DAMAGE CAUSE BY STRONG WIND & WIND LOADS STANDARD FOR BUILDING IN VIETNAM

Reported by

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CONTENTS

FOREWORD

The purpose of this report would like to show some basic information of typhoon and wind load standard for wind resistant design in Vietnam. Beside, other problems of situation of building structures, using foreign standards, and renovation of Building Code in Vietnam are discussed.

PART I: DAMAGE CAUSE BY STRONG WIND IN VIETNAM

1. OUT LINES OF VIETNAM

1.1. Geographical:

Vietnam is stretch of land strengthening along Indochinese peninsula, which is located in South-east Asia. Mainland stretches from $23^0 23'$ to $08^0 02'$ north latitude and widens from $102^0 08'$ to $109^0 28'$ east longitude. Length counted in straight line from north to south stays at about 1,650 km, width from west to east maximizes at 600 km and minimize at 50 km.

Entire territory of Vietnam includes 329,241 sqr.km of mainland and 1,000,000 sqr.km of territorial sea. Inland border of about 3,730 km, shares its border with People Republic of China in the north with border length of 1,150 km, People's Democratic of Laos with length of 1,650 km and United Kingdom of Cambodia with length of 930 km in the west. Vietnam has sea border in the east, south and southeast, over the China Sea and Thailand gulf is the republic of Philippines, Indonesia, Singapore, Brunei and United State of Malaysia.

Fig. 01: Map of Vietnam in region

Fig. 02: Map of Vietnam topography >>>

1.2. Topography

Vietnam covers relatively complicated terrain: countless mountains, numerous rivers, stretching and meandering coastline, percentage relation between mountain and plains in mainland area indifferent among regions.

In the northern part, the topography is as follows, three sides of the west, east and north are mountains and hills, south side is coastline and the middle is plain, mainly as the Red and Thaibinh River being consolidated for million years.

Central part is sloping and narrow, its mountains, plains are closing to its coastline. The part is cut and divided by rivers originating from western mountain ranges flowing into the South China Sea. Along the coastline are small plains. Between sloping mountainsides are narrow and deep valleys.

Southern part's topography is even and flat. Cuulong delta is a low-lying region with average height of about 5m above the sea surface. Some regions of this delta as Longxuyen quadrangle, DongThapMuoi and western Hau River are lower than average sea level, therefore, this area of about 1 million hectares affected by floodwater for 2-4 months per year.

1.3. Climate

Vietnam lies in *tropical region*, which is meeting place of many atmosphere blocks resulting from continent and Equator Ocean therefore tropical climate of Vietnam deeply suffers from Asia monsoon regime, mainly as northeast and southeast monsoon. However, northeast monsoon is only strong in northern and north central parts so Vietnam enjoys two different climate regions.

The north enjoys two typical seasons: hot season is from May to October and cold season is from November to coming April.

The South is mainly affected by southeast monsoon with heat and wetness round year. Both parts of the country all enjoy different climate sub-region depending on its features of geography and topography position.

There is little difference among regions if temperature is counted averagely as follows Hanoi 24^{0}C (City locates in the north of Vietnam), Hue 25^{0}C (City locates in the midland of Vietnam), Hochiminh City 27^{0}C (City locates in the south of Vietnam), and Dalat 17,6^{0}C (City locates in Central highland of Vietnam). However, there is large difference among months between the north and the south, different temperature in the north is about 10 to 15^{0}C and it is about 2 to 3^{0}C in the south.

There is about 100 rainy days with total amount of rainfall of 1500 > 2000 mm per year in Vietnam.

The humidity always is more than 70% in all locations in Vietnam.

1.4. The population: 81.30 million (2003- Source: World Bank).

1.5. The GDP: 39.20 billion US$ (2003- Source: World Bank).

1.6. The GNI per capita: 480.0 US$ (2003- Source: World Bank).

2. NATURAL DISASTER IN VIETNAM

2.1. The frequency of natural disaster:

Vietnam is one of most disaster-prone countries in the world. The tables below describe the relative frequency of deserter in Vietnam (Table 1) and Geographic Areas and Economic Zones of disasters (Table 2).

Table 1: Disaster relative frequency in Vietnam can classified as follows [1]

High	Medium	Low
Flood, Inundation	Hail rain	Earthquake
Typhoon, tropical depression	Landslide	Technology Accident
Flash flood	Forest fire	Frost
Whirl-Wind	Salt water intrusion	
Drought		

Table 2: Assessment of Disasters Severity in Different Geographic Areas [1]

Natural Disaster	Geographic Areas and Economic Zones							
	North east and north west	Red River Delta	North central coast	South central coast	Central highlands	North east south	Mekong River Delta	Coastal Economic zone
Storm	+++	++++	++++	++++	++	+++	+++	++++
Flood	-	++++	++++	+++	+++	+++	+++++	++++
Flashflood	+++	-	+++	+++	+++	+++	+	+++
Whirl-wind	++	++	++	++	+	++	++	++
Drought	+++	+	++	+++	++	+++	+	+++
Desertification	-	-	+	++	++	++	+	++
Saline intrusion	-	+	++	++	+	++	+++	++
Inundation	-	+++	++	++	-	++	+++	+++
Landslide	++	++	++	++	+	++	+++	++
Storm surge	-	++	++	++	++	++	+++	++
Fire	++	+	++	+++	-	+++	+++	+++
Notes: The Table shows the assessment of disaster severity in each zone: Very severe (++++) Severe (+++) Medium (++) Light (+) None (-)								

2.2. Damage assessment caused by disasters for the 10 recent years:

Damages Statistics caused by natural disaster in Vietnam from 1994 to 2003 shows in the table 3.

Table 3: Assessment of Disaster Severity in Different Geographic Areas [1]

Item	Unit	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Total**
People killed	No	508	399	1243	3083	434	901	775	629	389	186	**7375**
Houses collapsed	No	7302	11043	96927	100000	12171	52585	12253	10503	9802	4487	**395202**
Rice fields submerged	ha	700000	200000	900000	600000	100000	100000	700000	100000	46490	200000	**4692313**
Shrimp, fish poll broken	ha	6364	120	4761	34619	215	1419	2877	1002	310	10581	**65955**
Ships sunk, damaged	No	43	1117	1017	3008	231	845	109	2033	26	183	**11764**
Area of forest fire	Ha	8322	9648	12758	1361	14812	1139	850	1845	15548	1402	**115664**
Total	billion-VND	**2850**	**1129**	**7998**	**7730**	**1459**	**5427**	**5098**	**3370**	**1958**	**1589**	**40.835**
Note: US$ approximates 15700 VND												

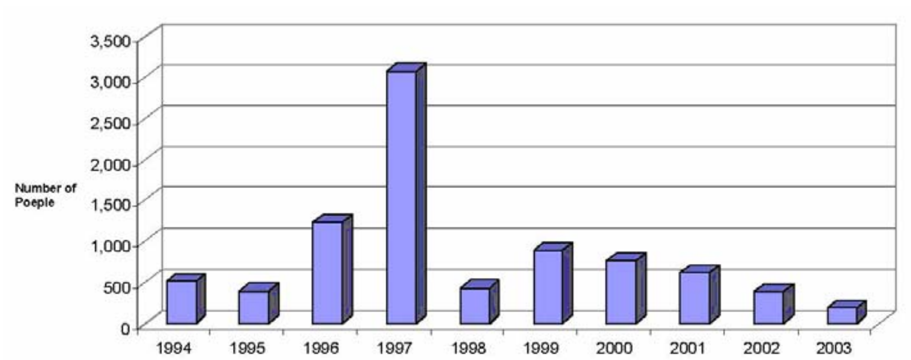

Fig. 03: Graph of people killed by natural disaster from 1994-2003 [1]

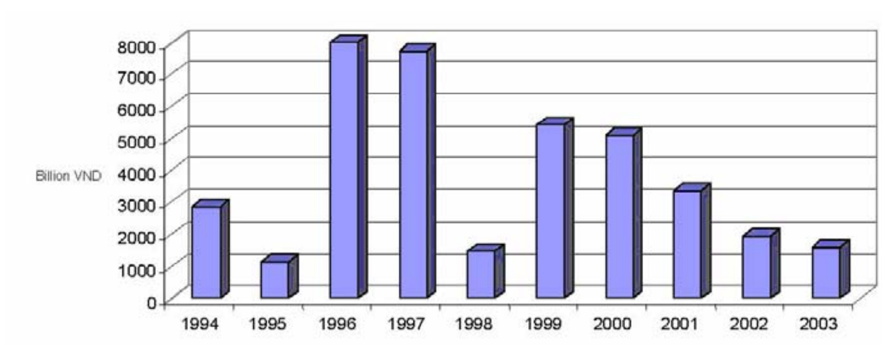

Fig. 04: Graph of damage cost caused by natural disaster from 1994-2003[1]
Note: 1US$= 15700 VND

2.3. Damage assessment caused by each kind of disasters:

Table 4 showed damage assessment caused by each kind of disaster in Vietnam (Source: The OFDA/CRED International Disaster Database [3]).

