Indonesia Wind Environments and Structural Standard

Fariduzzaman[a]
[a]*Aero-Gas dynamics and Vibration Laboratory (UPT-LAGG) BPPT, Kawasan PUSPIPTEK- Serpong. INDONESIA*

ABSTRACT: The overall Indonesia wind environments is well behave, daily warm and low speed. Only several local wind storm are reported. The paper will describe the Indonesian wind and the advantage of structural standard implementation.

KEYWORDS: mean wind, weather, wind disaster, structural standard

1 INTRODUCTION

The unique environments of Indonesia wind is closely related to its position, located in equatorial region, bounded by two big oceans (Pacific and Hindia) and two continents (Asia and Australia). The radiation heat of sun changes every 6 months: April to September, it heats to the most of north part and October to March, it heats to the most of the south part. Accordingly, there are two main seasons in the country: summer and rainy.

The global wind system influences the country in three modes of wind [1]:

- West monsoon wind, comes about December to April. The cold air in Asia which is high pressure moves to warm air in Australia which is low pressure, the wind flows from West-East to South-East of Indonesia. This is the season of rain.
- East monsoon wind comes about April to October. The cold air in Australia which is high pressure moves to warm air in Asia which is low pressure, the wind flows from South-East to West-East of Indonesia. This is the season of summer.
- Transition wind comes about March to May, it is called *Kemareng*, and September to November, it is called *Labuh*, In this period the sun path moves across the equator, generates low wind speed and uncertain wind direction. A heavy rain can suddenly occurs in short time.

Furthermore, the convergence depression in Pacific or Hindia Oceans might lead to severe tropical cyclone surrounding Indonesia. Although, the tropical cyclones do not have path to Indonesia islands, the tail can be touch the south or north part of Indonesia which brings heavy rains and strong wind. Flood or landslides disaster might be occurred in that region afterward [2].

2 MEAN WIND ENVIRONMENTS

The Indonesian agency for meteorology, climatology and geophysics (BMKG) and The Indonesian agency for aeronautics and space (LAPAN) regularly report wind environments in Indonesia. Particularly the BMKG, as a national center for meteorology. The agency releases satellite image and prediction map of wind environment, see Figure 1 and 2. Some times, the report also includes indications of possible growing and moving of tropical cyclone. Other institute also release the Indonesia wind environments, for instance NASA and NOAA.

