Tentative Revision Contents for Wind Load Provisions of the 2013 Version of the Korean Building Code-Structural

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ABSTRACT: This paper describes tentative revision contents for Wind Load Provisions of 2013 version of the Korean Government Guidelines of the Korean Building Code-Structural (KGG-KBCS-13). The work of revision will be carried out by Architectural Institute of Korea (AIK) on April 2012 and shall be completed in December 2013.

KEYWORDS: Buildings, Wind loads, Korean Building Code-Structural, Wind resistant design, Wind forces/pressure coefficient, Wind tunnel test.

INTRODUCTION

On April 2005, unified Korean Government Guidelines of Korean Building Code-Structural has been established. The KGG-KBCS-05[1)] consists in eight sections as followings:

- Section 1 General;
- Section 2 Structural Experiments and Qualifications, which was newly added;
- Section 3 Design Loads, which was adapted the KGG-SDLB-00[2)];
- Section 4 Foundations, which was adapted the 1974 version of Recommendations of the AIK for Structural Foundation of Buildings[3)];
- Section 5 Concrete Structures, which was adapted KGG-CS-03[4)] and it was based on the Ultimate Strength Design;
- Section 6 Masonry Structures, which was adapted the 2003 version of Recommendations of the AIK for Masonry Structures;
- Section 7 Steel Structures, which was adapted the KGG-SBS-03[5)] (based on the Allowable Stress Design) and the 1998 version of Recommendations of KSSC[6)] for Steel Building Structures (based on the Limit State Design); the Limit State Design would be basically encouraged however the Allowable Stress Design can be used; and
- Section 8 Wooden Structures, which was adapted the 2003 version of Recommendations of the AIK for Wooden Structures[7)].

The Architectural Institute of Korea (AIK) carried out the revision work of KGG-KBCS-05 and it was approved by the Ministry of Construction and Transportation (MOCT). Therefore, the KGG-KBCS-05 should be legally used for the structural design of buildings and structures in Ko-

rea. The first revision work of KGG-KBCS had been performed in 2008 and the AIK carried out the revision work. The second revision work of KGG-KBCS has been started on April 2012. The AIK set up eight sub-committees for the work of KGG-KBCS-2008[8] on April 2012. Each sub-committee established to a tentative guidelines for revisions. I am a member of sub-committee for wind load. In this paper, tentative contents which are changed from version of 2008 or added to new version of 2013, for the revision of wind load provisions of KGG-KBCS shall be introduced.

1. Velocity pressure

For estimating the wind pressure p_f on the windward external wall, the velocity pressure q_Z corresponding to the design height of Z above ground level shall be taken. However, for estimating the leeward or the side walls, the velocity pressure q_H corresponding to the mean roof height of H shall be taken.

$$p_f = G_f q_Z C_{pe1} - G_f q_H C_{pe2}$$

Where G_f = Gust effect factor

C_{pe1} = Wind pressure coefficients on the windward face

C_{pe2} = Wind pressure coefficients on the leeward face

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- Instead of velocity pressure q_Z which is changed in according to the height Z above ground surface at windward face, uniform velocity pressure q_H at reference height H shall be taken in windward face.

$$p_f = G_f q_H (C_{pe1} - C_{pe2})$$

- Effects of changing wind pressure in according to vertical profile shall be included in wind pressure coefficient C_{pe1} of windward face.

$$C_{pe1} = 0.8k_Z + 0.03(D/B)$$

$k_Z = (Z/H)^{2\alpha}$: Wind pressure distribution factor for vertical profile

Where B = Horizontal dimension of building breadth

D = Horizontal dimension of building depth

α = Exponent of the power law in the wind speed profile.

2. Wind pressure coefficient

The external pressure coefficients for closed or partially opened buildings are given in Table 1.

Table 1. External pressure coefficients for walls

	D/B	C_{pe}	Applicant velocity pressure
Windward walls	All values	0.8	q_z
Leeward walls	0~1	-0.5	q_h
	2	-0.3	
	≥ 4	-0.2	
Side walls	All values	-0.7	q_h

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- As shown in Table 2, wind pressure coefficient C_{pe} for wind windward wall and leeward wall shall be changed in according to side ratio D/B.
- Wind pressure distribution factor for vertical profile k_Z, as shown in Table 3, shall be reflected on the effects of changing wind pressure in according to vertical profile of windward face

Table 2. External pressure coefficient for wall [9)]

