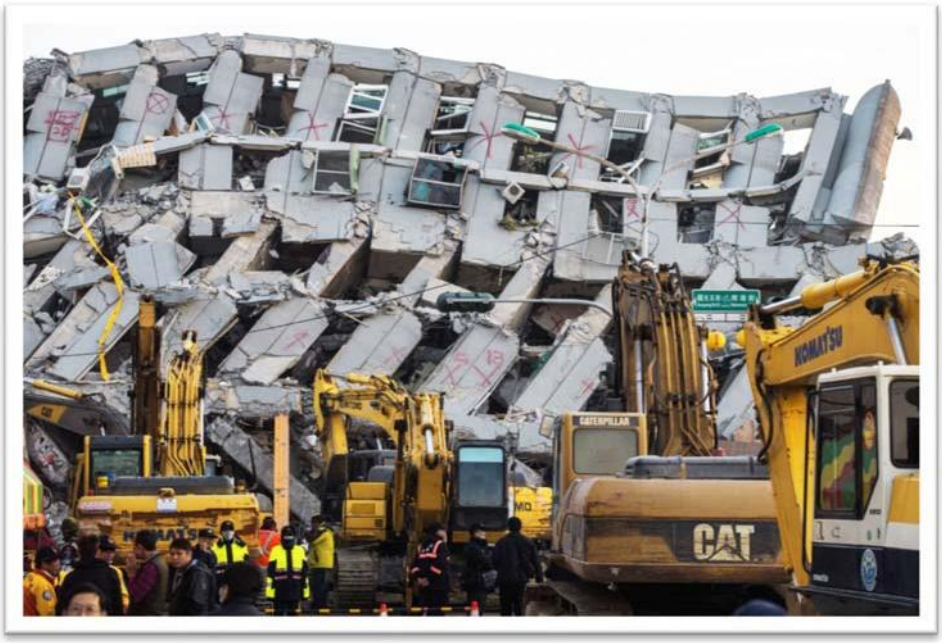
Post-Tensioned Slab Design of Lateral Resistance to Wind and Earthquake

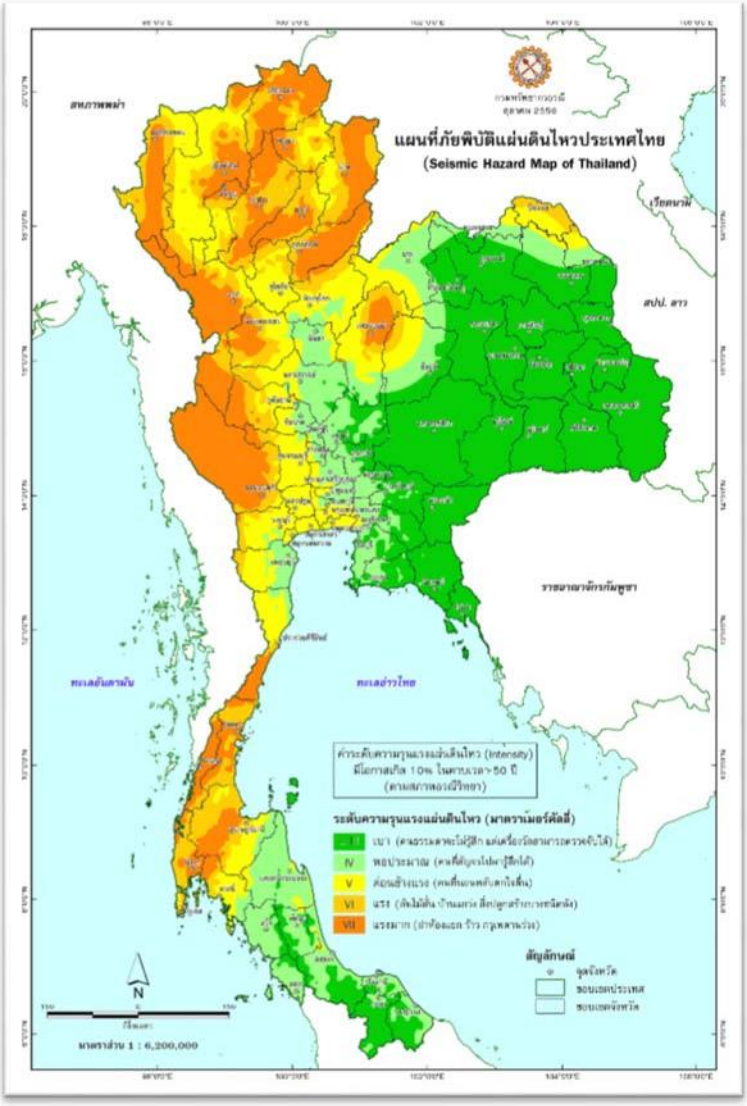
Concrete structures shall be designed to sustain not only with gravity loads, but also lateral loads which act through the entire service life of buildings. Most of lateral loads are occurred from:

1. Earthquake load prescribed by regulation subjected to the location and occupancy category of structures
2. Wind load prescribed by regulation



Collapsed building due to earthquake

I. Earthquake Load

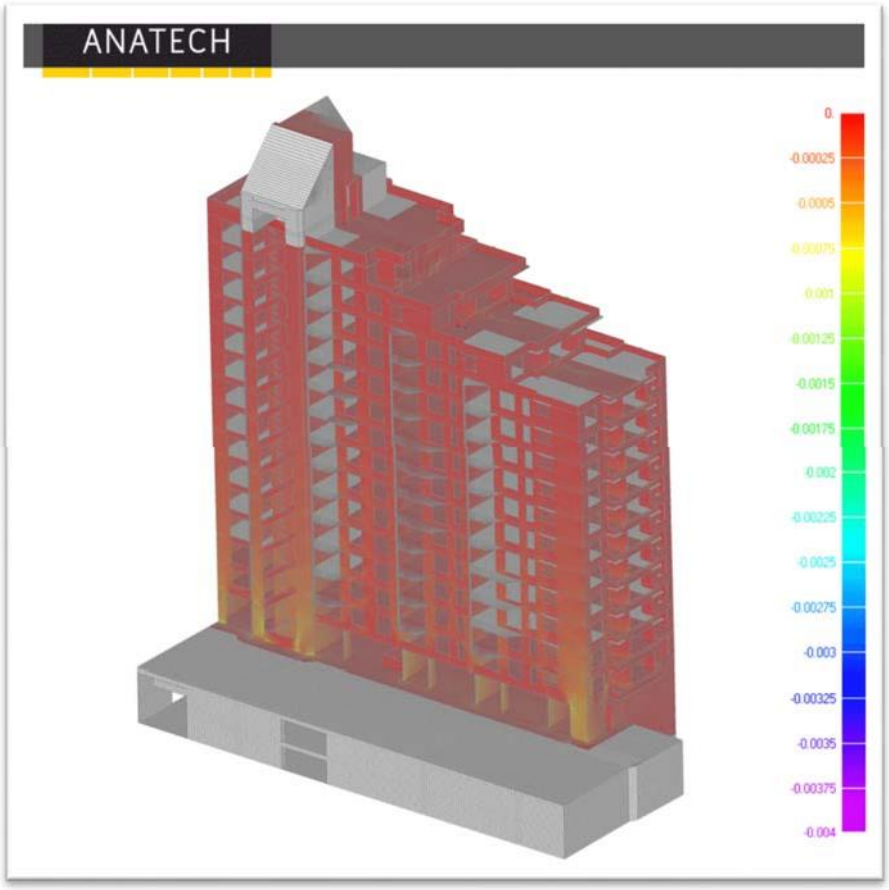


Map of seismic hazard in Thailand

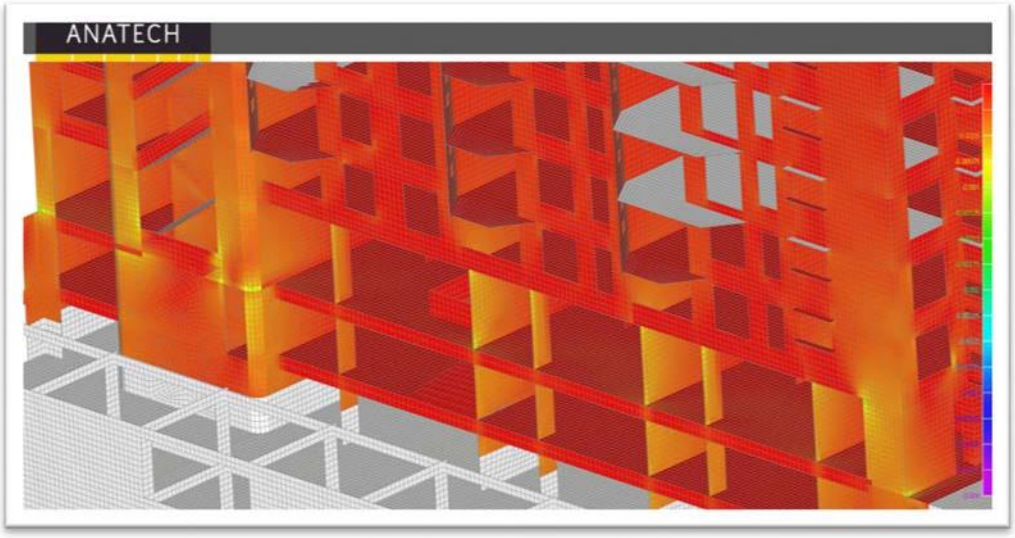
The calculation of seismic force acted on structures follows the Ministerial Regulation which specified about load resistance, stiffness, sustainability and subsoils that support the structures to resist against earthquake load B.E 2552.