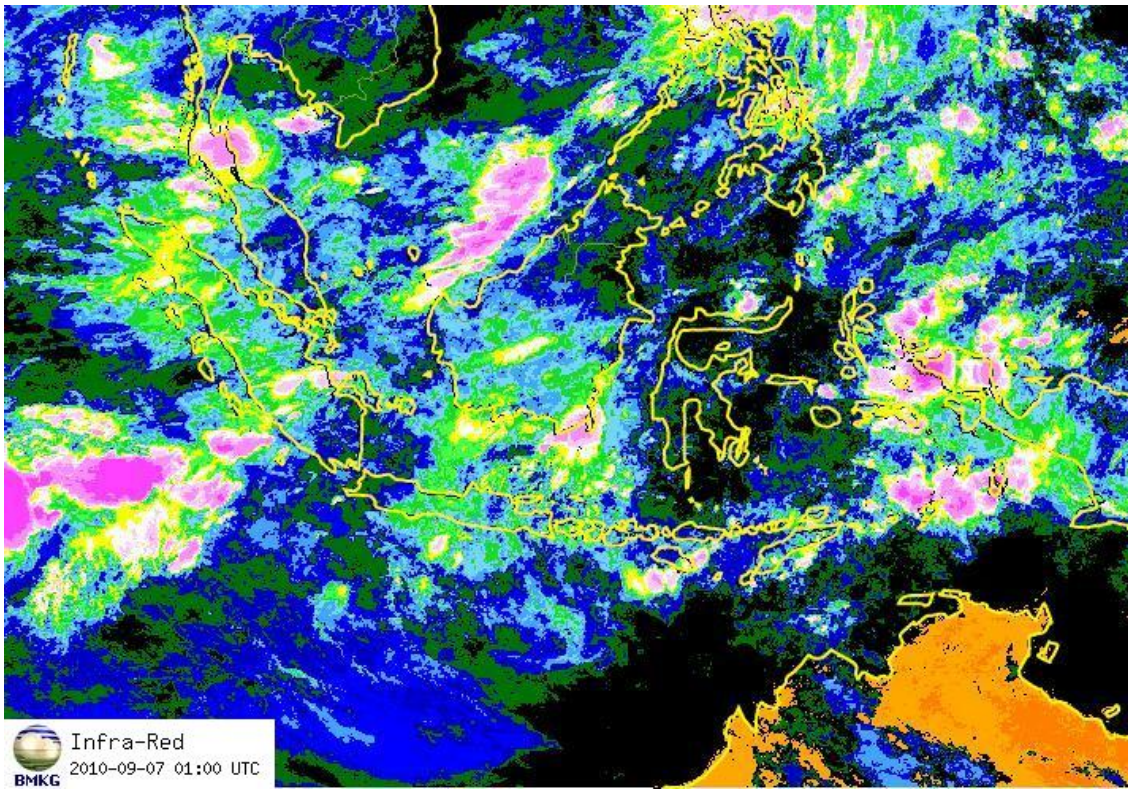

Figure 1. Satellite image of Indonesia sky for 7 September 2010 (Courtesy of BMKG)

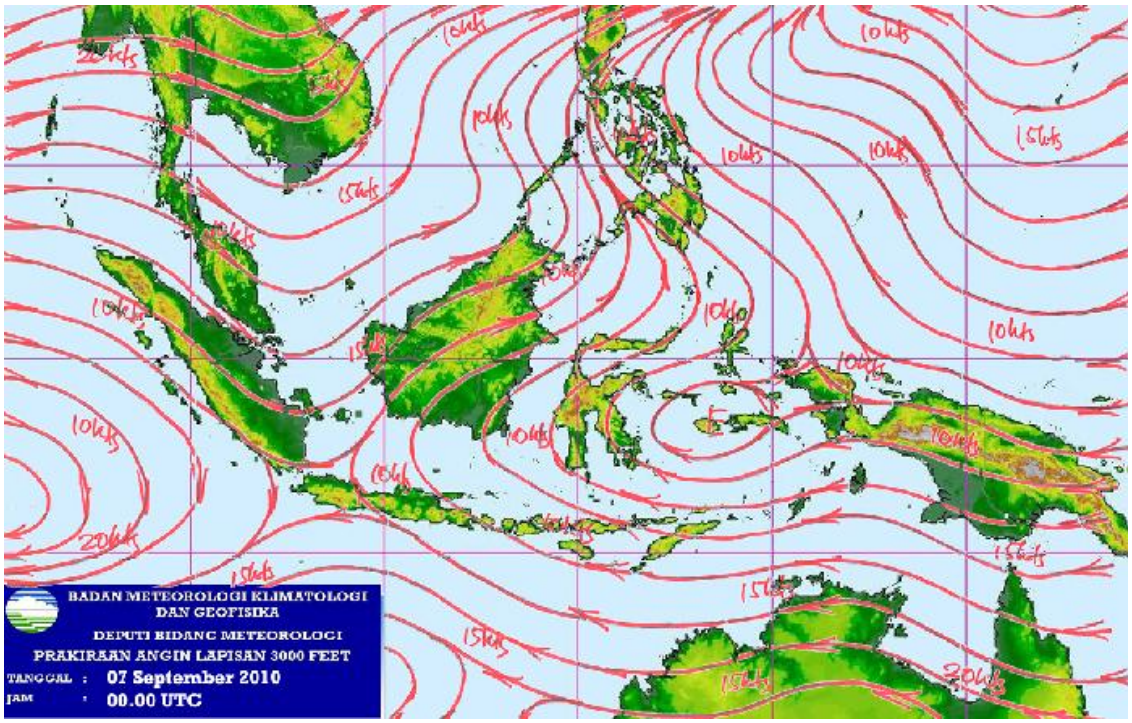

Figure 2. Prediction of Indonesia wind environments for 7 September 2010 (Courtesy of BMKG)

The above satellite image and BMKG prediction show that the maximum wind is less than 10 m/s. There is only a little bit higher in South East region, namely Nusa Tenggara islands, 5.5m/s to 6.5 m/s. The other regions is about 2.7 m/s to 4.5 m/s [4].

To see into more detail, several records of big island are presented on Figure 3 to 6. The record was collected by LAPAN (The Indonesian agency for aeronautic and space) [3].

Figure 3. Wind Environment of Jawa Island (courtesy of LAPAN): Yellow < 3.8m/s, Green 3.9m/s -4.9 m/s, Orange 5.0m/s- 5.8 m/s, Red > 5.8m/s.