Table 4: Summarized Table of natural Disasters in Viet Nam from 1953 to 2004

	# of Events	Killed	Injured	Homeless	Affected	Total	
						Affected	Damage-US (000's)
Drought	5	0	0	0	6,700,000	6,700,000	416,770
Aver. per event		0	0	0	1,340,000	1,340,000	83,354
Epidemic	8	1,120	0	0	28,628	28,628	0
Aver. per event		140	0	0	3,579	3,579	0
Flood	38	4,413	1,034	316,445	26,972,355	27,289,834	1,320,600
Aver. per event		116	27	8,328	709,799	718,154	34,753
Insect Infestation	1	0	0	0	0	0	0
Aver. per event		0	0	0	0	0	0
Slides	5	317	73	39,000	0	39,073	2,300
Aver. per event		63	15	7,800	0	7,815	460
Wild Fires	1	0	0	0	0	0	0
Aver. per event		0	0	0	0	0	0
Wind Storm	62	19,831	8,261	3,568,675	34,084,354	37,661,290	1,023,075
Aver. per event		320	133	57,559	549,748	607,440	16,501

**Events recorded in the CRED EM-DAT. First Event: Sep/1953, Last Entry: Dec/2004.*

Table 5: Top 10 Natural Disasters in Viet Nam sorted by numbers of people killed and affected [3]

Disaster	Date	Killed		Disaster	Date	Affected
Wind Storm	Nov-64	7,000		Wind Storm	15-Sep-80	9,027,174
Wind Storm	2-Nov-97	3,682		Wind Storm	23-Jul-80	6,624,710
Wind Storm	Oct-53	2,300		Flood	7-Jul-00	5,000,000
Wind Storm	26-Sep-53	1,000		Wind Storm	Oct-89	4,635,762
Wind Storm	23-Oct-85	798		Flood	Aug-78	4,079,000
Wind Storm	25-May-89	751		Flood	9-Oct-96	3,750,000
Flood	18-Oct-99	622		Flood	18-Oct-99	3,504,412
Epidemic	1-Jan-64	598		Drought	Dec-97	3,000,000
Wind Storm	24-Jul-96	585		Flood	7-Sep-85	2,800,000
Wind Storm	Sep-83	578		Wind Storm	6-Sep-86	2,502,502

3. TYPHOON IN VIETNAM

3.1. The frequency of typhoon evens in Vietnam:

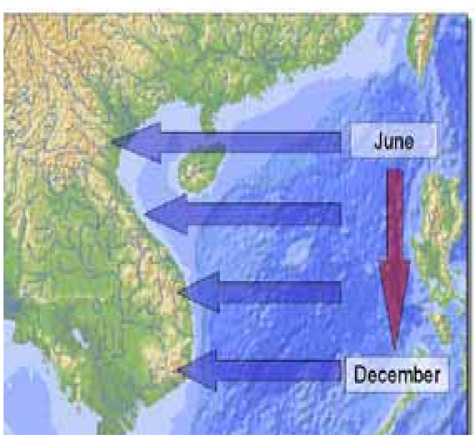

Fig. 05: most areas usually affected by typhoons in Vietnam.

On average, there were *four to six typhoons* stroked the coast of Viet Nam every year [1 & 4]. However, in many years, Viet Nam is struck by 10 or more typhoons, for instance in 1964 (18 typhoons), 1973 (12 typhoons), 1978 (12 typhoons), and 1989 (10 typhoons).

The areas most affected by typhoons are coastal provinces in the North and Centre of Viet Nam. However, typhoons in the South, though less frequent, can still cause immense damage. At the beginning of the typhoon season, in May and June, typhoons appear mostly in the North. As the typhoon season progresses, the path of the typhoon passes through the country moving towards North to south from May to December (Figure 05).

Typhoons are most frequent in the period from June to October, and are very unpredictable.

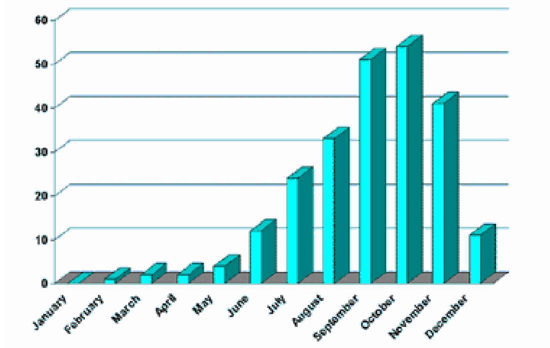

Fig. 06: The total number of Tropical Depressions, Tropical Storms and Typhoons by month to hit mainland Viet Nam over a 53 year period from 1945 to 1998 [2].
[2]: UNDP Project VIE/97/002 -- Disaster Management Unit

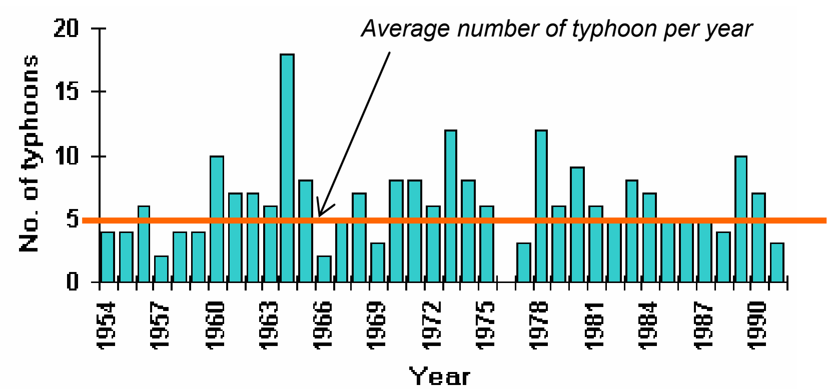

Fig. 07: Number of Typhoons by Year to hit Viet Nam [2].

3.2. The typhoon tracks

Generally, typhoons begin from South China Sea then move to Vietnam in directions of West, West-North or West-South. Figures 8a, b, and c, d shows the typhoon tracks in 1996, 1997, 1998 and 1999 [2].

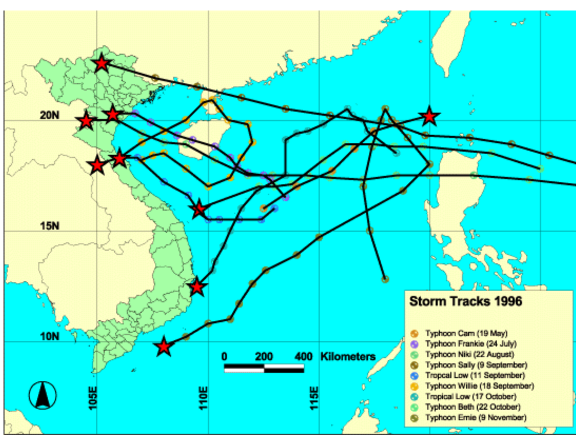

Fig. 08a: Typhoons tracks 1996

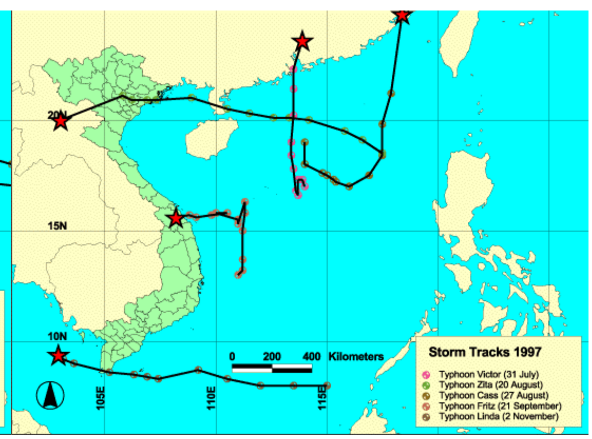

Fig. 08b: Typhoons tracks 1997

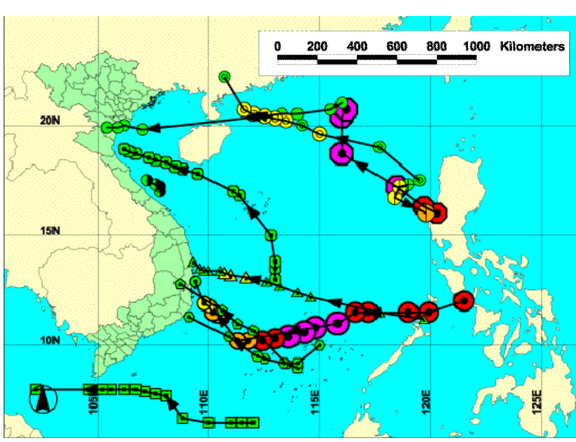

Fig. 08c: Typhoons tracks 1998

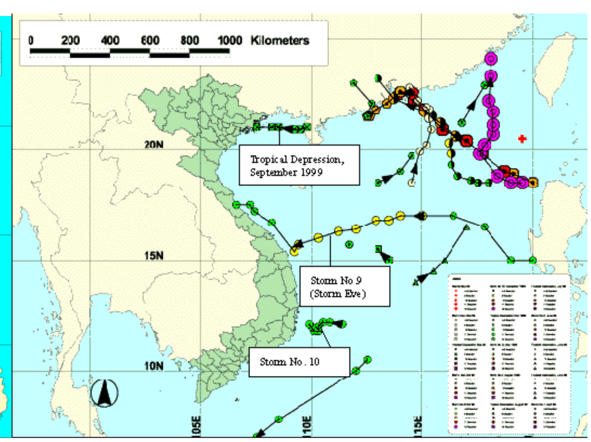

Fig. 08d: Typhoons tracks 1999

3.3. Typhoon damages in Vietnam:

There are only some official summarized statistical documents of Vietnam on damages cause by Typhoon, which made by United Nations Develop Project VIE/97/002- Disaster Management Unit and that are not enough statistical data (e.g. number of killed people, injured people, homeless, economic loss .etc. for each event).

However, all of documents asserted that the damages caused by typhoon are second ranking in Vietnam [1, 2, 3, 4,] but most of top 10 worst damages is caused typhoons (table 5).

Table 6 list damages cause by typhoons and strong wind in Vietnam from 1952 to 2000[4].

Table 6: Summarized Table of damages cause by typhoon in Viet Nam from 1952 to 2000

