Wind Loading and Wind Environment in the Philippines: Recent Developments in 2006-2007

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ABSTRACT: This paper is presented at the 4th Workshop on Regional Harmonization of Wind Loading and Wind Environmental Standards in Asia-Pacific Economies (APEC-WW) in Shanghai, China. It discusses recent events related to new developments in wind loading and wind environment standards in the Philippines between late 2006, particularly those activities that were held since the 3rd APEC-WW held in New Delhi, India, and 2007 prior to the 4th APEC-WW. The first event is a discussion forum held in December 2006 by the Association of Structural Engineers of the Philippines (ASEP) on damaged structures, particularly outdoor billboard structures (usually lattice structures supporting large advertisement boards), due to Typhoon Xangsane (Philippine Name: Milenyo) of 2004. Next, there were a series of presentations at various local and regional conferences of papers on dynamic wind effects, extreme wind speed mapping, and typhoon engineering in general. The ASEP National Structural Codes Committee has also started to convene, and updates to the National Structural of the Philippines (NSCP), including its wind loading provisions in particular, are targeted to be released in 2008.

KEYWORDS: Philippines, ASEP, Typhoon Xangsane/Milenyo, typhoon engineering, NSCP

1 INTRODUCTION

This paper is presented at the 4th Workshop on Regional Harmonization of Wind Loading and Wind Environmental Standards in Asia-Pacific Economies (APEC-WW) in Shanghai, China. It discusses recent events related to new developments in wind loading and wind environment standards in the Philippines between late 2006, particularly those activities that were held since the 3rd APEC-WW held in New Delhi, India, and 2007 prior to the 4th APEC-WW. This is a continuation of the paper written by the same authors (Pacheco et al, 2006), and presented at last year's APEC-WW in India, which presented recent developments in the Philippines between 2005 and 2006.

2 A DISCUSSION FORUM ON TYPHOON-DAMAGED BILLBOARD STRUCTURES

2.1 *Two destructive typhoons of 2006*

In 2006, of around seven (7) typhoons that made landfall in the Philippines, two caused significant damages. The first of these two, Typhoon Xangsane (Philippine Name: Milenyo), made landfall just south of the highly urbanized Metro Manila (Fig. 1) and toppled hundreds of different lightweight structures. Of those damaged, outdoor billboard structures (lattice structures supporting large advertisement boards) gained the most media coverage. A total of around 40 billboard structures including a number of very large ones were damaged due to Typhoon

Milenyo/Xangsane, some of which even caused deaths. The maximum gust speed of Typhoon Milenyo recorded in Metro Manila is around 45 m/s.

Typhoon Durian (Philippine Name: Reming) also caused significant damages particularly in the Bicol Region in northeastern Philippines (near the Pacific Ocean where Reming formed). A maximum gust speed of around 90 m/s was recorded by the government's meteorological agency (the Philippine Atmospheric, Geophysical, and Astronomical Services Administration or PAGASA) when Typhoon Reming made landfall in one of the easternmost islands in the Philippines. Most of the damages caused by Typhoon Reming resulted in heavy landslides and flooding, soliciting many humanitarian efforts soon after Typhoon Reming left the Philippines.

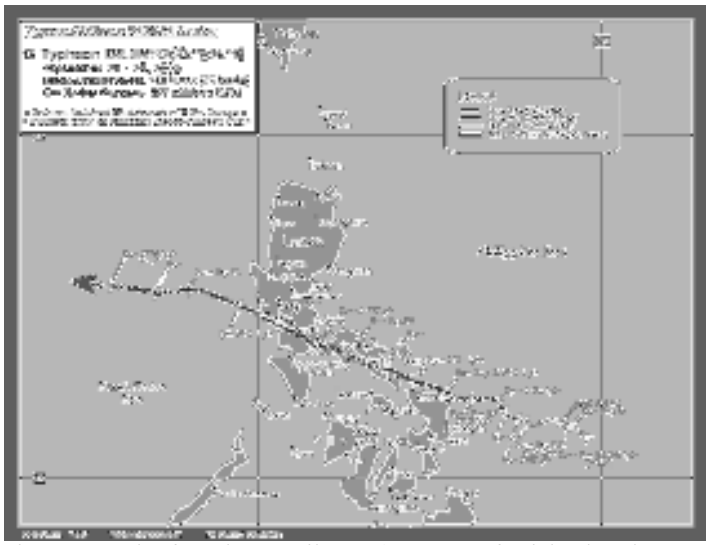

Figure 1. Path of Typhoon Milenyo (courtesy of Michael Padua, Typhoon2000.com)