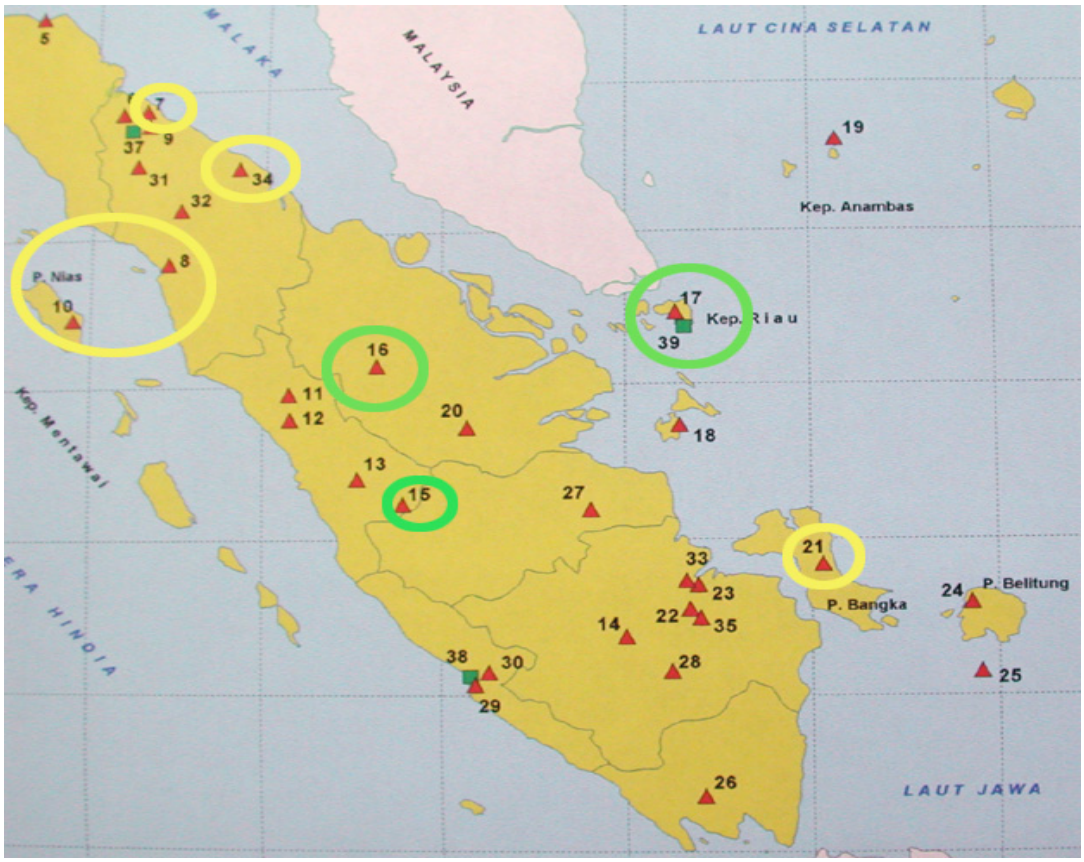

Figure 4. Wind Environment of Sumatera Island (courtesy of LAPAN): Yellow < 3.8m/s, Green 3.9m/s -4.9 m/s, Orange 5.0m/s- 5.8 m/s, Red > 5.8m/s.

Figure 5. Wind Environment of Sulawesi Island (courtesy of LAPAN): Yellow < 3.8m/s, Green 3.9m/s -4.9 m/s, Orange 5.0m/s- 5.8 m/s, Red > 5.8m/s.

Figure 6. Wind Environment of Papua Island (courtesy of LAPAN): Yellow < 3.8m/s, Green 3.9m/s -4.9 m/s, Orange 5.0m/s- 5.8 m/s, Red > 5.8m/s.

There are also several records which were collected by Indonesian wind energy research group and NREL [5], [6], particularly for Nusa Tenggara region, the most potential locations for wind energy development in Indonesia. See Figure 7 and 8.

Figure 7. Wind Environment of Nusa Tenggara region (courtesy of LAPAN): Yellow < 3.8m/s, Green 3.9m/s -4.9 m/s, Orange 5.0m/s- 5.8 m/s, Red > 5.8m/s.

