

# Wind Engineering Joint Usage/Research Center FY2021 Research Result Report

Research Field: Wind Hazard Mitigation/Wind Resistant design  
Research Year: FY2021  
Research Number: 21212004  
Research Theme: "Comparison of external and internal pressures in tornado-like flow obtained using different simulators world-wide"  
Representative Researcher: Dr Sabareesh Geetha Rajasekharan

Budget [FY2021]: Yen 475000JPY (including 100000JPY as a travel budget \*1)  
Facility you use: Tornado simulator, 20 days (estimated facility cost 2000000JPY: 100000JPY/day x 20 days \*2)

\*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:

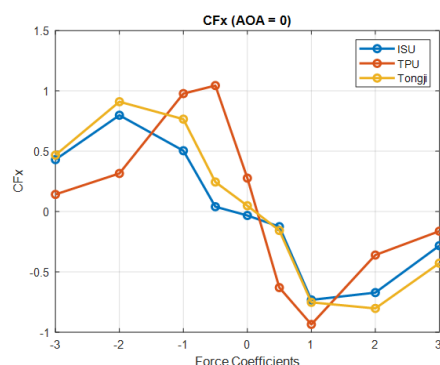
Determine the external pressures on building models exposed to tornado-like flow using different simulators worldwide.

Compare the force coefficients between different simulator results and make meaningful interpretations

## 2. Research Method:

External pressure on building model exposed to tornado like flow were estimated at different locations with respect to the tornado core. The angle of attack was varied to have different faces exposed to tornado like flow. Two such cases were analyzed in the present study AOA=0 deg and AOA =90 deg . Force coefficients were estimated for three mutually perpendicular directions.

## 3. Research Result



The different force coefficients were compared between the three simulators namely-Iowa State University(ISU), Tongji University (TPU) and Tokyo Polytechnic University (TPU). Results for  $CF_x$  for AOA=0deg is as shown in figure above. It can be observed that the trend in force coefficients followed a behavior akin with the core radius size of the tornado-like flow. Further results are being prepared to be communicated to a journal.

## 5. Research Group

1. Representative Researcher: Dr.Sabareesh Geetha Rajasekharan

### 2. Collaborate Researchers

1. Prof. Yukio Tamura (Co-Researcher) Professor, School of Civil Engineering, Chongqing University No.83 North St., Shapingba District, Chongqing, CHINA / Program Coordinator, Wind Engineering JURC, Tokyo Polytechnic University, Atsugi, Kanagawa, JAPAN
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4. Prof. Yongchul Kim, (TPU/WERC member) Professor, Wind Engineering Research Center, Tokyo Polytechnic University, Atsugi, Kanagawa, JAPAN Tokyo Polytechnic University
5. Prof.Partha.P.Sarkar (Co-Researcher), Professor, Iowa State University, Department of Aerospace Engineering United States
6. Prof.Shuyang Cao (Co-Researcher), Professor, State Key Laboratory for Disaster Risk Reduction, Tongji University, China

## 6. Abstract (half page)

Research Theme Comparison of external and internal pressures in tornado-like flow obtained using different simulators world-wide

Representative Researcher (Affiliation): BITS-Pilani Hyderabad Campus

The first part of the experiments was conducted in JURC FY 2019, where the velocity of tornado flow in the convergence region was obtained. Further pressure coefficients on a rectangular building model was obtained. As part of JURC FY 2020, pressure measurements were made on a cube model subjected to tornado-like flow. During FY 2021, the results of force coefficients obtained using tornado-like flow simulator at TPU were compared with those at Iowa State University and Tongji University. The results obtained through these studies will provide greater insight into simulating tornado-induced wind loads using tornado-simulators and extending it to understand the real time wind loads acting on structures under an actual tornado. In FY 2021, more locations of the building model with respect to tornado-centre were identified and external pressures were captured at these locations. Also two different orientations of building model were considered with respect to the tornado like flow viz, AOA=0deg and AOA=90deg. For different locations of building model for these two angles of attack of tornado flow on the building model, pressure values were captured and force coefficients were further obtained. Mean pressure coefficients for same location of building model at two different orientations are as shown in the figures