	GLIDE No.	Dis. Subset	Dis. Name	Year/month/ day	Killed	Injured	Homeless	Affected	Total of Affected	Damage US$ ('000s)
1	ST-1952-0032-VNM	Typhoon		1952/10/..						
2	ST-1953-0019-VNM	Typhoon		1953/09/26	1000					
3	ST-1953-0020-VNM	Typhoon		1953/10/..	2300					
4	ST-1956-0050-VNM	Typhoon		1956/11/..	56					
5	ST-1964-0063-VNM	Typhoon		1964/11/..	7000			700000	700000	50000
6	ST-1971-0029-VNM	Typhoon		1971/05/01	23			50000	50000	
7	ST-1971-0057-VNM	Typhoon		1971/10/23	89					
8	ST-1973-0047-VNM	Typhoon		1973/11/10	100			150000	150000	
9	ST-1977-0088-VNM	Typhoon		1977/07/22				1000	1000	
10	ST-1980-0068-VNM	Typhoon		1980/07/23	132	210	164500	6460000	6624710	
11	ST-1980-0090-VNM	Typhoon		1980/09/15	176	174	250000	8527000	8777174	
12	ST-1982-0112-VNM	Typhoon		1982/10/18	70	290		1300000	1300290	
13	ST-1983-0077-VNM	Storm		1983/05/..	76					
14	ST-1983-0125-VNM	Typhoon		1983/09/28	453	324	265000	580000	845324	
15	ST-1983-0452-VNM	Typhoon		1983/11/10	658	508			508	
16	ST-1984-0035-VNM	Typhoon		1984/04/15	21	94	1000		1094	
17	ST-1984-0103-VNM	Typhoon		1984/11/..	134	289		650416	650705	
18	ST-1985-0114-VNM	Typhoon		1985/10/23/	670	257		225000	225257	
19	ST-1986-0109-VNM	Typhoon		1986/09/06	401	2502			2502	
20	ST-1987-0200-VNM	Typhoon		1987/11/18	101			352000	352000	
21	ST-1987-0363-VNM	Storm		1987/12/..	22					
22	ST-1988-0460-VNM	Typhoon		1988/10/10	101			600000	600000	
23	ST-1988-0503-VNM	Typhoon		1988/11/06	20			720000	720000	
24	ST-1989-0104-VNM	Typhoon		1989/07/24	104	491			491	
25	ST-1989-0128-VNM	Typhoon		1989/10/13	52	762		4635000	4635762	
26	ST-1989-0178-VNM	Typhoon		1989/05/30	151	106		336000	336106	21000
27	ST-1990-0069-VNM	Typhoon	Becky	1990/08/..	19	108	0	500000	500108	
28	ST-1990-0418-VNM	Typhoon		1990/11/15	68				0	
29	ST-1990-0608-VNM	Typhoon		1990/10/23	15		2000		2000	
30	ST-1991-0210-VNM	Typhoon	Fred	1991/08/17	17	16	455905		455921	9500
31	ST-1991-0444-VNM	Storm		1991/12/28	251	200		10000	10200	1000
32	ST-1991-0711-VNM	Storm		1991/03/15	8			10708	10708	
33	ST-1991-0713-VNM	Typhoon	Zeke	1991/07/13	21	6		770	776	
34	ST-1992-0061-VNM	Typhoon	Chuck	1992/06/29	14	11	2230	44945	47186	400
35	ST-1992-0143-VNM	Typhoon	Angela	1992/10/23	17	12	980	31180	32172	18000
36	ST-1993-0088-VNM	Typhoon	Kyle	1993/11/23	130	16	5490	6000	11506	
37	ST-1993-0133-VNM	Storm		1993/03/16	3	16	2000		2016	
38	ST-1993-0231-VNM	Typhoon	Lola	1993/12/08	73	20	4695	20520	25235	
39	ST-1994-0658-VNM	Typhoon		1994/08/28	30	57000		11000	68000	
40	ST-1995-0274-VNM	Typhoon	Zack	1995/11/01	16	51	0	23000	23051	21200
41	ST-1996-0110-VNM	Typhoon	Franki e &	1996/07/24	585	591	0	386500	387091	362000

			Niki							
42	ST-1996-0227-VNM	Typhoon	Willie	1996/09/16	9	0	0	280000	280000	138000
43	ST-1996-0446-VNM	Storm		1996/09/..	33	0	0	200000	200000	
44	ST-1997-0267-VNM	Typhoon	Linda	1997/11/02	3682	857	383045	697225	1081127	200000
45	ST-1997-0358-VNM	Typhoon	Fritz	1997/09/25	10	50			50	5000
46	ST-1998-0159-VNM	Tornado		1998/05/08	42	0	500	0	500	
47	ST-1998-0374-VNM	Typhoon	Chip, Elvis & Dawn	1998/11/..	283	92	40000	2400000	2440092	93000
48	ST-1998-0434-VNM	Typhoon	Faith & Gil	1998/12/16	43	0	3010	81635	84645	15000
49	ST-1999-0637-VNM	Tornado		1999/06/06	10					
50	ST-2000-0361-VNM	Storm		2000/06/12	3	29	100	0	129	
51	ST-2000-0448-VNM	Storm		2000/07/10	0	0	0	2005	2005	
52	ST-2000-0518-VNM	Typhoon		2000/08/20	17	4	0	0	4	7140
53	ST-2000-0540-VNM	Storm		2000/08/24	0	100	5630	0	5730	
54	ST-2000-0541-VNM	Storm		2000/08/24	0	3	0	500	503	35
55	ST-2000-0542-VNM	Tornado		2000/08/24	0	4	130	0	134	
56	ST-2000-0582-VNM	Typhoon		2000/09/10	2	69	10000	15000	25069	3000
	Grand Total				19311	65262	1596215	30007404	32000000	944275

3.4. Recent biggest typhoon Linda- year 1997 in Vietnam

At 12:00 noon on 01-Nov-1997, a tropical low pressure storm in the South China Sea north of the East Malaysian state of Saba escalated into a Typhoon, Typhoon Linda. By 13:00 PM 01-Nov-1997, the centre of Typhoon Linda had moved westward to a position 80 km south of the TruongSa Archipelago (7.9 N latitude and 111.8 E longitude). At that time, the strongest wind velocities near the centre of Typhoon Linda ranged from 60 to 90 km/h (Beaufort Scale 8 to 9) and even higher. At 10:00 AM on 02-Nov-1997, the center of Typhoon Linda had moved further westward towards Vietnam, and situated 120 km east of the coast of Travinh province, Soctrang province and Baclieu province (8.4 N latitude and 106.9 E longitude). On the night of 02-Nov-1997, the centre of Typhoon Linda hit the southern tip of Vietnam (the area from Baclieu province to Ca Mau province) with wind velocities of 75 to 102 km/h (Beaufort Scale 9 to 10). Thereafter, on 03-Nov-1997, Typhoon Linda moved to the West and Northwest, away from Viet Nam towards the West of the Gulf of Thailand, at a speed of 20 km/h.

Table 7 shows damages summary due to typhoon Linda 1997[2].

Table 7: Damage Summary caused due to Typhoon Linda (dated report 6th-January 1998)

Class	Category	Item	Unit	Amount
Humanitarian	People	People killed	No.	778
		People missing	No.	2,123
		People injured	No.	1,232
	Housing	Houses destroyed	No.	312,456
		Houses damaged	No.	34,557
	Education	Schools destroyed	Room	1,424
		Schools damaged	Room	5,727
Food & Food Production	Agriculture	Paddy Destroyed	Ha.	21,743
		Paddy damaged	Ha.	71242
	Fishery	Boats destroyed	No.	2897
Total Economic Loss			**US$**	593,000,000

Notes: In Vietnam (2004), 595 millions USD can build Three Cement Plants (Capacity of 1.4 million ton/year) or built 2.9 million sqr.m of apartment or enough food to supply to 1.5 million persons per year.

3.5. Some examples of typhoon and strong wind damages:

Damages cause by typhoon

Fig. 9: A house after Typhoon passed

Fig. 10: ThuaThien- Hue province in typhoon season 1997 (Vietnam Television Agency)

Fig. 11: A picture usually sew in the typhoon season of Central of Vietnam

Fig. 12: A house is collapsed cause by storm No. 2, date 13 June 2004, Binhdinh province and adjacent central provinces. Source: Labor Newspaper Date: 14 June 2004.

Fig. 13: Storm No. 08, Nov-2001
Family of Mr. Huynh Đuc Thang, Team 7, section 11, Tranphu-precinct, Quinhon-City

Fig. 14: An R.C. electrical- column are broken cause by storm (Hanoi, 2003).

Fig. 15: Fishing boats broken or sunk due to storm wave
Source: Labor Newspapers
Date: 11 March 2004.

Fig. 16: Floating- restaurant named Zambo is wrecked cause by storm No. 5, QuangNinh province.
Source: Vietnam Net, date 26-August 2003

Fig. 17: A tree fallen cause by storm No. 5, QuangNinh province.
Source: Vietnam Net, date 26-August 2003

Fig. 18: A classroom is damaged cause by a whirlwind. Date 20/05/2003- Binhminh- district, Vinhlong province.

Fig. 19: Metal Roofing of a small school had overturned cause by whirlwind.
Date 29 -May 2004, Quangnam province

Fig. 20: Some wood-house had collapsed Cause by whirlwind. Date 27 -March 2005, Nam Dong- suburb of Hue city.

Fig. 21: Tile- roofing of a brick-house had overturned cause by whirlwind. Date 14 -Apr 2004, BinhTriDong precinct, TanBinh district - HoChiMinh city

Fig. 22: A glass Window is broken cause by whirlwind. Saigon Super-Market, HoChiMinh city,
Source: Vietnam Net date 26 –Jun 2003. Glass thickness: 10

Fig. 23: An advertisement column is broken cause by whirlwind. Fortuna Hotel, Langha Street, Hanoi, Source: Vietnam Net, date 03-May 2005.

CONCLUSION

Vietnam is one of the most natural disaster-prone countries in the world and there were a lot of kind of natural disaster such as Flood, Inundation, Typhoon, Tropical depression, Flash flood, Whirl-Wind, Drought, Hail rain, Land slide, Forest fire, Salt water intrusion, Earthquake and other…

The most damage caused by Flood and Strong wind (mainly Typhoon and Whirlwind).

The damage caused by typhoon and other strong wind was serious. However, the database of damage due to strong wind was not enough statistical data of each event. Actually, the professional statistical work only began from 1997.

The Building damage caused by strong wind mainly almost concentrated to small building or small structures, which almost did not built by engineer.

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PART II: WIND LOAD STANDARD FOR BUILDING IN VIETNAM

1. SUMMARY

In Vietnam, the current Wind Loading used for Building design is a part of Vietnam-National-Standard, named ***Load and Actions- Norm for design*** (TCVN 2737-1995), which has valid since 19th-Dec, 1995 [1]. This load code was originated firstly in 1961, and has four update versions, including (QP 01-61), (TCVN 2737-1978), (TCVN 2737-90) and (TCVN 2737-1995).

The (TCVN 2737-1995) is issued by Ministry of Construction of Vietnam and is *mandatory-standard* in Construction industry. The outline of (TCVN 2737-1995) shows as follow.

1.1. Scope of applications

(TCVN 2737-1995) stipulates for the Loads and Actions, which used for designing of Structures, Foundation and Buildings.

(TCVN 2737-1995) does not stipulate for the Loads and Actions, which happened cause by the working of railway, motorway, sea-wave, stream-flow, loading and unloading of cargo, earthquake, whirlwind, temperatures, dynamic effect due to running-equipment and others.

With repaired-building, the load using for design-work should be determined by surveying-values on construction site.

Atmosphere effecting has to refer the climatic-values of "Vietnamese-Current-Climatic-Code for design" or values supply by Hydro Meteorological Service of Vietnam (HMSV).

This Norm also does not deal with load and action of very important buildings. This problem will be decided by authoritative-organization (e.g. Government).

Based on (TCVN 2737-1995), other industries as transportation, irrigation (water resource), electricity, post office. etc…Should to make the Private-Load-Standard, which are suitable to their industry.

1.2. Classification of loads

Depend on duration-time of acting, the (TCVN 2737-1995) device loads to 2 types, permanent (frequent) loads and temporary loads (included: long–term, short-term and special load).

