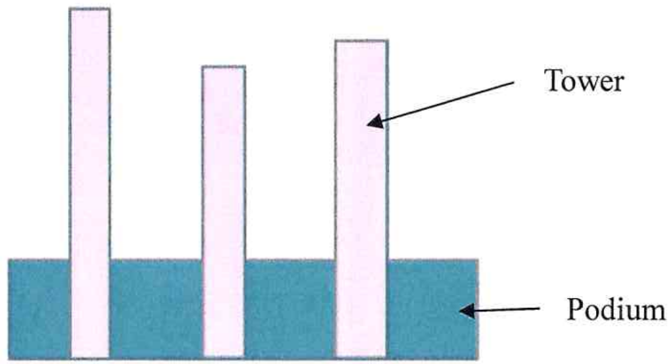
Amendments to the Explanatory Notes to the Code of Practice on Wind Effects in Hong Kong 2019 in December 2023 included:

(a) Clause 2.2.3 – Addition of guidelines for determination of fundamental frequency for assessing across wind effects;

(b) Clause 2.5 – Addition of design net pressure for hoarding and covered walkway associated with construction site; and

(c) Clause 4.3.1, Clause 6.4, Figure B-1, Appendices C2 and E3.1 – Textual refinement.

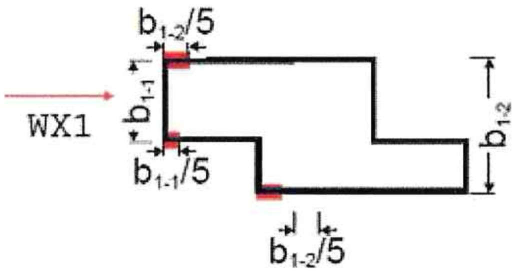
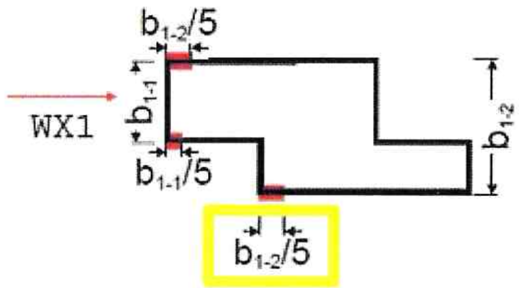
Amendments to the Explanatory Notes to the Code of Practice on Wind Effects in Hong Kong 2019

Item	Current version	Amendments
1. Clause 2.2.3	Last paragraph – According to a parametric study with selected parameters, assuming natural periods of $H/46$ in both directions, for buildings which satisfy $H/min(B,D)<5$, $H<100$m and $N>0.5$Hz, the along-wind base moment is always larger than the across-wind base moment in the same direction, even with consideration of some level of uncertainty on the period estimation. Therefore checking of the across-wind base moment is not required when these conditions are met.	Last paragraph – According to a parametric study with selected parameters, assuming natural periods of $H/46$ in both directions, for buildings which satisfy $H/min(B,D)<5$, $H<100$m and $N>0.5$Hz, the along-wind base moment is always larger than the across-wind base moment in the same direction, even with consideration of some level of uncertainty on the period estimation. Therefore checking of the across-wind base moment is not required when these conditions are met. For multiple towers over a common podium, the fundamental frequency for estimation of across wind effects could be assessed by either one of the following assumptions: (a) assuming individual tower standing alone and extended to the building base without connecting to the podium; 

