WIND CODE EVALUATION

NICARAGUA

Evaluation conducted by Guillermo Santana

NAME OF DOCUMENT: "Reglamento de Construcción que regirá el Territorio Nacional" (*Construction Regulation that will govern in the National Territory*)

YEAR: 1983

GENERAL REMARKS: Document elaborated by a technical committee under the supervision of the Ministry of Housing and Human Settlements of the Government of National Reconstruction of the Republic of Nicaragua.

SPECIFIC ITEMS:

1. SCOPE

1.1 Explicit Concepts and Limitations [Art. 1]

This norm applies to the design and construction of new buildings, as well as to the repair and retrofitting of existing facilities. It includes load prescriptions for earthquake, wind and even volcanic ash deposition, with the associated zoning. All provisions for wind are contained in Art. 20.

1.2 Performance Objectives [Art. 1]

The performance objectives are stated as a) to avoid the loss of lives and to reduce the possibility of physical damages to persons; b) to resist smaller earthquakes without damages; c) to resist moderate earthquakes with mild structural damages and moderate non structural damages; d) to avoid the collapse of buildings due to large earthquake, reducing the damages at economically admissible levels and e) to resist wind effects and other accidental actions without damage.

2. WIND HAZARD

2.1 Basic Wind Speed [Art. 20]

There are no definitions of basic wind speed in this norm. Instead, a basic wind pressure is prescribed to be resisted by all structures in every horizontal direction as well as horizontal and vertical suction effects. Wind pressures for structural design are not to be less than the ones specified in [table 8] transcribed below.

TABLA N≡ 8 WIND PRESSURES		
Height (m)	P_0 (kg/m^2)	
	Zone 1	Zone 2
H ≤ 10	40	70
10 < H ≤ 15	55	100
15 < H ≤ 30	80	135
30 < H ≤ 50	105	160
50 < H ≤ 75	135	200
Zone 1 — Covers the Pacific coast and the Northern region.		
Zone 2 — Covers all towns in the Caribbean coast.		

2.2 Topography
Not considered

2.3 Height above Ground (Case Specific)
Not considered

2.4 Ground Roughness (Number of Exposure Categories)
Not considered

3. WIND DESIGN ACTIONS

3.1 Importance Factors
Not considered

3.2 Scale Effects
Not considered

3.3 Pressure (Internal and External) [Art. 20]

Wind pressure is calculated according to the following expression

$$P = kP_0$$

where P_0 is given in [Table 8] and k is a dimensionless push coefficient defined in the table below and applied to the structure as recommended in the accompanying figure.

Slope	Windward Surface			Leeward Surface
	Windward Zone	Central Zone	Leeward Zone	
Less than 65°				
D/H < 0.3	–1.75 + 0.054θ	–1.0 + 0.027θ	–0.4 + 0.018θ	–0.68
D/H = 1.0	D/B, but not greater than 0.75	0.8D/B but not greater than 0.75	0.5D/B but not greater than 0.75	–0.68
Greater than 65°	0.75	0.75	0.75	–0.68

θ = Cover slope in degrees
D/H = Ratio of roof elevation and total height of building.
B = Width of building.

For D/H between 0.3 y 1.0, linear interpolation should be used.

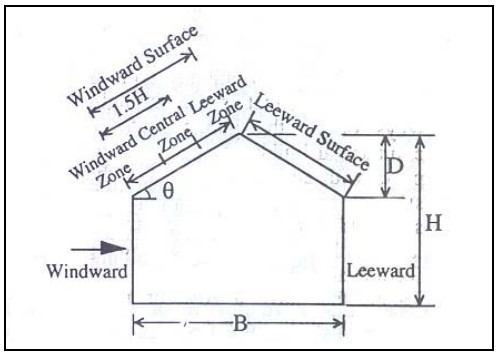

Fig 1. Wind action acting normal to cover for a two-slope roof.

3.4 Dynamic and Aero-elastic Effects (Gust Effects)

Not considered

3.5 Directionality Effects

Article 20 includes a provision simply stating that buildings should be analyzed under wind pressure acting along its principal axes and in both senses.

4. METHODS OF ANALYSIS

4.1 Simplified Procedure

No simplified procedure is stated.

4.2 Analytical Procedure

No analytical procedure is stated.

4.3 Experimental Procedure

No experimental procedure is stated.

5. INDUCED EFFECTS

5.1 Impact of Flying Objects

Not considered.

5.2 Wind Driven Rain

Not considered.

6. SAFETY VERIFICATIONS

6.1 Structure

Wind pressure is included in the load combinations as given in [Art. 32]:

a) Ultimate Strength Design.

$$C_1^u = 1.7\left(CM + CV\right)$$

$$C_2^u = \left(CM + CV\right) + S \text{ o } P$$

$$C_3^u = 0.8CM + S$$

b) Allowable Stress Design.

$$C_1^e = CM + CV$$

$$C_2^e = CM + CV + 0.71S \text{ o } P$$

$$C_3^e = 0.80CM + 0.71S$$

where *CM* = Dead load
CV = *Live load*
S = Horizontal seismic action
P = Wind pressure or force

6.2 Claddings and Non-Structural Elements

Not considered

7. SMALL RESIDENTIAL BUILDINGS

The provisions for seismic effects on small residential buildings as considered in this document (those consisting of Structural Type 4 lateral resisting systems [Art. 12]) implicitly apply for the case of wind in as much as the loading combinations include wind pressure instead of earthquake load (see 6.1 above). According to [Art. 28] this type of buildings can be analyzed using the *simplified method* [Art. 29]. No consideration is given to torsion, overturning moment nor drift for this method of analysis.

RECOMMENDATIONS FOR CODE IMPROVEMENT

Considerable improvements should be made on the wind code provisions for Nicaragua. In its present form, the norm is outdated and incomplete. Even though hurricanes affect mostly the Caribbean coast of Nicaragua with high winds and heavy rains, this area currently does not have a lot of infrastructure development. Nevertheless, climatic change implies that atmospheric effects will become more important in the future even in areas where hurricanes had not been a hazard. Thus, the importance of updated wind code is self-evident.