The permanent loads include:

- Weights of building (structures, substructures, and other part). This component can understand as dead load in foreign-standards;
- Weight and soil pressure and other (these loads do not change in construction-duration-time or in using-time of building)

The temporary loads:

- The *long-term temporary loads* was defined such detail in this code. Some examples are weight or action of equipment and machines in working-time, effecting of changed temperature or humidity. etc…. The "*frequent component of live load*" is one of types of long-term temporary loads.

- The *short-term temporary loads* also was defined such detail in this code. Example: weight, materials, and persons in repairing-building-time, acting of equipment and machines in constructing-duration-time, .etc…. The "live load" and "wind load" also knew as short -term temporary loads.

- The *special-loads* includes: earthquake load, exploding load, serious effecting (load) cause by technical and running-equipment (e.g. Loads originated when the car or train rushed to building. etc…), effecting of foundation-deformation when soil-structure was changed caused by landslide, effecting of fire and other…

In summary, (TCVN 2737-1995) stated all kind of loads or actions, which possible happened, and all designers have to consider them in design-work. However, this code mainly guides to estimate of Dead load (D), Live load

(L), Wind load (W) and Crane load (used for industrial-buildings). Seismic load (E) and other actions or effects have to refer another recommendations or specifications.

1.3. Concepts of (Design load) and (Basic load)

In the TCVN 2737-1995, reliability-factor of load understood that is over load factor, denoted by **γ** (normally **γ** >=1.0). The TCVN 2737-1995 also has instruction for choosing of γ and the values depend on purpose of analyzing (e.g. behavior capacity of section, cracking, buckling, deformation, deflection…etc…).

(**Design load**) = (**Basic load**) (**γ**); where the Basic-load and over load factor are stipulated in (TCVN 2737-1995).

1.4. Combination of Loads

Depend on character of building and the loads and action in considering; the load combination includes basic-load-combination (BLC) and special-load-combination (SLC).

- (BLC) includes (permanent loads) and (long-term temporary loads) and (short-term temporary loads).
- (SLC) includes (permanent loads) and (long-term temporary loads) and (short-term temporary loads may be occurred) and (one of special loads). Generally, (SLC) have to refer another specifications or recommendation.

The loading combination factor, denoted by ψ. The (TCVN 2737-1995) also has detailed-instruction for choosing ψ and the value depends on character of building and the number of load type.

The method makes BLC as follows:

- The case has one (permanent load) and the other load (temporary load): ψ=1.0 for (permanent load) and (temporary load).
- The case has one (permanent load) and more than two (temporary loads): ψ=1.0 for (permanent load) and ψ=0.9 for (long-term temporary loads) and (short-term temporary loads).

A simple example of BLC
A new civil building (e.g. office building, school, apartment…etc…) will construct in an area without earthquake and another special actions. There are only acting of dead load, live load and wind load. In this case, two load-combinations using for structural design as follows:

- BLC-1= 1.0D + 1.0L (one frequent load and one temporary load)
- BLC-2= 1.0D + 0.9L + 0.9W (one frequent load and two temporary loads)

Notes: values of 1.0 and 0.9 are combination factors.

2. WIND LOAD OF TCVN 2727-1995

2.1. Outline

In the (TCVN 2737-1995), mean-wind-speed ($V_{o,}$ m/s) using in design depend on the 3-seconds mean wind speed of 10 m height in flat, open country with a return period of 20 years. For calculating of wind load, (TCVN 2737-1995) is divided into 5 zone of wind pressure [1, 2].

This standard shows method to determinate wind load of buildings and other structures that responds elastically in strong wind.

2.2. Wind load definition and scope of application.

According to (TCVN 2737-1995), the wind load includes two component, that are static-pressure component and dynamic-pressure component.

The static -pressure component always must consider in any cases.

The dynamic-pressure component must consider in some cases that satisfy the following criteria:

- High-rise buildings which the height (H) is taller than 40.0 m;

- Frames of one story industrial-building, which the height of building (H) is taller than 36.0 m and the ratio (H/L) is larger than 1.5 (L is span of frame);
- Some flexible and slender buildings, what are sensitive to wind-action (e.g. stack, chimney, power transmission tower. etc…).

- In addition, for more flexible and slender building (or structures) have to check of aero-elastic instability. However, (TCVN2737-1995) has not defined any instruction for this problem and has to refer another specifications or recommendation.

.
The wind load normally acted on surfaces of building defined as wind force over unit area.

The reliability-factor (over load factor) of wind load (γ), γ=1.2 with assumption-lifetime of building is 50 years. If the lifetime of building is shorter, then could be used the adjust-factor (a_t) to determine design wind load (see table 7).

(Design wind load) = (Basic wind load) (γ) (a_t)

Table 7: The adjust- factor, a_t

Assumption life time of building (years)	**5**	**10**	**20**	**30**	**40**	**50**
a_t	0.61	0.72	0.83	0.91	0.96	1.0

2.3. Determination of basic static pressure of wind load:

2.3.1. Equation

For main structure, claddings and component (element), the "Basic Static Pressure" of wind load should be calculated from equation (5):

$$\mathbf{W = W_o\ k\ c} \qquad (5)$$

Where:

- W: basic-static-wind-pressure at height z (daN/m^2);
- W_o: criteria wind pressure (daN/m^2) depending on the location of Vietnam, described in 2.3.2 (criteria wind pressure is termnology in wind pressure map, W_o also can understand that is mean wind pressure);
- k: the factor consider to the variation of wind pressure depending on the height z and terrain category (wind pressure profile factor), described in 2.3.3;
- c: aerodynamic shape factor, described in 2.3.4.

2.3.2. Determination of W_o

(TCVN 2737-1995) shows detail of Wo value referring to Wind pressure Map (Fig. 24) or administrative location name of Vietnam. The value of W_o gets from Table 8.

Table 8: criteria wind pressure depending locations

Location in Map	**I**		**II**		**III**		**IV**	**V**
	I-A	**I-B**	**II-A**	**II-B**	**III-A**	**III-B**	**IV-B**	**V-B**
W_o (daN/m^2)	55	65	83	95	110	125	155	185

With locations I-A and I-B, the values in table 8 only used for designing of building in terrains as mountain-areas, hill-areas, plan-areas and valleys-areas. The influence by typhoon is weak in locations of I-A, II-A, III-A.

With complicated terrains as ravines, gulch defiles and other, the Wo should be supplied by (HMSV) or should be determined base on equation as follow:

$$\mathbf{W_o = (0.5)\ \rho^2\ V_o^2 = (0.0613)\ V_o^2} \qquad (6)$$

Where:

- **V_o**: mean wind speed (m/s) corresponds to the 3-seconds mean wind speed over category B (table 9) at an elevation 10m with a return period of 20 years.
- **ρ:** air density (1.225 kg/m^3 can be used).

If houses or buildings located in the mountain-areas or island-areas which has the same level and category and be placed closed to climate station then should be referred the values of W_o what be attached to appendix of TCVN2737-1995.

2.3.3. Determination of k-value

The terrain definition as table 9:

Table 9: the terrain category

Category	Construction site conditions
A	Exposed open, no significant obstructions, a few scattered obstructions what the height is less than 1.5 m (e.g. grassland without tall tree, sea, large lake, large rier, etc…).
B	Open, a few scattered obstructions that the height is less than 10 m (e.g. suburb or town that scattered domestic house, villages, thin-forest, sampling-forest, etc…).
C	Not open, a lot of obstructions close to each other and their height is more than 10 m (e.g. city, dense wood; thick forest…etc…)
Note: With each building, the it's category (A or B or C) is chosen depend on contruction site topography, which do not change in distance of 30h (when H ≤60m) or 2 km (when H>60m) from windward-surfaces of building; H is height of building.	

k is defined by equation as follows: $k = 1.884(z/z_g)^{2a}$

Category A: z_g= 250m; a=0.07; Category B: z_g= 300m; a=0.09; Category C: z_g= 400m; a=0.14; z_g is gradient heght.

Values of **k** should be referred table 10:

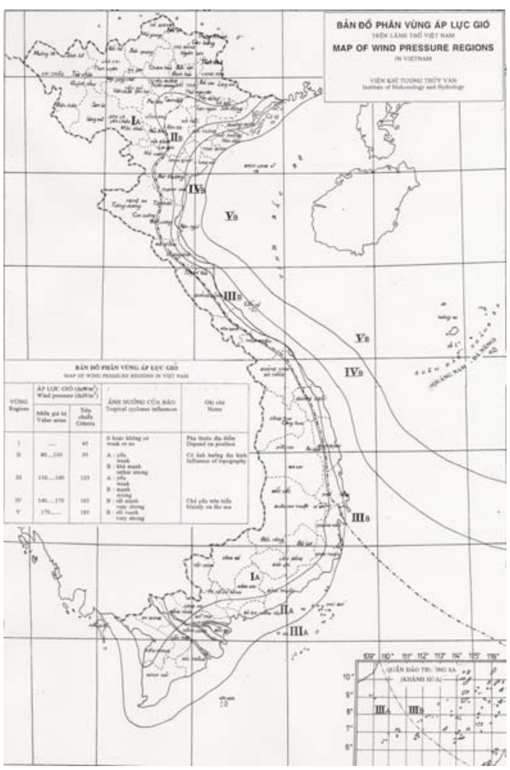


Fig. 24: Map of Wind pressure regions in Vietnam

Table 10: the **k**-value

Height, z(m)	***k**-value depend on each category*		
	A-Category	B-Category	C-Category
3	1.00	0.80	0.47
5	1.07	0.88	0.54
10	1.18	1.00	0.66
15	1.24	1.08	0.74
20	1.29	1.13	0.80
30	1.37	1.22	0.89
40	1.43	1.28	0.97
50	1.47	1.34	1.03
60	1.51	1.38	1.08
80	1.57	1.45	1.18
100	1.62	1.51	1.25
150	1.72	1.63	1.40
200	1.79	1.71	1.52
250	1.84	1.78	1.62
300	1.84	1.84	1.70
350	1.84	1.84	1.78
≥400	1.84	1.84	1.84
Notes: - With intermediate-level, k-value could determine by elastic-Interpolation-method. - The different wind directions may be getting the different terrain category.			

Notes:

In the cases what the surrounding building topography are not flat so the height (z) for determining of k should be referred as follows:

- Case 1: If the ground slope, i ≤ 0.3 so height z is calculated by the distance from ground level (the position what building located) to point in considering on building.
- Case 2: If the ground slope, 0.3< i < 2 so height z is calculated by the distance from Zo- level (Fig. 25) to point in considering on building.
- Case 3: If the grounds slope, 2 ≤ i so height z is calculated by the distance from Zo- level (Fig. 25) to point in considering on building.