Item	Current version	Amendments
		(b) assuming individual tower integrated with the portion of the podium measured from structural wall/column edge of the modelled tower by not exceeding the minimum of 20m, three bays of the podium structure, and the middle line between the modelled tower and its nearby tower, subject to no substantial openings in floor slabs of the integrated portion of the podium. The effect of those floor openings might be considered separately; or (c) assuming individual tower integrated with the portion of the podium in conformity with the recognised engineering principles and engineering practices. Alternatively, if an integrated computer model of the towers and podium was set up, the dominant fundamental frequency of the mode of vibration mainly aligned with the across-wind direction of the respective towers obtained from the computer analysis could be adopted based on engineering justification. For cases where the tributary extent could not be clearly defined based on the above-mentioned criteria (b), an integrated computer model with all the towers and podium might be used to obtain the dominant fundamental frequency of the respective towers.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>2. Clause 2.5</td><td>End of 2nd paragraph –
For designing hoarding and covered walkway associated with construction site, contractor shed, bamboo shed, tent or marquee that are not for residential use, wind pressures of not less than 37 per cent of the pressures given in the Code should be used.</td><td>End of 2nd paragraph –
For designing hoarding and covered walkway associated with construction site, contractor shed, bamboo shed, tent or marquee that are not for residential use, wind pressures of not less than 37 per cent of the pressures given in the Code should be used. In particular for hoarding and covered walkway associated with construction site, the design net pressure in Table 2-1 may be used.

Table 2-1 Design net pressure for hoarding and covered walkway associated with construction site
<table>
<tr><th>Height above ground level, Z(m)</th><th>Design Net Pressure (kPa) (all-inclusive value)</th></tr>
<tr><td>≤ 2.5</td><td>0.63</td></tr>
<tr><td>5</td><td>0.70</td></tr>
<tr><td>10</td><td>0.77</td></tr>
</table>
Notes:
(a) For intermediate values of height, linear interpolation is permitted.
(b) Cp and Ss have been included.
(c) Beneficial effect due to self-weight of steel members may be considered.
(d) Topography factor should be considered in location where local topography may adversely affect wind effect.</td></tr>
<tr><td>3. Clause 4.3.1</td><td>Last paragraph –
However, the accidental dominant open scenario is out of scope of this Code, as discussed in Appendix B1.3.</td><td>Last paragraph –
However, the accidental dominant open scenario is not a compulsory requirement of this Code, as discussed in Appendix B1.3.</td></tr>
<tr><td>4. Clause 6.4</td><td>Last sentence of 2nd paragraph –
If a building removal investigation is not carried out, then the shelter benefit is limited to 80% of the along-wind value in accordance with the Code.</td><td>Last sentence of 2nd paragraph –
If a building removal investigation is not carried out, then the shelter benefit is limited to 80% of the loads of the Standard Method. The comparison should be in the form of total base moments.</td></tr>
</table>

Item	Current version	Amendments
5. Figure B-1	Top left figure – 	Top left figure – 
6. Appendix C2	2nd paragraph – Outlying high damping value was recorded for a 200m building which was cubic.	2nd paragraph – Outlying high damping value was recorded for a 250m building which was cubic.
7. Appendix E3.1	The critical torsional load cases can be obtained by the following procedures: 1. For each tower, the loads on individual towers are calculated following the Code as shown in Figure E-7(a), (b) and (c). 2. Obtain the eight translational governed loads according to Section E2. In each subzones defined in Figure E-5, the resultant force ($F_{lateral-i}$) can be calculated by vector summation. For example, $F_{lateral-1}$ is the resultant force by F_{1-1}, F_{2-1} and F_{3-1}, as shown in Figure E-7(d). 3. For each $F_{lateral-i}$, the maximum projecting diagonal breadth B_i can be identified as shown in Figure E-7(e).	The critical torsional load cases can be obtained by the following procedures: 1. For each tower, the loads on individual towers are calculated following the Code as shown in Figure E-7(a), (b), (c) and (d). 2. Obtain the eight translational governed loads according to Section E2. In each subzones defined in Figure E-5, the resultant force ($F_{lateral-i}$) can be calculated by vector summation. For example, $F_{lateral-1}$ is the resultant force by F_{1-1}, F_{2-1}, F_{3-1} and F_{4-1}, as shown in Figure E-7(e). 3. For each $F_{lateral-i}$, the maximum projecting diagonal breadth B_i can be identified as shown in Figure E-7(f).