2.2 *Photos of damages due to Typhoon Milenyo*

Typhoon Milenyo was of particular interest to structural engineers and those concerned with wind effects on structures, mainly because many billboard structures in Metro Manila collapsed. Example photos of damages due to Typhoon Milenyo were included in last year's Philippine country report for the APEC-WW (Pacheco et al, 2006) and more were presented at the workshop. Some of these are again shown in Figure 1. Notice that certainly, these damaged structures are generally lightweight structures.

Figure 2. Selected photos of billboard structures damaged due to Typhoon Milenyo. (Credits to websites shown above in parentheses)

2.3 *Organization of discussion forum*

The damages themselves were controversial in part because of the deaths associated with these collapsed structures. Many, including government agencies such as the Department of Public Works and Highways (DPWH), the Metropolitan Manila Development Authority (MMDA), and city and municipal governments, as well as private individuals and organizations involved such as the United Architects of the Philippines (UAP), the Association of Structural Engineers of the Philippines (ASEP), the Philippine Institute of Civil Engineers (PICE), and different construction professionals, and owners and operators in the billboard industry expressed concern that once another typhoon hits Manila the same damages might occur.

The Philippine Government itself through the DPWH then requested ASEP to come up with a statement regarding the extent of damages due to Typhoon Milenyo. ASEP then initiated and organized a discussion forum that brought representatives from the different sectors involved to talk about the damages due to Typhoon Milenyo particularly on billboard structures. The discussion forum was held on December 22, 2007, with nine (9) resource persons from ASEP, the DPWH, PAGASA, and other parties involved in the billboard industry who all gave presentations.

2.4 *Outcome of discussion forum*

The outcome of the discussion forum is generally positive as reported by Sarausad (2007). The main discussion points were:

- Statistics/inventory of billboard structures
- Latticed vs. solid billboard structures
- Architectural requirements
- Climatology and meteorology
- Structural design, detailing, and construction issues
- Professional liabilities and responsibilities
- Maintenance and periodic design review

Consequently, the following resolutions were made:

- The DPWH to continue screening, reviewing, and evaluating billboard structures, and to order for dismantling of deficient ones
- City and Municipality Building Officials to conduct at least a bi-annual stock inventory of billboard structures, noting type of structure, dimensions, and construction information, among others; owners of billboards to submit their inventory of their own billboards
- The wind speed map should be updated; PAGASA ready to forge a Memorandum of Agreement with ASEP in updating wind data and wind speed map
- PAGASA to upgrade climactic data recording equipment
- PAGASA and a major university with government funding to consider creating a wind tunnel testing laboratory
- Billboard owners and operators to increase the fees paid to structural engineers
- Billboard owners and operators to acquire the services of competent structural engineers only for the structural design and/or evaluation of billboard structures

3 VARIOUS PAPERS AND PRESENTATIONS ON DYNAMIC WIND EFFECTS, EXTREME WIND SPEED MAPPING, AND TYPHOON ENGINEERING IN THE PHILIPPINES

3.1 *A thesis study on dynamic wind effects on lattice towers*

A thesis study done by one of the authors (Aquino, 2006) under the M.S. Civil Engineering Program was submitted and accepted at the College of Engineering of the University of the Philippines, Diliman, Quezon City in 2006. A brief presentation of the findings of this study was included in last year's Philippine country report (Pacheco et al, 2006). In summary, the study:

- suggested estimation formulas for the natural frequency, structural damping, aerodynamic damping, and mode shape exponent for lattice towers in the Philippines, based mostly on experimental data;
- suggested a "gust effect factor" (or "dynamic response factor") formulation for determining wind actions in the structural design or evaluation of lattice towers following the requirements of the 2001 National Structural Code of the Philippines (NSCP-2001); and,
- illustrated via the use of a simple and general single-degree-of-freedom (SDOF) model and a case study of an actual lattice tower modeled as a full multiple-degree-of-freedom (MDOF) system, that consideration of dynamic wind effects on lattice towers is necessary.