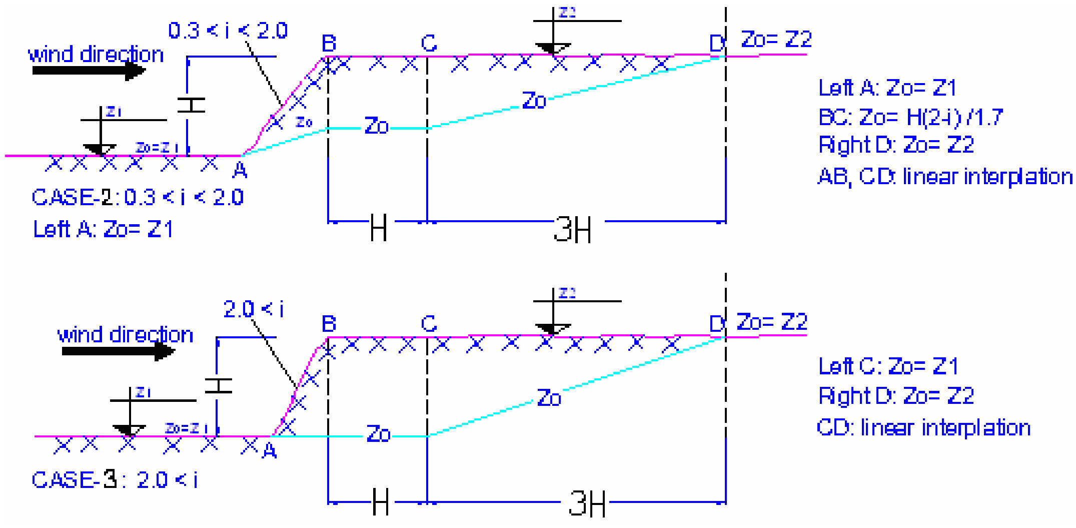


Fig.25: Zo plan to determinate height (z)

2.3.4. Determination of c-value

2.3.4.1. The c-value for analyzing frame structures

The (TCVN 2737-1995) gives an introduction in diagram, of wind load action and aerodynamics shape factor in detail of 43 typical shapes of building, claddings and element (Refer TCVN 2737-1995, Vietnamese version).
In the case, if buildings, structures, and other, in which their shapes are omitted (absented) from (TCVN 2737-1995) then aerodynamics factor have to refer the wind-tunnel-test-results or other recommendations.

The aerodynamic shape factor also is defined external and internal aerodynamics shape factor

An example: determination of aerodynamic shape factor (c) of closed building with roof of two-way slopes in (TCVN 2737-1995).

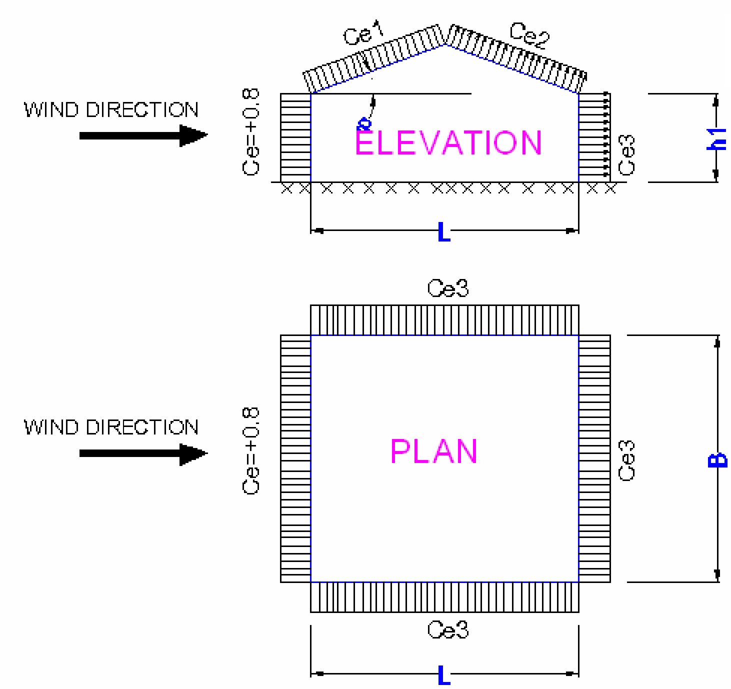


Fig. 26: c-factor for building with roof of two-way slopes.

C - factor	α (deg.)	(h_1/L)			
		0	0.5	1.0	≥ 2.0
C_{e1}	0	0	-0.6	-0.7	-0.8
	20	+0.2	-0.4	-0.7	-0.8
	40	+0.4	+0.3	-0.2	-0.4
	60	+0.8	+0.8	+0.8	+0.8
C_{e2}	≤ 60	-0.4	-0.4	-0.5	-0.8

b/L	C_{e3} when (h_1/L) is		
	≤ 0.5	1.0	≥ 2.0
≤ 1.0	-0.4	-0.5	-0.6
≥ 2.0	-0.5	-0.6	-0.6

Note: If the wind blows to gable of building, (direction is orthogonal to the wind direction what showed in Fig. 26) then the values of C_{e1} and C_{e2} are -0.7.

At the zones in building, which the values of external-aerodynamics shape factor is minus, then in *strength-component-design* has to considering "local pressure".

In this case: c_{local}= c D; D=2.0 for ZONE (1) and 1.5 for ZONE (2); see Fig. 27;

Where: D is the factor considering to local pressure. D-factor could ignore if slope angle $\alpha \leq 10^0$ (α: see Fig. 26)

Notes: for determinates the total forces on building should not be used D-factor.

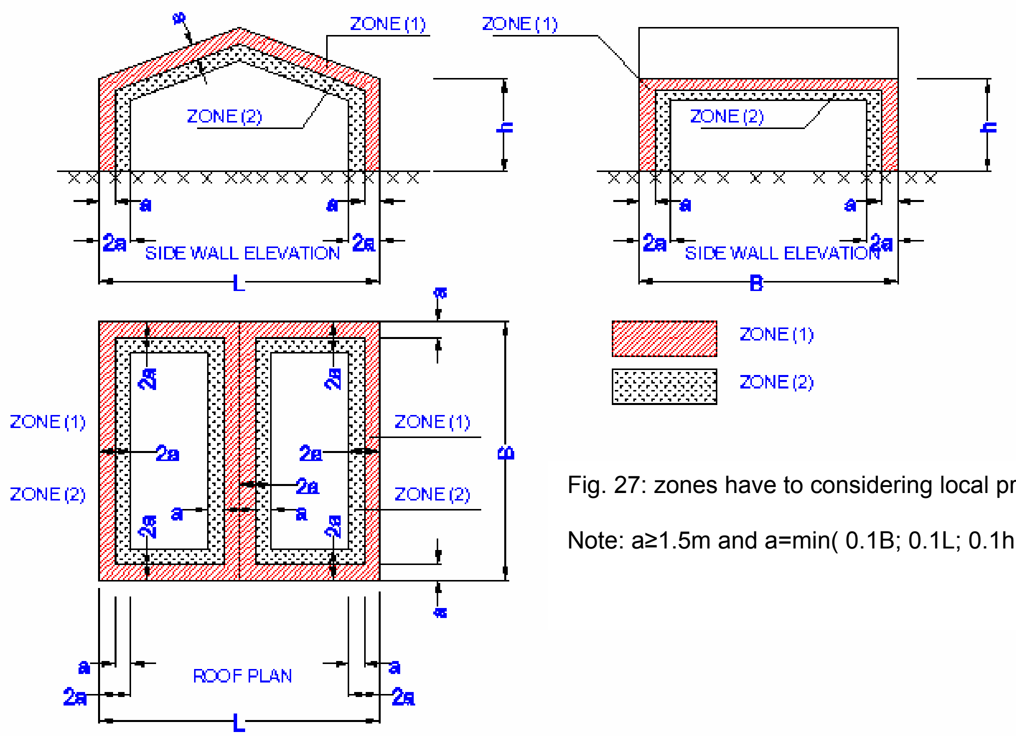


Fig. 27: zones have to considering local pressure factor in design

Note: a≥1.5m and a=min(0.1B; 0.1L; 0.1h)

2.4. Determination of Basic Dynamic Pressure value of wind load

Based on values of *the natural vibration frequency* of building in considering (denoted by f_s(Hz) for mode s) and *the limited value of natural vibration frequency*, which is defined in this standard (denoted by f_L (Hz) and these values shows in table 11), the (TCVN 2737-1995) divides four cases to determine basic dynamic pressure of wind load as follows:

- Case I: $f_1 > f_L$, see item (2.4.1); f_1 (Hz) is natural vibration frequency for the first translational mode in along wind direction (mode 1)
- Case II: $f_1 < f_L$ and the building and component of structures with be analyzed as single-degree-of-freedom system, see item (2.4.2);
- Case III: $f_1 < f_L < f_2$, see item (2.4.2); f_2 (Hz) is natural vibration frequency for the second translational mode in along wind direction (mode 2)
- Case IV: $f_s < f_L$, see item (2.4.3); f_s (Hz) is natural vibration frequency for s-th mode in along wind direction (mode s).

2.4.1. Case I ($f_1 > f_L$)

In this case, the basic wind dynamic pressure (Wp) should be calculated as follow:

$$\mathbf{W_p = W \zeta \lambda} \qquad (7)$$

Where:

- W: basic-static-wind-pressure at height z (daN/m2) is calculated by equation (5);
- ζ: the dynamic pressure-factor depending on the height (z) and terrain category; the value is referred table 12;

- λ: the factor considering to the effect of ratios between surfaces of building (spatial interrelated ration). The surfaces had to considering in analyzing are windward wall, leeward wall, sidewall that received wind load and transfer them to main structures of building (e.g. Frames). (TCVN2737-1995) give out the determination of λ in the case that surfaces of building are rectangular only. In this case, the λ-value is determined base on referring the value of ρ and ɣ (table 13 and 14). The table 13 shows the definition of ρ and ɣ when wind direction is X direction (see Fig. 28). Table 14 shows the value of λ in each case of ρ and ɣ.

