WIND CODE EVALUATION

COSTA RICA

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NAME OF DOCUMENT: "Reglamento de Construcciones" (Construction Code), Chapter XX- Design of Building Structures, Article XX.7- Wind Loads.

YEAR: The Construction Code was approved by "Colegio Federado de Ingenieros y de Arquitectos de Costa Rica" (Engineers and Architects Professional Society) in September, 1980 and by "Instituto Nacional de Vivienda y Urbanismo" (National Institute for Urban and Housing Affairs) in March, 1983. Minor reforms were approved in June 1987 and March 1988.

GENERAL REMARKS: Chapter XX of the Construction Code refers to Design of Building Structures. Article XX.7 contains the regulations for Wind Design. Article XX.6 refers to the Costa Rican Seismic Code for seismic design regulations

SPECIFIC ITEMS:

NOTE: Bracketed numbers refer to Code specific chapters or articles: [XX.7.1].
Parenthesis numbers refer to Items of this document: (see 2.3).

1. SCOPE

1.1 Explicit Concepts and Limitations. [XX.7.1;XX.7.2]

Norms apply to all types of construction except for bridges or structures likely to exhibit complex aerodynamic behavior.

Wind forces must be considered during the construction process as well.

1.2 Performance Objectives.

No performance objectives are included.

2. WIND HAZARD

2.1 Basic Wind Speed. [XX.8.3]

There are no defined values of Basic Wind Speed in the Code. It is stated that the maximum instantaneous wind speed V should be estimated from reliable statistical data. A Basic Wind Pressure q is defined in terms of the maximum instantaneous wind speed V as:

$$q = .005\ V^2$$

Where q is in kg/m^2 and V in km/h

2.2 Topography. [XX.10.3]

It is stated that Basic Wind Pressure (see 2.3) should be increased by 20% in places of irregular topography (gorges, cliffs, outcrops, etc.)

2.3 Height above Ground (Case Specific). [XX.9]

In absence of data for maximum instantaneous wind speed V, the code specifies the Basic Wind Pressure (see 2.1) distribution along height for the two exposure categories (see 2.4) according to the following Table:

Height above ground (m)	**Basic Wind Pressure (kg/m^2)** **Ground Roughness** (see 2.4)	
	Cities	**Open Fields**
0	55	70
10	--	105
15	75	120
20	85	125
30	95	135
40	105	145
50	110	150
75	120	165
100	130	170

From this Table, the corresponding maximum instantaneous wind speed V at 10m above ground for Open Fields can be calculated as V = 145 km/h (see 2.1).

2.4 Ground Roughness (Number of Exposure Categories). [XX.9]

Two Exposure Categories are considered and Basic Wind Pressures are defined for each one (see 2.3):

a) Open field
b) Cities or places of similar roughness.

3. WIND DESIGN ACTIONS

3.1 Importance Factors. [XX.1; XX.10.4]

Three Use groups are defined; with their corresponding Use Coefficients I defined by the following Table:

Group	Group Description	Use Coefficient I
A	Essential or Hazardous buildings	1.2
B	Ordinary buildings	1.0
C	Non permanent buildings. Buildings not classified in Groups A or B.	0.7

The Basic Wind Pressure q (see 2.1) is affected by the corresponding Use Coefficient I (see 4.2).

3.2 Scale Effects.

Not considered.

3.3 Pressure (Internal and External). [XX.12]

For each structure, the Basic Wind Pressure (see 2.3) is scaled by a Shape Factor C to determine the external wind pressure. Shape Factors may be either positive or negative (suction). As an example, for enclosed buildings, Shape Factors are 0.8 for external upwind walls, -.4 (suction) for external downwind walls and 1.2 sin (α) - 0.4 for inclined roofs (α being the roof slope angle). There are no indications for internal pressures.

3.4 Dynamic and Aeroelastic Effects (Gust Effects). [XX.10.1]

A brief paragraph states that, according to the importance of the building or the complexity of the structure, more refined methods of analysis can be used. These methods must be approved by a review board authority.

3.5 Directionality Effects. [XX.7.3]

In general wind should be considered for the two main horizontal directions of the building. For special cases other directions can be considered.

4. METHODS OF ANALYSIS

4.1 Simplified Procedure.

No simplified procedures are considered, although the analytical procedure (see 4.2) is very simple.

4.2 Analytical Procedure. [XX.7.4; XX.13]

For each horizontal direction, the design wind pressure p_z acting on the building or its components at a height z above ground level is defined as:

$$p_z = (q\ I)\ C$$

Where:
q = Basic Wind Pressure (see 2.3).
I = Use Coefficient (see 3.1).
C = Shape Factor (see 3.3).

The internal forces in the structural elements due to the design wind pressures are calculated using standard analytical procedures (elastic analysis).

4.3 Experimental Procedure.

Not considered.

5. INDUCED EFFECTS

5.1 Impact of Flying Objects.

Not considered.

5.2 Wind Driven Rain.

Not considered.

6. SAFETY VERIFICATIONS

6.1 Structure. [XX.7.4]

Wind loads W are considered extreme loads. They are combined with Dead D and Live L loads to determine the Ultimate Load U as:

$$U = 1.4D + 1.7L$$
$$U = 0.75\,(1.4D + 1.7L) \pm W$$
$$U = 0.9\,D \pm W$$

All structural elements must be dimensioned and detailed according to strength design theory.

6.2 Claddings and Non-Structural Elements.

Not considered.

7. SMALL RESIDENTIAL BUILDINGS.

Not considered.

RECOMMENDATIONS FOR CODE IMPROVEMENT

This outdated and incomplete Code can be viewed as clear evidence that wind hazard is not a problem in Costa Rica. Except for very light structures (i.e. warehouses), seismic loads are always more critical than wind for the entire territory. In fact, the main damage caused by the few destructive hurricanes that have affected the country has been the result of heavy rainfall rather than wind.

However, it is recommended than an updated Wind Code be drafted. A Wind Model Code could provide the basis for it.