3.2 *Presentation at the ASEP Forum on Billboards*

The authors (Pacheco & Aquino, 2006) also made a presentation at the ASEP Forum on Billboards on how a certain limitation of earlier versions of the structural code (i.e. the NSCP) in terms of accounting for the dynamic wind effects on such lattice-type structures may be one area for improvement in the code so that such types of structures may fare better under wind actions from future typhoons that might hit Metro Manila again. The presentation is based on the findings of the above-mentioned thesis study, extended to lattice or truss-type structures in general. The presentation basically showed that wind loads on such billboard structures maybe underestimated by about 15%.

3.3 *A paper on dynamic wind effects on lattice structures*

At the 12th ASEP International Convention (12AIC), a paper on dynamic wind effects on lattice structures (Aquino et al, 2007) based again on the above-mentioned thesis study was formally presented to the community of structural engineers in the Philippines who are involved in the design of structures to better resist extreme winds. At that time, the only questions raised from the audience were related to design wind speeds.

A similar paper (Aquino et al, 2006) was presented at the 2006 PICE National Convention held in Iloilo in Central Philippines, where the focus was on updating the NSCP to account for dynamic wind effects on lattice towers.

3.4 *A paper on extreme wind speed mapping presented at the 4th CECAR*

At the 4th Civil Engineering Conference in the Asian Region (4th CECAR) held on June 25-28, 2007 in Taipei, Taiwan, a paper on extreme wind speed mapping was presented. The title of the

paper was "Historical review of wind speed maps in the Philippines for various purposes: towards future development as typhoon hazard maps." (Pacheco et al, 2007)

The paper presented various studies from as early as 1973 to as recent as 2007 on extreme wind speed estimation in the Philippines, mostly presented as wind speed maps. Many ideas were learned from this historical review, which were used as basis for updating the next generation of wind speed maps in the Philippines.

3.5 *A paper on typhoon engineering efforts at the 4th CECAR*

A paper that summarizes recent typhoon engineering efforts in the Philippines (Pacheco & Aquino, 2007) was also presented at the 4th CECAR, with the title "Typhoon Engineering Efforts for Sustainability in the Philippine Setting." The paper presented various research efforts and possible future research in the field of Typhoon Engineering in general, and on wind engineering in particular.

3.6 *Presentations at various local PICE conferences*

Variations of the two papers presented at the 4th CECAR were also presented at various local PICE conferences in 2007 – in particular, at Regions I, IV, and V of the Philippines. This enabled the papers to reach a wider engineering audience. There were various questions that have been raised during these presentations, but one recurring question was: how to reconcile the ~90m/s recorded gust speed during Typhoon Reming with the 70m/s specified in the NSCP for the same location.

4 SCHEDULED UPDATE OF THE NSCP WIND LOADING PROVISIONS BY THE ASEP NATIONAL STRUCTURAL CODES COMMITTEE

The National Structural Codes Committee of ASEP has started to re-convene, with the aim of updating the current, 5th edition of the NSCP (dated 2001, released and approved in 2002).

The first agenda of the committee is to update the loads and actions part of NSCP. The ASCE7-05 is initially set as the basis code for the NSCP wind loading part. However, the committee has deemed it necessary that a forum will need to be organized to solicit the opinions and expertise of all structural engineers in the Philippines. This forum is tentatively scheduled on November 23, 2007.

5 SETTING UP OF THE NATIONAL INSTITUTE OF CIVIL ENGINEERING

The National Institute of Civil Engineering (NICE) will be set-up at the University of the Philippines Diliman, Quezon City, College of Engineering, by integrating the Department of Civil Engineering with 3 existing research centers. A new center within the institute is proposed that will build in the medium-term a wind tunnel facility. It has been agreed that a wind tunnel is more urgent than a shaking table. The institute and the centers are anticipated to collaborate with other departments and colleges, e.g. collaboration with the Environment Engineering Program and the Environmental Science Program also at the University of the Philippines Diliman.

6 CONCLUSION

Much has been done over the past year between the 3rd APEC-WW in New Delhi, India, and the 4th APEC-WW in Shanghai, China, particular in the area of wind loading and wind disaster mitigation in the Philippines. Hopefully, those that have been planned for the following year are indeed implemented within the schedule, and that the amount of effort that has been exerted in the area of structural wind engineering in this past year is equaled if not exceeded in the next. Also, the hope is that the area of environmental wind engineering is given attention as much as the area of structural wind engineering.

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