Table 11: the limited value of natural frequency

Wind-pressure locations	f_L (Hz)	
	Δ= 0.30	Δ= 0.15
I-A, I-B	1.1	3.4
II-A, II-B	1.3	4.1
III-A, III-B	1.6	5.0
IV-B	1.7	5.6
V-B	1.9	5.9

Notes:
- R.C. building, Bick wall building and S.S. building which has surrounded wall, value Δ is 0.30;
- S.S. towers, S.S stack or steel truss tower which R.C. foundation, value Δ is 0.15;
- Δ: logarithmic-damping-ratio of vibration

Table 12: the ζ –value

Height, z(m)	*ζ -value depend on each category*		
	A-Category	B-Category	C-Category
≤5	0.318	0.517	0.754
10	0.303	0.486	0.684
20	0.289	0.457	0.621
40	0.275	0.429	0.563
60	0.267	0.414	0.532
80	0.262	0.403	0.511
100	0.258	0.395	0.496
150	0.251	0.381	0.468
200	0.246	0.371	0.450
250	0.242	0.364	0.436
300	0.239	0.358	0.425
350	0.236	0.353	0.416
≥480	0.231	0.343	0.398

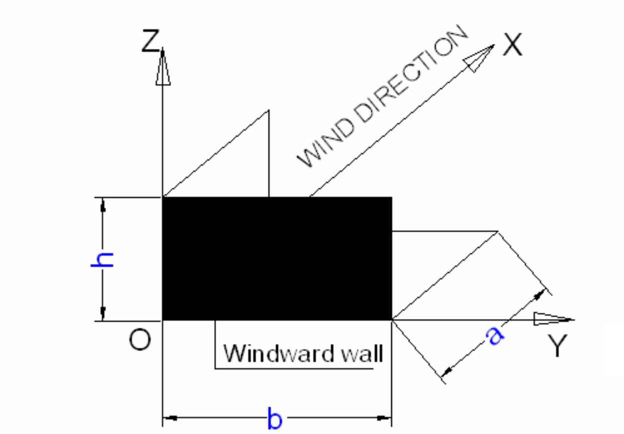


Table 13: the definitions of ρ and ɣ
(Wind direction is direction of X-axis)

Plan	ρ	ɣ
ZOY	b	h
ZOX	0.4a	h
XOY	b	a

Fig. 28: The coordinates system is used for determination of λ

Table 14: the value of λ.

ρ (m)	The value of λ when ɣ is						
	5	10	20	40	80	160	350
0.1	0.95	0.92	0.88	0.83	0.76	0.67	0.56
5	0.89	0.87	0.84	0.88	0.73	0.65	0.54
10	0.85	0.84	0.81	0.77	0.71	0.64	0.53
20	0.80	0.78	0.76	0.73	0.68	0.61	0.51
40	0.72	0.72	0.70	0.67	0.63	0.57	0.48
80	0.63	0.63	0.61	0.59	0.56	0.51	0.44
160	0.53	0.53	0.52	0.50	0.47	0.44	0.38

2.4.2. Case II ($f_1 < f_L$)

This case applied for buildings and component of structures which analyzing-model is as a single-degree-of-freedom system (e.g. frames of one-story industry building, water tower or other…etc…); the W_p should be calculated by equation (8) as follows:

$$\mathbf{W_p = W\,\zeta\,\xi\,\lambda} \qquad (8)$$

Where:
- W, ζ, λ : refer equation (7)

- ξ: the dynamic-factor is determined based on Δ (table 10) and factor $\varepsilon= ((1.2\ W_o)^{1/2})/\ (940f_1)$; f_1 and W_o should be referred by above equations. (TCVN 2737-1995) also shows the diagram (Δ, ε) to determine ξ (Fig. 29).

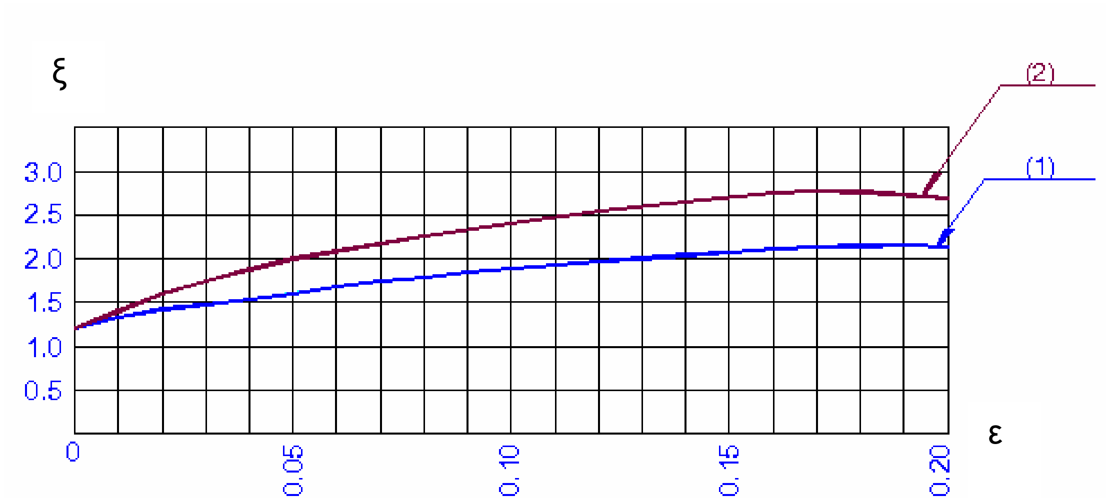


Fig. 29: diagram for determining of ξ

Graph (1): using for R.C Building, Brick wall and S.S Building (has surrounded wall), value Δ= 0.3

Graph (2): using for S.S tower, S.S stack, steel truss tower, which R.C Foundation, value Δ=0.15

2.4.3. Case III ($f_1 < f_L < f_2$)

This case also applied for the buildings have symmetric plan only and $f_1 < f_L$.
The value of W_p should be calculated by equation (9) as follows:

$$\mathbf{W_p = m\ \xi\ \psi\ y} \qquad (9)$$

Where:

- m: weight of building part, which centroid is at height z.
- ξ : the dynamic-factor referring equation (8)
- y: horizontal displacement of building at z-height of mode 1-natural vibration in wind direction. With the buildings has symmetric plan, could use values of y due to cause by *horizontal distribution forces*.
- ψ: the factor is determined by divides building in height to (r) parts what the wind pressure is constant on each part. Ψ is calculated by equation (10).

$$\Psi = \left(\sum_{k=1}^{r} y_k W_{pk}\right) / \left(\sum_{k=1}^{r} y_k^2 M_k\right) \quad (10)$$

Where:

- M_k (daN): weight of (k) th-part of building;
- Y_k: horizontal displacement of the centroid of (k) th building-part of mode 1-natural vibration;
- W_{pk}: uniform basic dynamic pressure of wind load of building-part (k) what be calculated by equation (7)

Otherwise, if buildings have symmetric plan and weight and the windward wide, which are constant in height of building, then W_p could be calculated by equation (11).

$$\mathbf{W_p = 1.4\ (z/h)\ \xi\ W_{ph}} \qquad (11)$$

Where:

- z, h, ξ should be referred above equations;
- W_{ph}: basic dynamic pressure at h-height (top of building) should be calculated by equation (7).

2.4.4. Case IV ($f_s < f_L$)

In this case, the building should analyze in considering to modes of vibration from 1st-mode sth-mode. Where, (s) is defined by requirement as $f_s < f_L < f_{s+1}$.

2.5. Procedure for estimating design wind loads

The design wind loads is calculated from equation (12)

$$\mathbf{q} = (\mathbf{W} + \mathbf{W_p})\, \gamma\, a_t\, A \qquad (12)$$

Where

- W: basic-static-wind-pressure at height z (daN/m^2), calculated by the method in (2.3);
- Wp: basic-dynamic-wind-pressure at height z (daN/m^2); calculated by the method in (2.4);
- γ: over load factor, γ=1.2;
- a_t: the adjust factor; calculated by the method in (2.2);
- A: projected area at height z (m^2)

Notes: basic-dynamic-wind pressure (Wp) must be considered in some cases as defined in item (2.2). Besides, Wp is zero.

References

[1]. TCVN 2737-1995, Load and Actions- Norm for design (Vietnamese version);
[2]. Tran Viet Lien, Nguyen Dang Bich, Nguyen Vo Thong (2004), On the wind pressure zone map of the Vietnam territory, Proceeding of Workshop on Regional Harmonization of Wind Loading and Wind environmental Specifications in Asia-Pacific Economies (APEC-WW), Tokyo Polytechnic University, Nov-2004.

PART III: SITUATION ON BUILDING STRUCTURES AND USING FOREIGN STANDARDS IN VIETNAM

1. SITUATION ON BUILDING STRUCTURES

1.1. Out line of solution for Building Structures in Vietnam

In Vietnam, the developing of construction industry depend on characters such as economic level, natural condition, social condition, available material, manufacturing-level, managed and policy system, and others. The solution of building structures are not only depend on above reason, but also depend on some particular characters such as architect solution, designed-level, available material, requirement-time to constructing, and others.

The solutions of building structures had built during last 10 years could be classified as follows:

Large Span Building (Gymnasium, Stadium, Large-low-rise-storage, Exhibition hall…) mainly had been used Space-Steel-Truss for Roof and Reinforce Concrete (R.C) or Steel (S) for supporting structures (see Table 15)

Civil Building (Hotel , Office, Hospital, Supermarket, Apartment, School, Resident and other…) mainly used R.C Structures (see table 16).

Light Industrial Building (textile, food and seafood processing,…) normally is low-rise building. The structure had been used S-Structures.

Heavy Industrial Building (Building Material, mechanical, metallurgical,…), the using of R.C Structures and S. Structure are multiform and depend on the private character of each projects.

Besides, in Vietnam there are many Private Resident Buildings (PRB), which built by themselves (not by Construction Company and engineer). In the big city, PRB mainly made by R.C Structure. In the town and countryside mainly made by brick-wall, wood truss (or S. truss) and tile-roof (or metal-roof). Nowadays, there are only some wood houses in mountain areas and rural areas.

