Wind Engineering Joint Usage/Research Center
FY2021 Research Result Report

Research Field: Wind Hazard Mitigation/Wind Resistant design
Research Year: FY2021
Research Number: 21212005
Research Theme: Impact of Tornado vortex induced aerodynamic loads on structural projections in low rise buildings
Representative Researcher:
Prof. Rajesh Goyal
Budget [FY2021]: 350,000JPY

*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

To evaluate the damage of projections in low rise structure due to aerodynamic loads caused by tornadoes.
To enhance the wind pressure database of low-rise buildings with attached projections.

2. Research Method

The building models will be prepared using the Perspex sheets having attached canopies. The models will be prepared for measuring the surface pressure on all the surfaces on tornado simulator. For measuring the surface pressure on the surfaces of building models, pressure tapings will be provided. With the help of pressure tapings, the pressure on the surfaces of building models will be measured using the pressure measuring instruments. It is proposed to measure the fluctuating pressure on the surfaces caused by aerodynamic wind loads. The measured pressures will then be analyzed and compared with the available recommendation of wind codes and other researchers.

3. Research Result

Some series of experiments were conducted with a tornado-like flow simulator in Tokyo Polytechnic University. A building model used in the experiments had a canopy as shown in Figure-1. In these experiments' temporal variations of wind pressure coefficients were measured for different distance between the centers of tornado-like flows and building models. The distances were normalized by radius of maximum wind of the swirling flows. Mean and fluctuating components of the pressure coefficients are shown in Figure-1. The distributions of the pressure coefficients were affected by separation of flows at the edge of a building model and pressure defect of the swirling flows.

Wind force were evaluated with the pressures on upper and lower surface of the canopy. Mean and fluctuating components of the wind force plotted to the relative distance between the centers of swirling flows and building models. Upper direction of the wind force indicated positive there. Maximum of the wind force acting on the canopy occurred near the center of the swirling flows. However, differences were seen in the mean and fluctuating components. It might be the different effects to the mean and fluctuating components of the tornado-like flows.

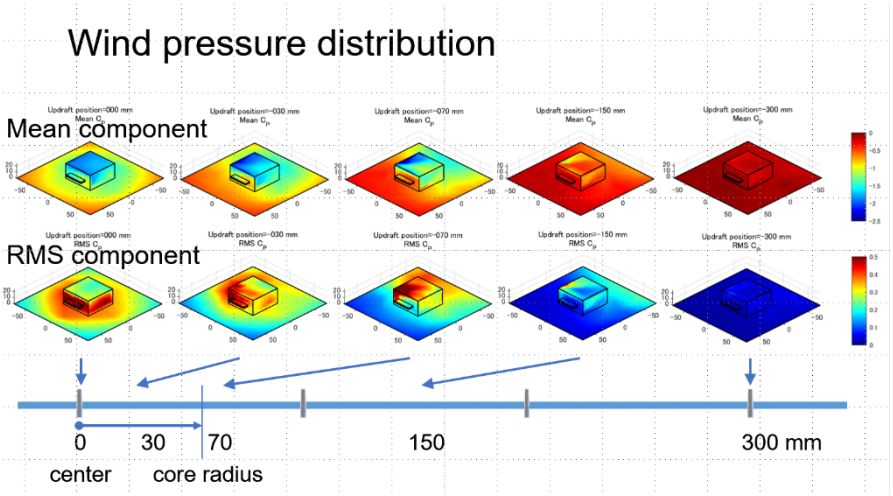

Figure-1: Wind pressure coefficients for different relative positions to the centers of tornado-like flows