The first step is to classify the shapes of structures. For regular shaped buildings and are located in the surveillance area specified in the **Section 6** of Ministerial Regulation, they can be calculated to find the seismic force by using Equivalent Static Force Analysis. Whereas the irregular shaped structures, the seismic force shall be calculated by using Dynamic Analysis or other methods which based on the fundamental theory of Dynamic Analysis. For both static and dynamic analyses can be found at the Standard for Earthquake Resistant Design of

Buildings (DPT 1302) which illustrates about the methodology of structural analysis for finding the allowable earthquake load (as shown in **Table** 2.7-1, Page 48) specified in the standard.



Lateral displacement of building subjected to lateral seismic load



Lateral displacement of building subjected to lateral seismic load

Table 2.7-1 Methodology of structural analysis for finding the allowable seismic base shear

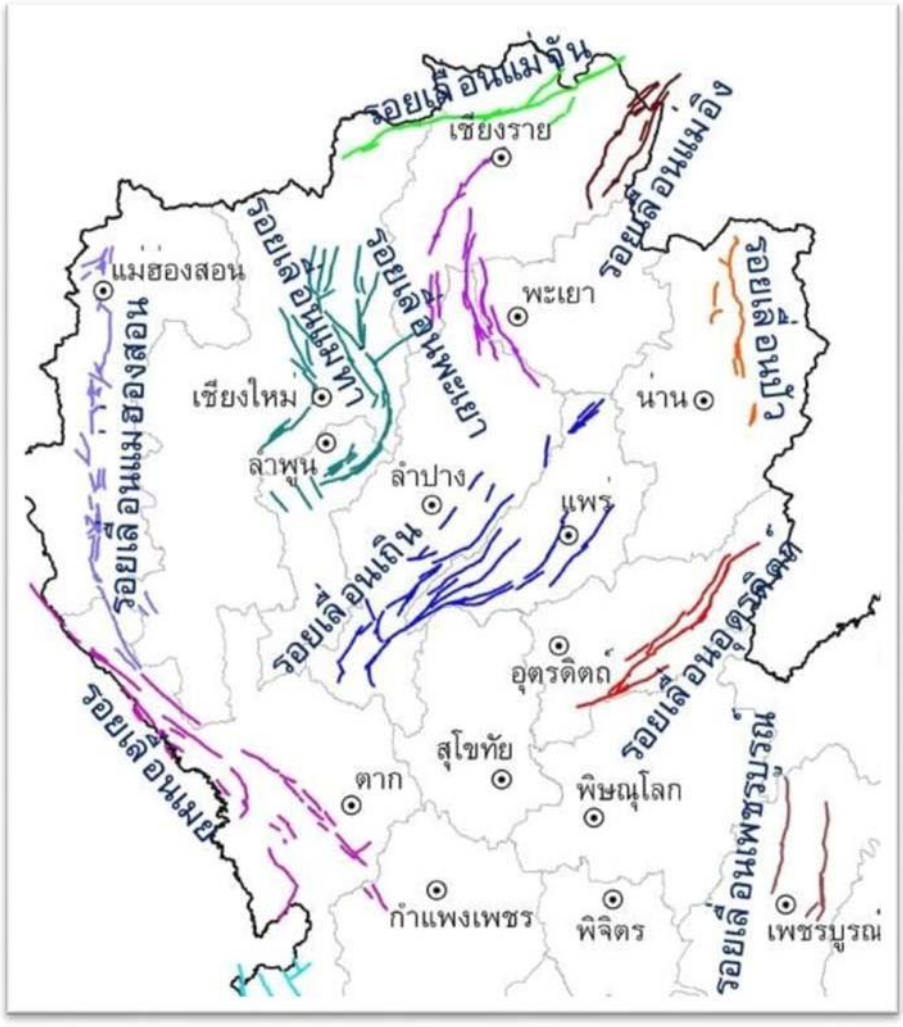
Type of Seismic Design	Structure	Equivalent Static Force Analysis	Modal Analysis	Time History Analysis
ข, ค	All buildings	Allow	Allow	Allow
ง	Buildings listed in occupancy category I or II which consist of light weight structures (Timber or cold rolled steel structures) and not exceed 3 stories height.	Allow	Allow	Allow
	All buildings and other structures listed in occupancy category I or II and which are not exceed 2 stories height.	Allow	Allow	Allow
	Regular shaped buildings with fundamental period of vibration less than $3.5T_s$.	Allow	Allow	Allow
	Buildings with fundamental period of vibration less than 3.5Ts and are irregular shapes in plan as shown in Figures 2, 3, 4, and 5 or in vertical direction as shown in Figures 4, 5ก or 5ข	Allow	Allow	Allow
	Other structures	Not allow	Allow	Allow