Table 15: Main structural solutions for Large Span Building

Main Solutions						
Foundation	Material had been used for Main structures				Roof	Cladding and Surrounding wall
	Shear -wall	Column	Beam	Floor slab		
R.C Bored pile or R.C. driven pile	R.C	R.C or S	R.C or P.C	R.C or P.C panel	S-truss and covering by metal sheets	Brick or Glass or Metal sheet
Legend: F: Footing (foundation); R.C: reinforce concrete; S: Steel; P.C: Prestressed Concrete						

Table 16: Main structural solutions for Civil Buildings

Number of Stories	Main Solutions						
	Foundation	Material had been used for Main structures				Roof	Cladding and Surrounding wall
		Shear -wall	Column	Beam	Floor slab		
1 to 2 stories (5 to 10m)	Brick F or Stone F or R.C F	Brick	Brick or R.C or S	R.C or S	R.C or S	R.C or S truss	Brick or Glass or Metal sheet
3 to 5 stories (12 to 20m)	R.C spread F or R.C raft F	RC	R.C	R.C	R.C	R.C or S truss and covering by metal sheets	Brick Or Glass
6 to 12 stories (25 to 50m)	R.C driven pile	R.C	R.C	R.C	R.C	R.C	Brick Or Glass
15 to 35 stories (42 to 135m)	R.C Bored pile, R.C Barret Wall	R.C	R.C	R.C	R.C	R.C	Brick Or Glass
Legend: - F: Footing (foundation); R.C: reinforce concrete; S: Steel, P.C: Prestressed Concrete. - Buildings, which are less than 6 stories and beam span more than 7.2m may be using Prestressed Concrete for Beam. - High rise building, which using flat slabs and without beam, may be using Prestressed Concrete for Slab.							

1.2. Tendency and prospects on solution of Building Structures in Vietnam

Large Span Building:

Roof structures, mainly, will be used Space-Steel-Truss for Buildings, which has requirement of high aesthetics such as Stadiums, Complex Gymnasiums, Exhibition & Fairs…etc. With other Large Span Building such as Supermarkets, Auto Garages, Large Storages…etc, mainly will be used S-frames.

High strength steel material will use for these building.

Civil Building (such as Hotel , Office, Hospital, Supermarket, Apartment, School, Resident and other…)

In next 10 years, mainly will be used R.C- Structures. The Prestressed Concrete Flat Slab will be applied to many Buildings such as Office, Hotel, and Hospital cause by architectural-characters and requirement of shorter-time in construction work.

In next 15 years, mainly will be used S-Structures and Composite-Structures especially in high-rise building (Up to now, there are some projects, which more than 40 stories-height will built in next 5 years and using S-Structure and Composite Structure)

Industrial Building: mainly will be used Steel-Structure as much as possible cause by the requirement of shorter-time in construction work.

Wood (timber) Structures: only be used in some special cases such as maintaining (repairing) of Pagodas, Temples or traditional cultural buildings, and small-pleasure-house in the spa or beach….

1.3. Some pictures of Building Structures in last 10 years.

In Vietnam, the Architectural characteristic are various in region. There is some typical building in Large Cities or Large Industrial Projects.

Large Span Buildings

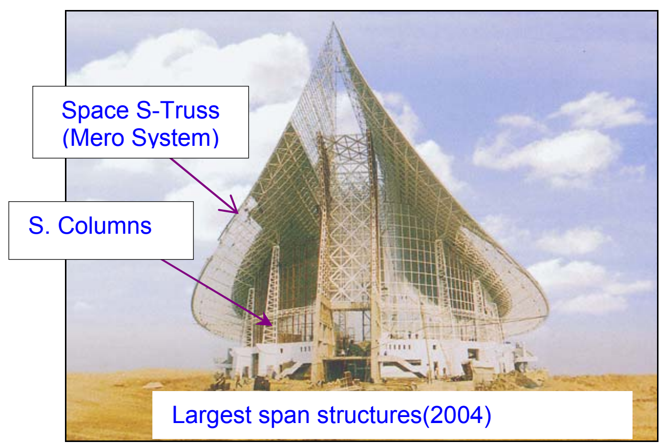
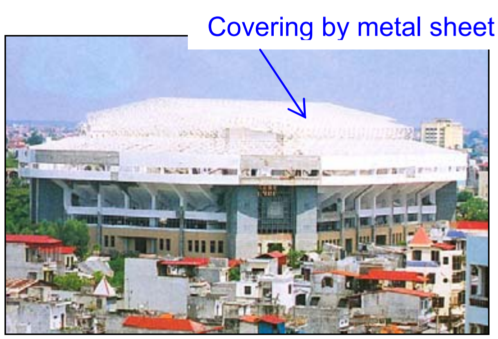
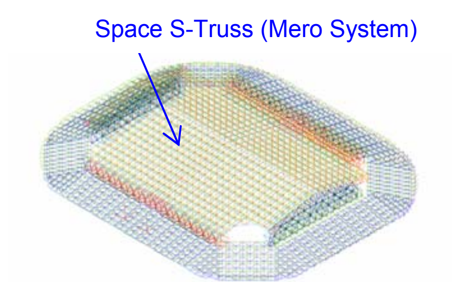


Fig. 30: **Haiphong Exhibition & Fair Building**
Haiphong City, (Copletted 2004)
Total area: 10000 sqr.m. Roof: length-160m, wide-84m, main-span: L=70m. Height: 35~48m.

Fig. 31: **QuanNgua- Gym.**
Hanoi Capital.
(Completed 2004)
Roof Area: 8600 sqr.m;
Roof size: Lengh-100 m,
Wide-80 m;
Main span: 60m





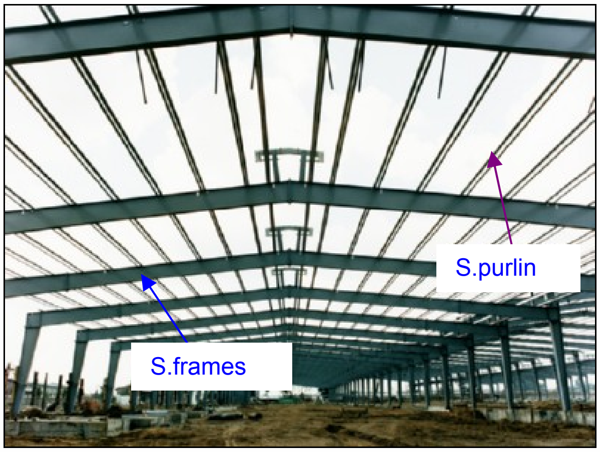


Fig. 32: **A typical low-rise and large span building.**
(Mainly using for Light Industry in Vietnam)

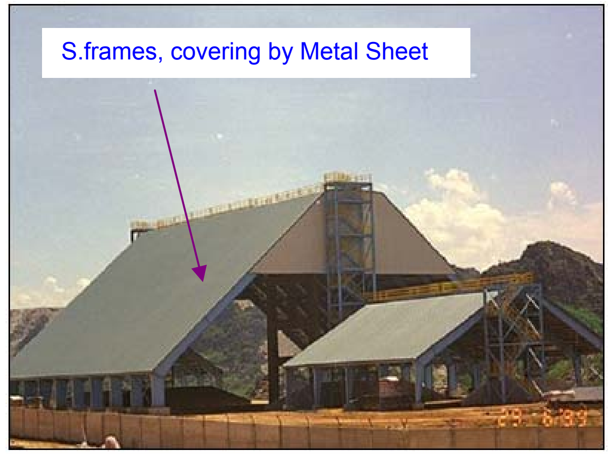


Fig. 33: **Coal Storage**- Nghison Cement Plant, Thanhhoa Province (Completed 2000), Area: 8251 sqr.m; Span: 53m

High-rise Buildings

Up to now, high-rise building (≥ 12 stories) mainly located in Hanoi and HoChiMinh City (Two biggest city in Vietnam). The number of high-rise buildings in Hanoi are more than 30 and HoChiMinh are more than 77 (2004). Beside there are about more than 70 other-undercontruction-highrise buildings.

Fig. 34: **Saigon Trade Center,**
Office, HoChiMinh City, 33 Stories, Height-145m
(**Tallest Building in Vietnam, 2004**)
Completed 1997.
R.C and S-Structures.

In the office, trade center or hotel building, mainly surround wall are made by glass

Fig. 35: **ThuanKieu Plaza,**
Office and Apartment, HoChiMinh City
30 Stories, Height-130 m, Completed 2003.
R.C structures, P.C Slabs.

In the apartment buildings, mainly surround wall are made by brick

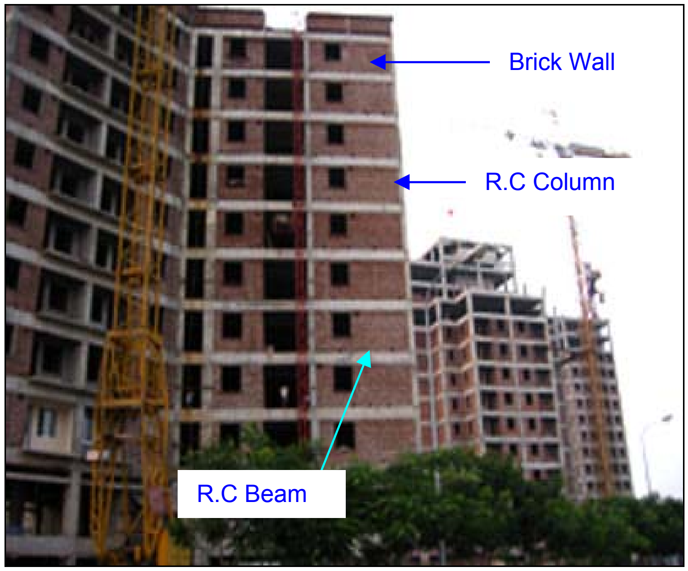
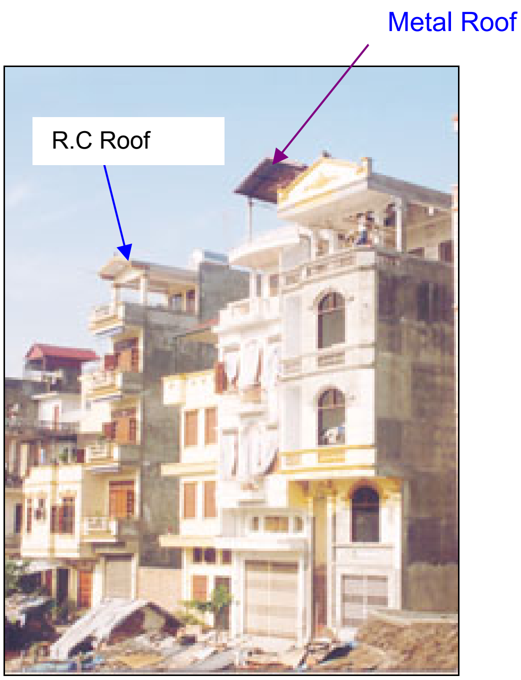


Fig. 36: **Typical Structures for Apartment Building**
In Vietnam among last 10 years(6 to 18 stories)
R.C Structures (Shear wall, Columns, Beams and Floor Slab)
Surrounding and Inside Brick Wall

