

# Wind Engineering Joint Usage/Research Center FY2015 Research Result Report

Research Field: Wind Hazard Mitigation/Wind Resistant Design

Research Period: FY2014～FY2015

Research Number: 142002

Research Theme: Comparison and calibration of Tornado Simulators  
異なる実験装置で得られた竜巻状旋回流の相互比較実験

Representative Researcher: Prof. Horia Hangan

Budget [FY2015]: 357000Yen

\*If the research was not continuous, this will be the Final Result Report, so the contents of the report have to be detailed.

\*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

The objective of proposed joint research is to compare tornadic flow characteristics obtained with different experimental facilities.

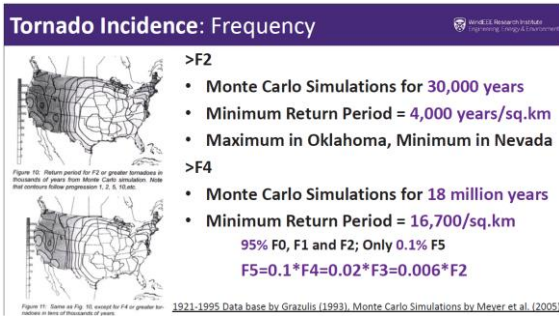
## 2. Research Method

For the first year, 2014, experimental conditions on setup and scales of the facilities were compared, as the preliminary exchange basic data between the Western University and Tokyo Polytechnic University.

For the second year, 2015, experimental results were compared between institutes. Tornado occurrence in US and Japan are compared and the results were presented in the International Conference on Wind Engineering, as one of special technical sessions.

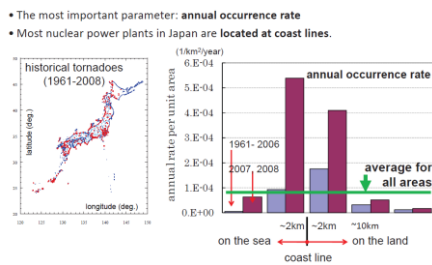
## 3. Research Results

Information on tornadoes in U.S and Japan was investigated. Figure-1 indicates basic information on tornado occurrence in both countries. Facilities in Western University and Tokyo Polytechnic University have been compared in their scale, abilities. Some parameters of tornadoes, eg. Radius of maximum winds, translating speeds, etc. in Japan and US were compared. Most of them were presented in the International Conference on Wind Engineering in June, 2015.



(a) U.S

### Characteristics of Japanese Tornadoes (1)



(b) Japan

Fig.-1 Tornado occurrence in U.S and Japan

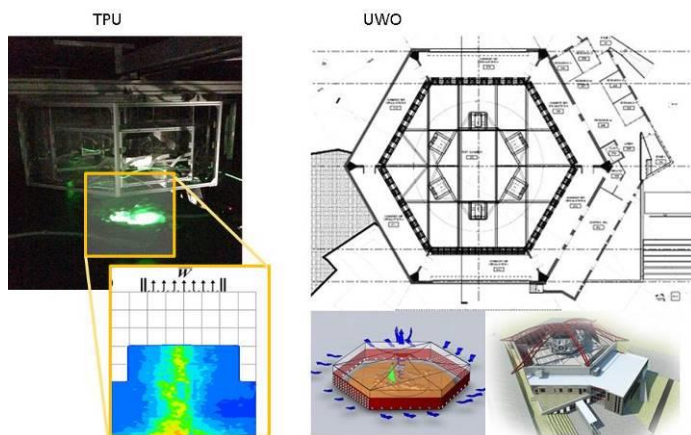


Fig.-2 Tornado-like-flow simulator in TPU and UWO

ICWE14 INTERNATIONAL CONFERENCE ON WIND ENGINEERING

JURC TPU Wind Effects on Buildings and Urban Environment

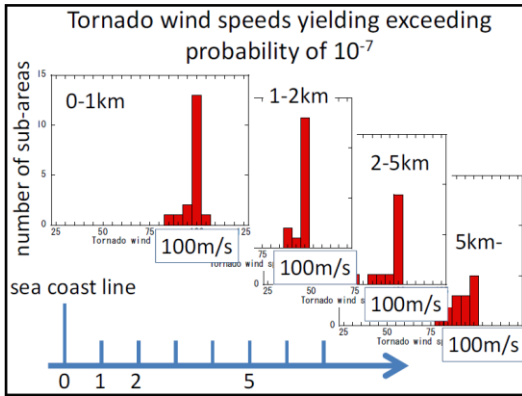
### Statistical properties of tornadoes in Japan and tornado risk model for nuclear power plants

Yukio Tamura, Masahiro Matsui, Seiszo Kawana, Fumiaki Kobayashi  
Department of Architecture, Faculty of Engineering, Tokyo Polytechnic University, Kanagawa, Japan  
School of Civil Engineering, Beijing Jiaotong University, Beijing, China

### Tornado Parameters in Japan

- Comparison with US statistics
- Japanese tornadoes' parameters are almost the same as those in US.