All buildings located in the surveillance area and Area 1 in **Section 3(1)** and with those located in Area 2 in **Section 3(2)** are specified that the ductility of the entire structural systems shall be equal to the Limited Ductility in accordance with the Standard for Earthquake Resistant Design of Buildings issued by the Department of Public Works and Town & Country Planning (DPT 1301-54).

LINK DOWNLOAD

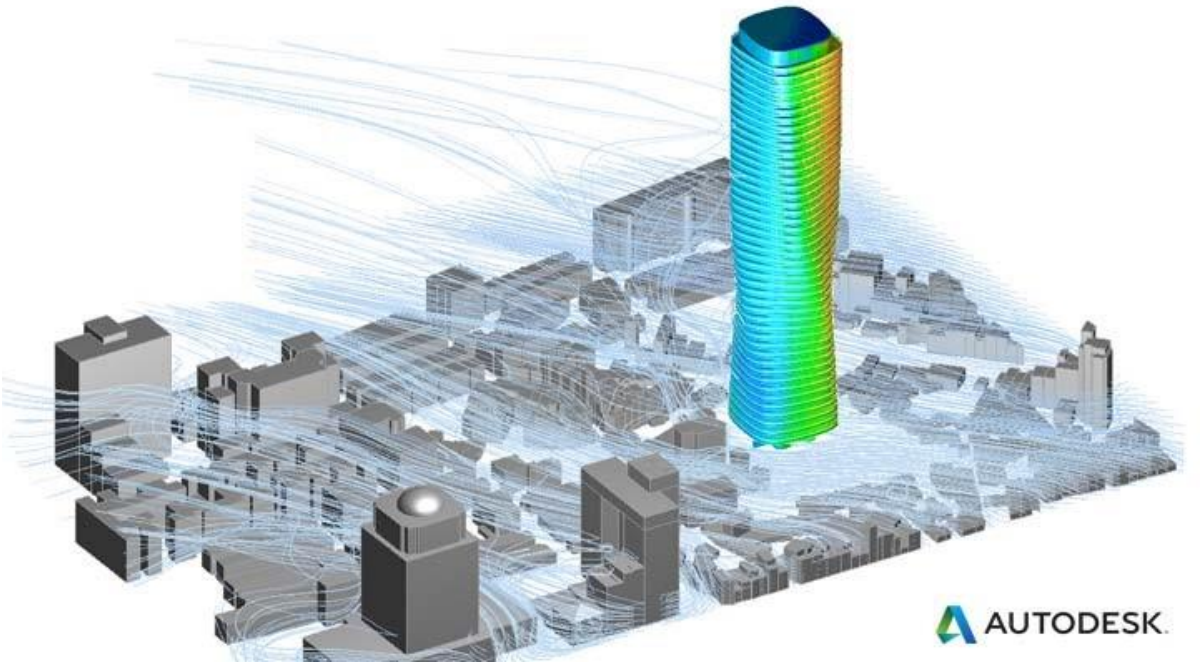
DPT 1302

DPT 1302-54

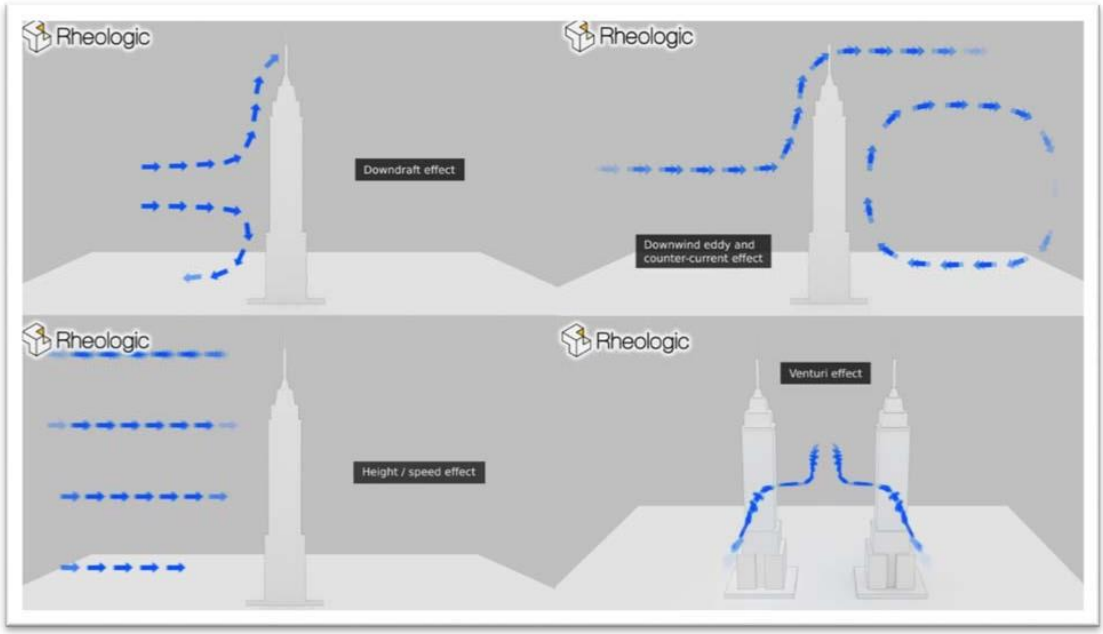


Map of Active Fault in Thailand

II. Wind Load



The calculation of wind load in accordance with Ministerial Regulation (No. 6, B.E 2527) was issued by following the Building Control Act B.E 2522 specified in the **Section 17** as followings:



Various forms of wind load act on structures

Section 17: Wind load shall be considered in building designs. In case it does not have any reference from any reliable institute or organization, and wind load shall be considered, the designer can use wind load as the followings:

Height of Structures	Minimum Wind Load in KPa (Kgf/m^2)
1. Structures which are not higher than 10 m	0.5 (50)
2. Structures which are higher than 10 m but not exceed 20 m	0.8 (80)
3. Structures which are higher than 20 m but not exceed 40 m	1.2 (120)
4. Structures which are higher than 40 m	1.6 (160)

This specification allows stresses to occur in any part of structures all the way through to the resistance of soil below foundations exceed 33.3% of the allowable stress specified in the Ministerial Regulation. However, the durability of those parts of structures shall not be less than their durability in case wind load is not considered.

Buildings which located in Bangkok and its vicinity areas are controlled by the Building Control Act for Bangkok B.E 2544 specified about strength of materials and load resistance in Category 10, **Section 109** as follows:

Section 109: Wind load shall be considered in building designs. In case it does not have any reference from any reliable institute or organization, and wind load shall be considered, the designer can use wind load in accordance with the **Table** below:

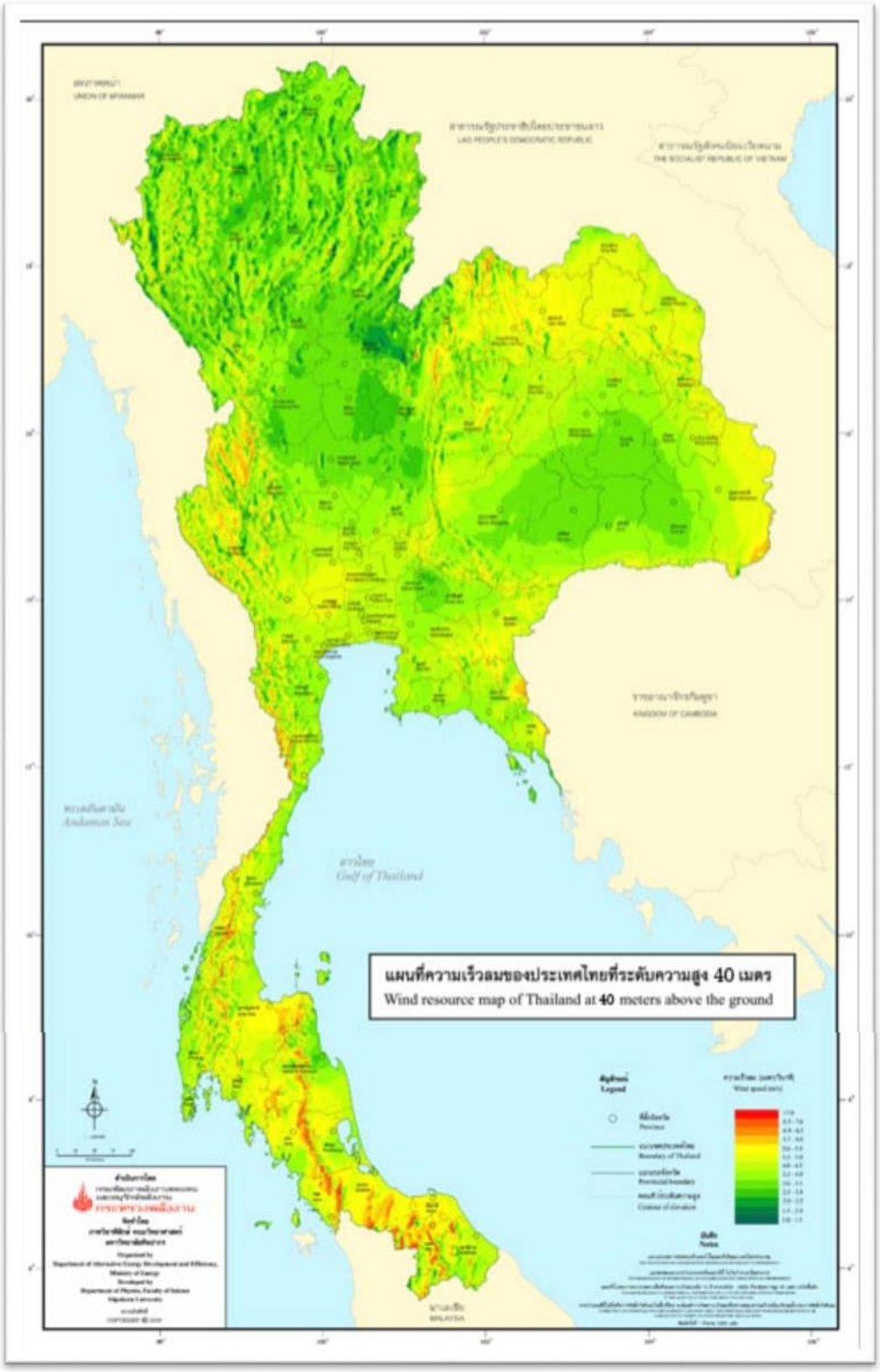
Height of Structures	Minimum Wind Load in KPa (Kgf/m^2)
1. Structures which are not higher than 10 m	0.5 (50)
2. Structures which are higher than 10 m but not exceed 20 m	0.8 (80)
3. Structures which are higher than 20 m but not exceed 40 m	1.2 (120)
4. Structures which are higher than 40 m	1.6 (160)
5. Structures which are higher than 80 m	2.0 (200)

This specification allows stresses to occur in any part of structures all the way through to the resistance of soil below foundations exceed 33.3% of the allowable stress specified in the Ministerial Regulation. However, the durability of those parts of structures must not less than their durability in case wind load is not considered.

In B.E 2550, the Department of Public Works and Town & Country Planning, Ministry of Interior issued the Thai Standard for Wind Calculation and Building Response (DPT 1311-50) which enhanced the calculation of wind load becomes more accuracy in accordance with the international standard by providing both simplified and detailed methods. This standard is now becoming increasingly popular in the design of buildings in Thailand to resist wind load.

LINK DOWLOAD: DPT 1311-50

- Introduction
- Part 1
- Part 2
- Part 3



Map of Wind Speed in Thailand at 40 m Height