Wind Engineering Joint Usage/Research Center
FY2018 Research Result Report

Research Field: Wind Hazard Mitigation/Wind Resistant design
Research Year: FY2018
Research Number: 182001
Research Theme: Researches on characteristics of wind forces acting on high-rise buildings

Representative Researcher: Dr. Achal Kumar Mittal

Budget [FY2018]: Yen 200000

*There is no limitation of the number of pages of this report.
*Figures can be included to the report and they can also be colored.
*Submitted reports will be uploaded to the JURC Homepage.

1. Research Aim: Interference effects on local peak pressure between tall buildings under varying plan ratios and over an extended interference zone region

2. Research Method: To assess the wind-induced interfering effects between two buildings, wind tunnel experiments on a tall building model with various location arrangements and different plan ratios of an interfering building are to be carried out in a Boundary Layer Wind Tunnel under urban wind exposure condition (at Tokyo Polytechnic University (TPU), Japan). The experimental model would comprise of two buildings: the principal building and the interfering building. Three building plan ratios will be considered in the study (Br=0.7,1,1.5). The interfering building is placed at different upstream arrangements with respect to the principal building at (Sx, Sy) = (0, 0). The center-to-center spacing between them is varied by S_x longitudinally and S_y laterally. The local peak pressures on all faces of the principal building will be measured for 0 to 360 degree wind directions at every 5 degree interval.

3. Research Result: Refer Page - 3

4. Published Paper etc.
[Underline the representative researcher and collaborate researchers]
[Published papers]

S. Behera, A. K. Mittal, D. Ghosh, Y. Tamura, W. Kim, “Wind interference effect between tall buildings for changing plan ratios”, *International Workshop on Wind Effects on Buildings and Urban Environment*, March 10-12, 2019, Tokyo Polytechnic University, Atsugi, Japan.

5. Research Group
1. Representative Researcher: Dr. Achal Kumar Mittal, Senior Principal Scientist,
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2. Collaborate Researchers

Names	Department	Organization
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6. Abstract (half page)

Tall buildings are vulnerable to lateral loading. The facades of these buildings are susceptible to wind loads. It is very difficult to assess the wind condition around the tall building in presence of other surrounding buildings due to wind interference effect. The data from experiments carried out in Boundary Layer Wind Tunnel at Tokyo Polytechnic University, Japan was utilized to study wind interference effect between square plan tall buildings. The interfering building used was of same height as that of the principal building but with three different plan or side ratios .i.e. 0.7, 1.0 and 1.5. The local peak pressures on all four faces of the principal building were obtained for 25 different upstream arrangements and for 72 wind directions each at an interval of 5°. The maximum and minimum peak pressure coefficient contours on front face of principal building are compared both for isolated as well as for interference at selected wind directions. The interference effect is quantified in terms of interference zone factors and corresponding contour charts were developed. It is observed that Interference zones extend over larger area as the building plan ratios increases. The minimum interference factor depends on the plan ratios of the interfering building especially along the oblique direction. The percentage variation of net pressure coefficient at top of principal building (both along and across) for all three interfering building types in tandem for 0° and 180° wind directions was also studied in this paper.

Keywords: Tall Building, Interference effect, Wind Tunnel, Pressure coefficient

Research Theme: Researches on characteristics of wind forces acting on high-rise buildings
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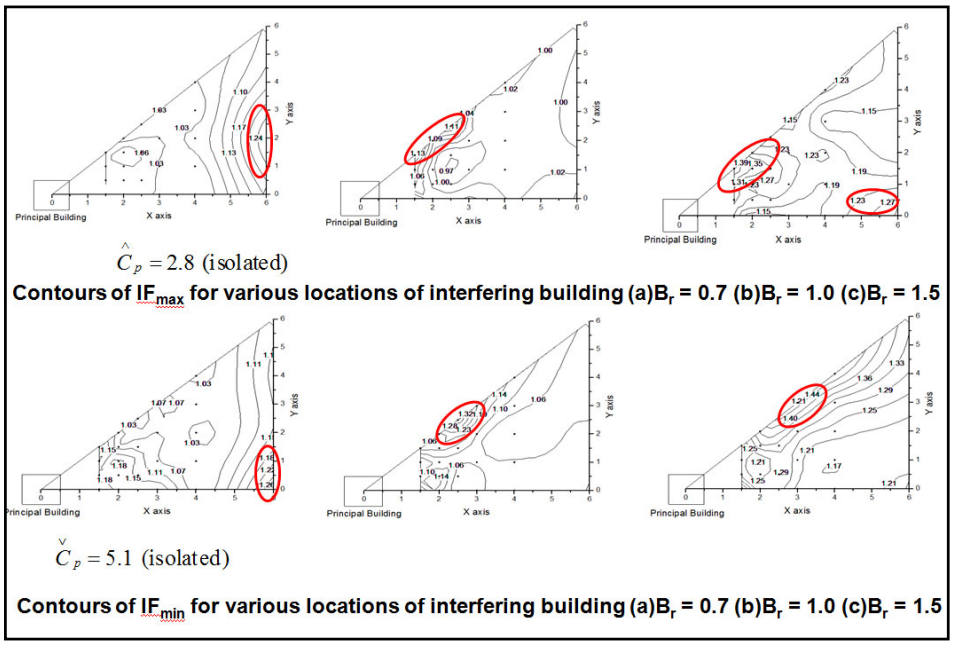
Summary

- When the interfering building is located near the principal building, interference effects for maximum positive peak pressures were generally beneficial due to shielding, but minimum negative peak pressures significantly increased due to interference.
- $\hat{C}_p$ at top level of principal building for 0° wind direction and (1.5B,0) interference location reduces by 3% for Br = 0.7, and upto 40% in case of Br = 1.0 and drastically reduces by 77% for Br = 1.5.
- $\check{C}_p$ at top level of principal building for 0° wind direction and (1.5B,0) interference location increases significantly by 3 to 6 times for Br = 0.7 to 1.5
- Interference effects zones extend over larger area as the building plan ratios increases.
- The influence zone of IF_{min} depends on the plan ratios of the interfering building especially along the oblique direction.
- Higher Values of IF_{min} and IF_{max} for Br = 0.7 observed at farthest interfering building locations (6B,0) & (6B,0.5B). It is speculated that still higher values may be obtained for farther locations; hence, experimentation for interference effects beyond (6B, 0) is recommended.

Figures



$\hat{C}_p = 2.8$ (isolated)

Contours of IF_{max} for various locations of interfering building (a)B_r = 0.7 (b)B_r = 1.0 (c)B_r = 1.5

$\check{C}_p = 5.1$ (isolated)

Contours of IF_{min} for various locations of interfering building (a)B_r = 0.7 (b)B_r = 1.0 (c)B_r = 1.5

References

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