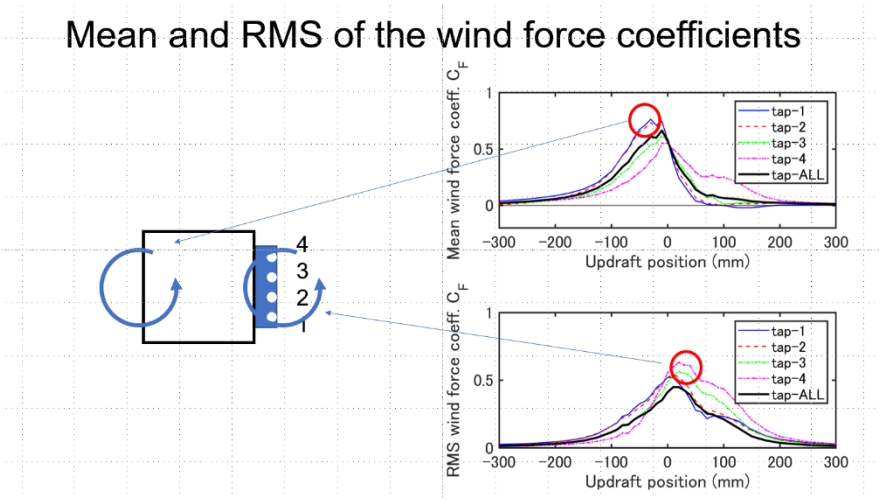

Figure-2: Wind pressure distribution on the lowrise building with canopy for cases of differenr distance between building moden and tornado center

4. Published Paper etc.
[Underline the representative researcher and collaborate researchers]
[Published papers]
1. Mohammed Moizuddin, Rajesh Goyal, Nakul Gupta, Masahiro Matsui "Evaluation of wind pressure on low-rise buildings and surrounding terrain under the influence of tornadolike vortex induced aerodynamic loads" Indian Journal of Engineering and Material Science, Vol.29, June 2022. (SCI Indexed Journal)
2.

[Presentations at academic societies]
1.
2.

[Published books]

1.
2.

[Other]
Intellectual property rights, Homepage etc.

5. Research Group
1. Representative Researcher
Rajesh Goyal, Professor, NICMAR Delhi NCR, India

2. Collaborate Researchers
1. Moizuddin, Research Scholar, RIMT University, Punjab, India
2. Masahiro Matsui, Professor, WERC, Tokyo Polytechnic University, Japan

6. Abstract (half page)

Research Theme: Impact of Tornado vortex induced aerodynamic loads on structural projections in low rise buildings
Representative Researcher (Affiliation): Prof. Rajesh Goyal, National Institute of Construction Management and Research (NICMAR)
Summary・Figures

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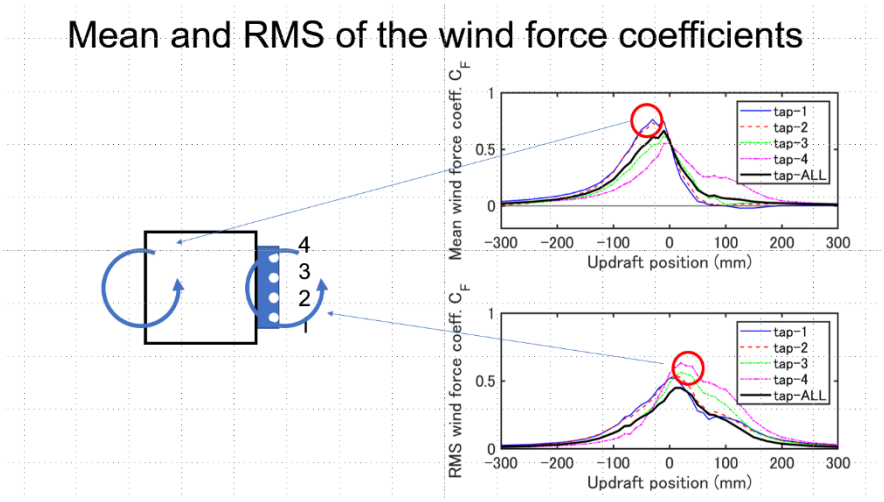

Figure: Wind pressure distribution on the lowrise building with canopy for cases of differenr distance between building moden and tornado center