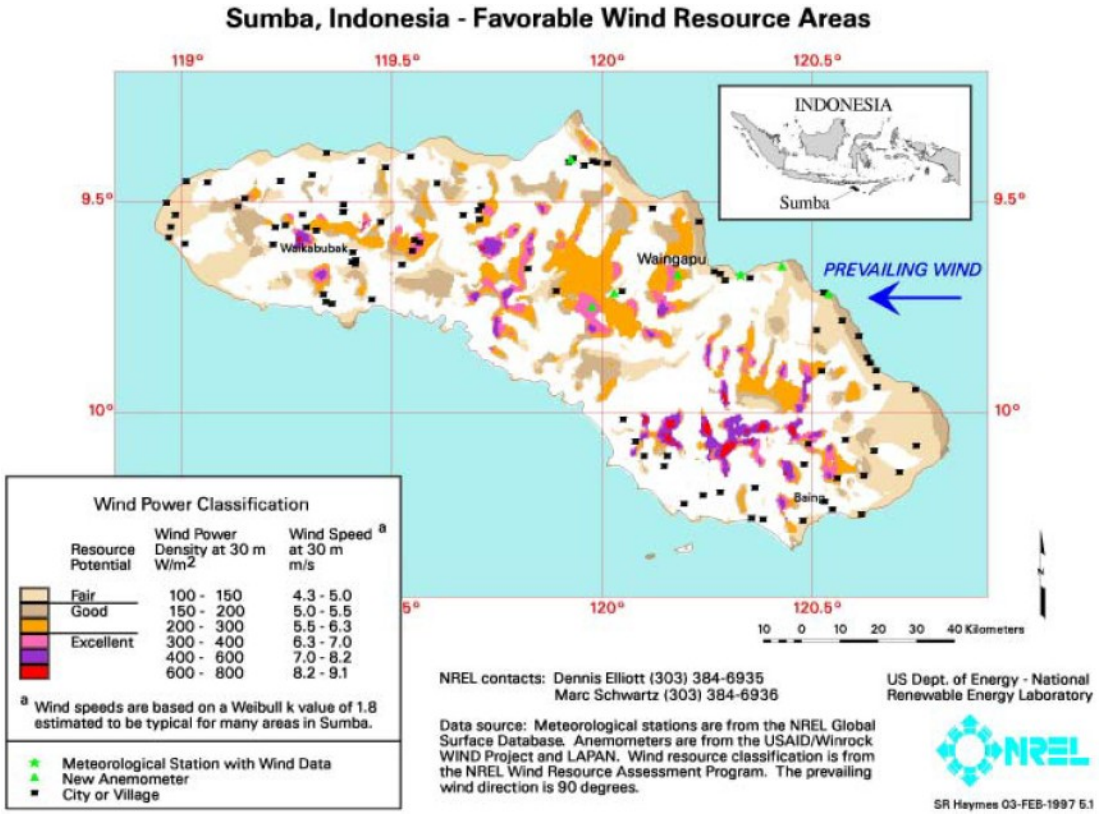

Figure 8. Wind Environment of Sumba (an island in Nusa Tenggara) [6]

3 EXTREEM WIND DISASTERS

Extreme wind in Indonesia come from local or global influences. A local depression might generate a rotational wind, with small magnitude however. The effect will be severe if the housing structures is weak, roof tiles are loose and those ruins changes into airborne flying debris. Additionally, heavy rain also increases the structural loads.

Figure 9 Puting Beliung Wind (Yogya-karta)

Figure 10 Heavy rain affects structural loading

The global wind effect was experienced in 2004, when a depressions in Sunda Straits increased rain volume, drives floods and landslides in Jawa and Sumatera. Also severe disasters are resulted due to improper implementations of regulation, for instance:

- Local government does not force to implement modern structural codes and improve the quality of building materials. Many people build their houses based on their tradition or culture. Generally speaking, the traditional house is secure against seismic but weak against wind disturbances.
- Ecosystem balance is broken, forest trees are destroyed and rivers are wear down. As results the floods and landslides occur in rural as well as in center of cities

Figure 11. Traditional Minangkabau House (West Sumatera): seismic-proof but not wind-proof

Figure 12. Commercial billboard too close to public road

Figure 13. Slum housing using metal sheet for roof

Figure 14. Loose tile roof, need formal code

Figure 15. Strong wind and wave destroy coast line housing

Figure 16. Flood and landslide demolished houses, indirect effect of global wind

4 CONCLUSION

In spite of well behave wind environment, local and global wind extreme might produce structural disaster, directly or indirectly. Typical direct disaster is dismounting roof tiles and flying debris. Typical indirect disaster is occurrence of floods and landslides.

If a wind storm produces a serious disaster, this is an indication that:

- A safe building standard is not implemented yet
- A tight control on structural construction is not properly performed
- A good collaboration between center of disaster mitigation or meteorological research institute and local government have to be improved

For the purpose of building codes, it is proposed that the whole Indonesia regions only apply one zone of wind speed.

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