	D/B	C_{pe}
Windward walls	All values	$0.8k_Z + 0.03(D/B)$
Leeward walls	≤ 1	-0.5
	>1	$-0.5+0.25\ln(D/B)^{0.8}$
Side walls	All values	-0.7

Notes B = Horizontal dimension of building breadth.
D = Horizontal dimension of building depth

Table 3. Wind pressure distribution factor for vertical profile k_Z [9)]

$Z \leq 20m$	$Z > 20m$
$(20/H)^{2\alpha}$	$(Z/H)^{2\alpha}$

Notes Z = Height above ground
H = Building height
α = Exponent of the power law in the wind speed profile

3. Dynamic response due to the wind induced vibration of across-wind direction

The KGG-KBCS-08 described only along-wind load estimating method.

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- Wind loads W_L on structural frames caused by across-wind vibration shall be calculated by followings.

$$W_L = 3 g_L C_{M,L}{}' q_H A \left(\frac{Z}{H}\right) \sqrt{1+R_L}$$

Where $g_L = \sqrt{2\ln(600 n_L)} + 1.2$

$C_{M,L} = 0.0073(D/B)^3 - 0.0629(D/B)^2 + 0.1959(D/B)$

R_L = Resonance factor for across-wind vibration

n_L = Natural frequency for first mode in across-wind direction

- The tip displacement $X_{\max,L}(z)$ and acceleration $\hat{\sigma}_{\ddot{x},L}(z)$ for buildings caused by across-wind vibration shall be calculated by followings. These were formulated based on the results of High Frequency Base Balance Test for various building types and terrains.[10)]

$$X_{\max,L}(z) = g_L \sigma_{x,L}(z)$$

Where $g_L = \sqrt{2\ln(600 \nu_L)} + 1.2$

$$\sigma_{x,L}(z) = \frac{\sigma_{M,L}}{(2\pi n_L)^2 M_L{}^* H} \sqrt{1+R_L}$$

ν_L = Level crossing number in across-wind direction

$\sigma_{M,L}$ = Rms overturning moment coefficient in across-wind direction

$M_L{}^*$ = Generalized mass in across-wind direction

R_L = Resonance factor for across-wind vibration

$$\hat{\sigma}_{\ddot{x},L}(z) = g_L \sigma_{\ddot{x},L}(z)$$

Where $g_L = \sqrt{2\ln(600 \nu_L)} + 1.2$

$$\sigma_{\ddot{x},L}(z) = \frac{\sigma_{M,L}}{M_L{}^* H} \sqrt{R_L}$$

4. Simplified procedure for estimating wind load

The KGG-KBCS-08 was described only detailed procedure for estimating wind load of buildings.

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- Simplified procedure can be applied to buildings which satisfy the following conditions.
  1) Shapes and structural systems of buildings are not special
  2) Mean roof height is less than 20m
  3) $H / \sqrt{BD} \leq 1.0$
- Horizontal wind loads W_{SF} for structural frames shall be calculated from following.[11)]

$$W_{SF} = 0.25 V_0^2 H^{0.44} C_e C_F A$$

Where V_0 = Basic wind speed

H = Mean roof height

C_e = Exposure factor which is generally 1.0 and shall be 1.45 for open terrain with few obstruction and 2.0 for costal area.

$C_F = C_{pe1} - C_{pe2}$: Wind force coefficient

A = Subjected area

- Wind loads W_{SC} on cladding of building shall be calculated from following. [11)]

$$W_{SC} = 0.12 V_0^2 H^{0.44} C_e (GC_{pe} - GC_{pi}) A_C$$

Where C_e = Exposure factor which is generally 1.0 and shall be 1.70 for open terrain with few obstruction and 2.2 for costal area.

GC_{pe} = Peak external pressure coefficient on components/cladding of building

GC_{pi} = Peak internal pressure coefficient on components/cladding of building

A = Subjected area on components/cladding of building

CONCLUSION

It is necessary timely to revise the Loads Standard corresponding to the needs of technical and economical developing. The 2008 version of the wind load provisions of the KGG-KBCS-08 are carried out in an effort to contain more detailed, realistic and reasonable load data. We are sure that it will be more suitable for the structural design practice and provide more realistic, economical design environment to the structural engineers. However, the wind load provisions of the KGG-KBCS-08 could not sufficiently include the rational evaluating methods necessary to esti-

mate the safety or habitability of buildings and structures. Many studies have been carried out under financial support of the MOCT and revision work has continued to incorporate study results. These results[9), 10), 11)] shall be introduced into new KGG-KBCS version in 2013, thus new version may be developed and enriched.

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