Essential Information in Wind Tunnel Testing Methodology Proposal

<table>
<tr><th colspan="2">Typical Items</th><th>Essential Information</th></tr>
<tr><td colspan="2">General</td><td>(a) Name and location of wind tunnel test laboratory.</td></tr>
<tr><td rowspan="4">Modelling and Instrumentation</td><td>General
(See clause 6.1.1 and 6.1.2)</td><td>(a) Site location;
(b) Plan of building including geometry, elevations with floor levels;
(c) Ratios of H/B and H/D of building and frequency modes to be considered; and
(d) Scope of the wind tunnel test, e.g. determination of wind load, acceleration, pressure for cladding/curtain wall/building elements and others.</td></tr>
<tr><td>Topographic Model
(See clause 6.1.3, 6.1.5 and 6.1.6)</td><td>(a) Scale, extent and material(s) of model;
(b) Blockage ratio;
(c) Approaching wind profiles including mean wind speed and turbulence intensity profile; and
(d) Number of wind directions and their intervals.</td></tr>
<tr><td>Proximity Model
(See clause 6.1.3, 6.1.4, 6.1.5 and 6.1.6)</td><td>(a) Scale and extent of model;
(b) Source of information of surrounding buildings;
(c) Material(s) of model (including proposed and surrounding buildings);
(d) Reynolds number and blockage ratio;
(e) Number of wind directions and their intervals;
(f) Matching height of peak gust pressure;
(g) Topographic multiplier; and
(h) Matching peak gust pressure of the 2019 Code.</td></tr>
<tr><td>Instrumentation
(See clause 6.1.1 and 6.3)</td><td>(a) Method of measurement;
(b) Data sampling frequency and length, and full-scale-equivalent duration;
(c) Number and density of pressure taps (if applicable); and
(d) Additional requirements (if any).</td></tr>
<tr><td>Wind Climate</td><td>Directionality
(See clause 6.5.2)</td><td>(a) Source of wind climate data;
(b) Directionality factors (if applicable); and
(c) Analysis technique, i.e. Sector Method, Up-crossing Method, Storm Passage Method or other methods.</td></tr>
</table>

Typical Items		Essential Information
Testing Configurations	Testing Configurations (See clause 6.4)	(a) Existing configuration; and (b) Removal configuration with applied principle for building removal, and total number of buildings/ building lots to be removed.
Post-Processing	Theoretical Background	(a) Theoretical background, e.g. dynamic modal analysis/ random vibration theory, pressure integration method, design peak cladding pressure determination and peak building acceleration assessment.
	Load Combination (See clause 6.6)	(a) Background for determination of load combination factors with proposed number of load cases; and (b) Additional requirement (if any).
	Load Distribution (See clause 6.6)	(a) Background for computation of vertical distribution of storey wind loads.
Quality Assurance	Quality Assurance Plan	(a) Details refer to Appendix D.

Remark: Reference clauses of the Code of Practice on Wind Effects in Hong Kong 2019 are shown in brackets.

(12/2023)

Essential Information in Quality Assurance Plan for Wind Tunnel Test

	Typical Items	Essential Information
1.	Wind Tunnel Models	(a) Procedures on fabrication and checking of model(s); (b) Limitations of the modelling, testing and analysis techniques and tolerances; and (c) Procedures including inspection and endorsement by RSE (with flowchart).
2.	Instrumentation for Wind Tunnel Testing	(a) Details and time intervals of calibration of device/ apparatus for the test; and (b) Checking on the proper operation of device/apparatus including generation of the wind profile before commencement of and during the test.
3.	Data Analysis/ Reporting	(a) Checking of accuracy and consistency of input and output data of the computer software by sample calculations; (b) Procedures for verification of the test results and measures to minimise errors/irregularities in the test results; (c) Reporting system and follow-up actions such as re-testing for irregularities noted; (d) Proper recording system for all details of the test, including photographic records of the wind tunnel test setup, model and test apparatus; and (e) Procedures on preparation, checking and endorsement of test reports.
4.	Supervision	(a) Details, including names and posts, of supervisory personnel in-charge of each stage; (b) Monitoring and frequency of checking during the course of the test, analysis and reporting; and (c) Name of the independent engineer serving as the RSE's representative.