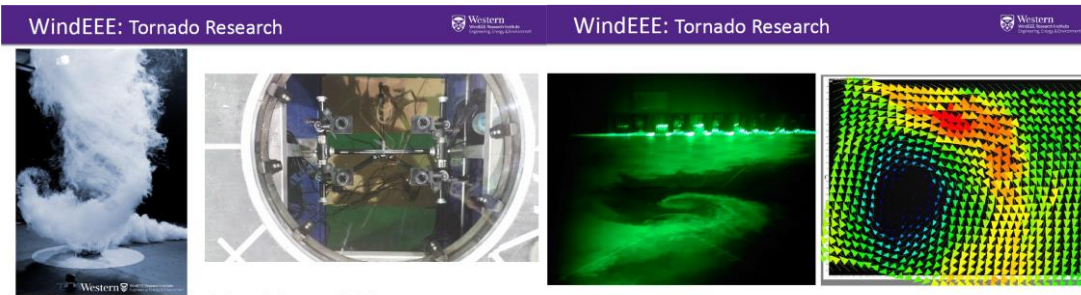
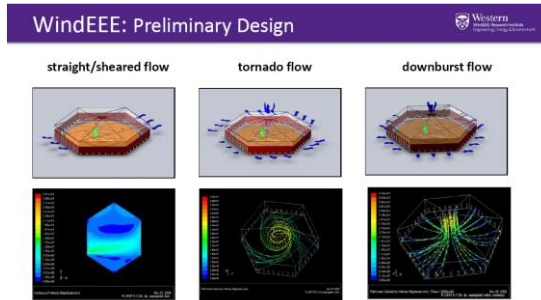
[1] American Nuclear Society, American National Standard for Estimating Tornado and Extreme, Wind Characteristics at Nuclear Power Sites, (ANSI/ANS- 2.3-1983), 1983  
[2] U. S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research Regulatory Guide 1.76, Design-Basis Tornado and Tornado Missiles for Nuclear Power Plant, 2007



Proposed Design tornado (Rankine model)	
<b>Max. tornado wind speed</b> $U_{max} = 100 \text{ m/s}$ for all over Japan ex. prob. $10^{-7}$	<b>Radius of max. winds</b> $R_{max} = 30 \text{ m}$ (decided from previous evaluation)
<b>Moving speed</b> $C = 16 \text{ m/s}$ (decided from previous evaluation)	<b>Pressure depth</b> $D_p (= \rho U_t^2) = 85 \text{ hPa}$
<b>Max. tangential wind speed</b> $U_t (= U_{max} - C) = 84 \text{ m/s}$	<b>Rate of pressure change</b> $dP/dt (= D_p/R_{max} \times C) = 45 \text{ hPa/s}$



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#### 4. Published Paper, etc.

Yukio Tamura, Masahiro Matsui, Seiszo Kawana, Fumiaki Kobayashi, Statistical properties of tornadoes in Japan and tornado risk model for nuclear power plants, 14th International Conference on Wind Engineering, Port Alegre, Brazil, 2015

M. Refan, D. Parvu, H. Hangan, Tornado vortex characteristics in WindEEE Dome, 14th International Conference on Wind Engineering, Port Alegre, Brazil, 2015

Horia Hangan, Novel Techniques in Wind Engineering, 14th International Conference on Wind Engineering, Port Alegre, Brazil, 2015

#### 5. Research Organization

##### 1) Representative Researcher

Horia Hangan University of Western Ontario, Canada, Professor

##### 2) Collaborate Researchers

Yukio Tamura Tokyo Polytechnic University, Japan, Professor

Masahiro Matsui Tokyo Polytechnic University, Japan, Professor

Akihito Yoshida Tokyo Polytechnic University, Japan, Associate Professor

Rei Okada Tokyo Polytechnic University, Japan, GCOE Associate Professor

## **6. Research workshop**

TPU WE-JURC Special Open Seminar, Advanced structural wind engineering, March, 14, 2015, organized by JURC TPU, co-sponsored by Japan Association for Wind Engineering (JAWE), Architectural Institute of Japan (AIJ), Japan Society of Civil Engineers (JSCE)

Special Technical Session on Non-synoptic winds (1), Chair Veleria Durañona, International Conference on Wind Engineering, Port Alegre, Brazil, June 23, 2015