Low-rise Buildings



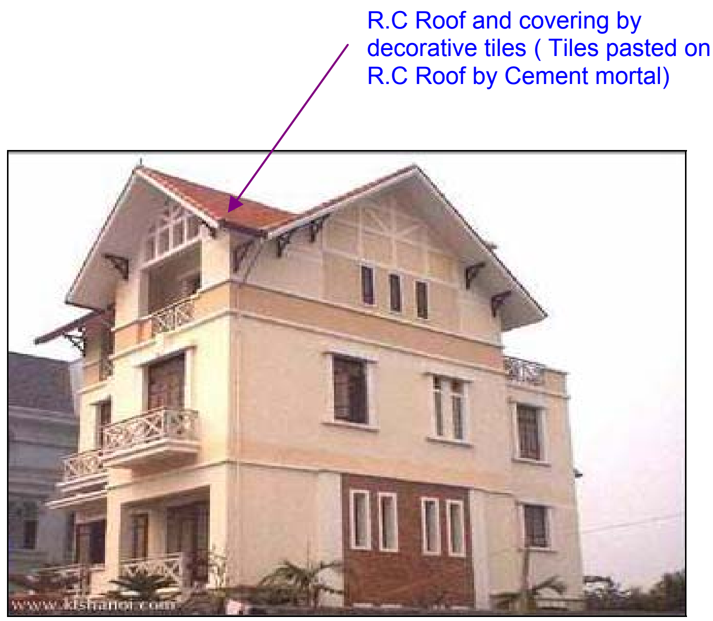


Fig. 37: **Some typical Private Houses** (in Hanoi and HoChiMinh City)
Structures: R.C Frame and R.C Floor Slab and Brick wall

2. SITUATION ON USING FOREIGN STANDARDS AND RENOVATION OF BUILDING CODES IN VIETNAM.

Cause by some historical reasons so there was many Foreign Standards used for Construction works in Vietnam.

2.1. Foreign Standards had used in Vietnam

Before 1975

- In the North of Vietnam had used standards from foreign countries such as Soviet Union (strongest influence), China, Germany (GDR), France, Cuba, and others.
- In the South of Vietnam had used standards from foreign countries such as US (strongest influence) and other Western countries.

After 1975

- From 1975 to 1990, Vietnam used standards from foreign countries such as Soviet Union (strongest influence), China, Germany (GDR), and France, Cuba, Swede, Japan and other.
- From 1990 up to now, Vietnam used standards from foreign countries or organizations such as US, UK, Japan, France, Germany (FRG), Australia, China, Russia, EURO, ISO and others. The strongest influence foreign standards are US, UK, EURO, Japan and ISO.

2.2. Legal documents of allowing of Foreign Standards in Vietnam

Before Construction Law issued (Dec-2003), the Document No. 07/1999/TT-BXD issued by Ministry of Construction (MOC) informed problems of using Foreign Standards in Vietnam. There were only standards of Countries and Organization such as ISO, EURO, US, UK, France, Germany, Russia, Japan and Australia, could be used in Vietnam if got the agreement letter (applied for each project)

Construction Law (Dec-2003), Clause 6 informed that Foreign Standards could be used in Vietnam if got the agreement letter from Authority- Oganizations. Normally, Ministry of Construction or Ministry of Transportation or Ministry of Industry will decide this problem (depend on character of each Project)

After Construction Law (Dec-2003), The document No. 09/2005/QD-BXD, dated 07-Apr 2005 (4 pages), issued by MOC informed on Regulation of using Foreign Standards in Constructive Activities in Vietnam. In chapter 3: has instruction of processing to get the agreement letter.

The document No. 09/2005/QD-BXD, also stipulated the Basic Principles of Using Foreign Codes in Vietnam as bellows

- Make sure that Products and Building after construction will be: i) safety for people, building (also for building what located near by the building in considering); ii) Satisfy to Requirements of Ecological and Environmental Conditions of Vietnam; iii) Economical saving.
- Make sure that the synchronism and realizable in all constructive duration (designing, constructing, using, maintaining and other)
- Must be used the data related to some private conditions of Vietnam such as Natural and Climate conditions and Geological conditions and hydrographic conditions and Zoning and intensity of Earthquake
- Must be satisfied to the requirements of current Vietnamese standards.

2.3. Renovation of Standards System in Construction Industry.

Nowadays, Vietnam is mixing with World Trade so the renovation and harmonization of standards become to very important problems. The Vietnamese Government had asked Industries to make a plan to solve this problem.

In Construction Industry, the renovation of standards had been interested early. Duration 1990~2003, there were a lot of meeting to discuss on this problem but no result and deciding in detail.

Date 19th-March 2005, A research project named “Researching on synchronize Vietnamese standards systems in Construction“had finished but not published (*Leaded by Prof. Nguyen Van Lien, who also is Vice Minister of Construction).* Purposes of this project are giving solution to renovate Vietnamese Standard Systems in Construction, which the tendencies are, innovation and integration with foreign standards (Source: Ministry Of Construction, Website http://www.moc.gov.vn/)

Solution and route:

- One of systems such as EURO Code, Japan Standards and American Standards should be used as fundamental-standards-system for making New-Vietnamese-Building-Code.
- Renovating, amending and completing Current Vietnamese standards in order for using in duration 2005>2010.
- Before 2010, will be published New-Vietnamese-Building-Code (mainly, most strongest influence standards are Principle of Building Design, Load and Action, Reinforce Concrete Structure, Steel Structures, Principle of Foundation Design and other standards using of construction-site-work…) and encourage of using New Vietnamese Building Code.
- Changing and amending of academic books, lectures and other documents in universities.
- Official using of new Vietnamese standards as soon as possible (after 2010).

According to successful in using New-Vietnamese-Building-Code should be cared to some private characteristics of Vietnam such as economical level, available material, un-available material, manufactured level…In addition, the training and retraining for structural designers , student also lecturers in University and other (the persons usually use Building Codes) are very important.

2.4. Some example of Using Foreign Standards for Structural Design in Vietnam

Japanese Standards

Fig. 38: **Binh Bridge -** Haiphong City
Total length:1.28 km, Completed 13-May-2005

Fig. 39: **Baichay Bridge –** HaLong City
Total length:1.0 km, Will be completed in 2006

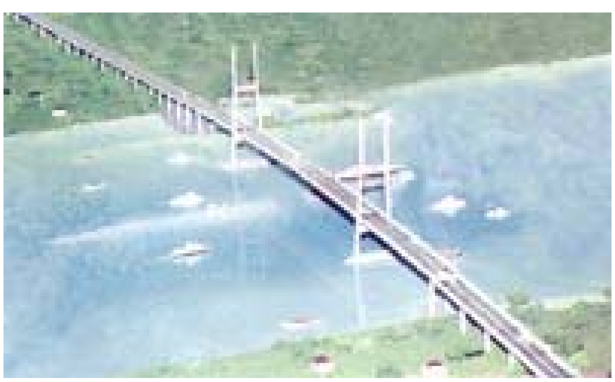


Fig. 40: **Thanhtri Bridge,** Hanoi Capital
Total length: about 5.0 km, Will be completed in 2006

Fig. 41: **Nghíson Cement Plant** (1.4million ton/year), Thanhhoa Province, Completed in 2000

Fig. 42: **Nikko Hotel-** Hanoi Capital
15 stories (above ground),
Completed 2000

Fig. 43: **CaiLan Port**, Halong City
Completed 3 of 10 Wharf and used from July-2004

Australia Standards

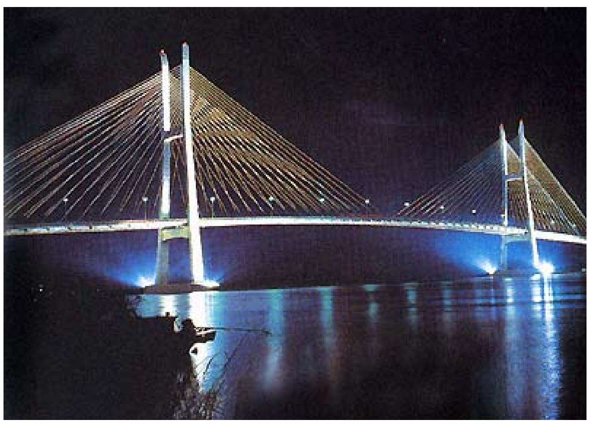


Fig. 44: **Mythuan Bridge,**
Tiengiang-VinhLong Provinces
Total length: 1.5km, Completed June-2000

Fig. 45: **Melia Hotel,** Hanoi Capital
22 stories, Completed 2000

EURO Country Standards

Fig. 46: **Sofitel Plaza Hotel Hanoi,**
Hanoi Capital, 20 stories

Fig. 47: **Sheraton Hotel Hanoi**,
Hanoi Capital, 22 stories

Fig. 48: **Butson Cement Plant** (1.4 million ton/year)
Hanam Province, Completed 1997, French Standards

Fig. 49: **Holcim Cement Plant**
(1.6 million ton/year), Kiengiang province

American Standards

Fig. 50: **Gia Phu Packaging Co., Ltd.**
A lot of low-rise industry buildings such as above, which made by ZAMIL Steel Com.

Fig. 51: **Financial Tower,** HoChiMinh City
61stories, 272m height, steel structures
Started work 24-Apr 2005

Combined-Standards

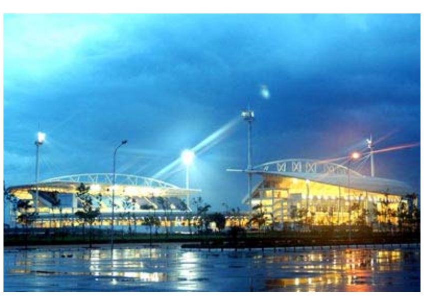


Fig. 52: **MYDINH National Stadium**
42000 seat, Hanoi Capital
Completed 2003.
R.C Frames designed by British Standards.
Roof Structures designed by Chinese Standards

Russian Standards (Before 1990: Soviet Union Standards)

Fig. 53: **Palace of culture & friendship,** Hanoi capital

Fig. 54: **ThangLong Bridge,** Hanoi capital
Total length: more than 2km

Fig. 55: **HoaBinh Hydroelectric plant,** HoaBinh Province

CONCLUSION

During last 10 year, Vietnam mainly used Reinforce concrete Structure in Civil-Building, Steel-Structure in Industrial Building and Large Span Structures.

In the next 10 year, the Steel-Structure will become popular in Construction Industry.

The renovation and harmonization of Vietnam Building Codes are indispensable, especially in order to joint to World Trade. Therefore, solutions and plan solving this problem are very important.

END