SEISMIC CODE EVALUATION

TRINIDAD AND TOBAGO

Evaluation Conducted by Myron Chin

NAME OF DOCUMENT: [Small Residential Buildings] Trinidad and Tobago Small Buildings Code, Board of Engineering of Trinidad and Tobago **www.boett.org**

YEAR: 2001 updated second draft version (July)

GENERAL REMARKS:

"In the preparation of this code, extensive use has been made of the Parts of the Caribbean Uniform Building Code (CUBiC) which deals with earthquakes". It was noted that at this time CUBiC is being considered for revision and the management committee for the revision project has elected to make use of the International Code Council Inc. of the USA in the provision of the base documentation for this review. In like manner for this code use has been made of the ICC year 2000 International Residential Code Final Draft 1998" [Foreword].

The exercise was managed by the Board of Engineering of Trinidad and Tobago sponsored by the Joint Consultative Council of the Construction Industry (T&T) and the Interim National Physical Planning Commission (T&T) with support of the Trinidad and Tobago Bureau of Standards (TTBS).

Note: Bracketed numbers refer to Code specific Chapters or Articles. [ ]
Parenthesis numbers refer to item of this document. ( )

CONTENTS

SPECIFIC ITEMS:

1. SCOPE

1.1 Explicit Concepts and Limitations

This Code shall apply to the construction, alteration, movement, enlargement, repairs, equipment, use, occupancy, location, maintenance, removal and demolition of buildings for single or multiple family residential or general purpose use of not more than two stories in height and with a floor area of three hundred square metres or less" [1.201].

[1.2.2] "The Code is intended to provide minimum requirements to safeguard life, limb, health and public welfare".

1.2 Performance Objectives

To provide minimum requirements to safeguard life, limb, health and public welfare. It calls for minimum requirements for building materials in common use and takes into consideration the need for protection against wind and earthquake.

The code stresses that "before any construction work commences, it shall be determined whether planning permission and other approvals would be required from the competent (relevant) authorities". It stresses that "a preliminary inspection of the site shall be undertaken ..."

[3..1.1.1] Preliminary Investigation

[3.1.7]Earthquake considerations

[3.1.7.1] Earthquake resistant construction

[3.1.7.1.1] General

Trinidad and Tobago is in an earthquake zone and has experienced varying degrees of damage due to earthquakes. It is therefore essential that buildings are designed and constructed so that they have some resistance to the shaking or lateral forces produced by earthquakes.

[3.1.7.1.2] Effect of soil type

[3.1.7.1.2.1]

The type of soil at the site may have a significant effect upon the resistance of the

building to an earthquake. However for buildings within the scope of this code the effect of the soil type is not so significant provided that the building is not constructed on loose saturated sands, which may liquefy during an earthquake and cause collapse of the building.

[3.1.7.1.2.2]

The earthquake may also, due to shaking of the ground, compact loose sand or fill material, and if a building is constructed on such material, the building will be damaged**.**

[3.1.7.2] Rules for the construction of earthquake resistant buildings
It is recommended that the following rules be followed for the construction of buildings.

[3.1.7.2.1] Masonry Buildings
An important factor contributing to the earthquake resistance of masonry buildings is the detailing and placing of steel reinforcement. A registered professional should undertake the design of a reinforced concrete frame building. The reinforcing guide given in this section therefore must only be used for simple single storey buildings constructed of approved quality masonry blocks. For the minimum quantities of reinforcing steel to be used refer to Clause Vertical Structures.

[3.1.7.2.2] Timber Buildings
There are two additional areas of concern with respect to timber buildings:
All corners and intersections must be adequately braced.
Earthquake and hurricane forces tend to remove timber buildings from their supports by shaking. Because of this sills shall be securely fastened to foundations.

[3.1.7.2.3] Steel Buildings
The natural ductility of steel protects the frame from severe damage. However, in many cases masonry block walls are used and the precautions already listed for these walls will apply. The wall reinforcement must now be anchored by welding to the steel columns and beams, or the steel frame encased in concrete in which case the wall reinforcement can be tied into the concrete cage encasing the steel frame.

[3.2.6] Lateral load design

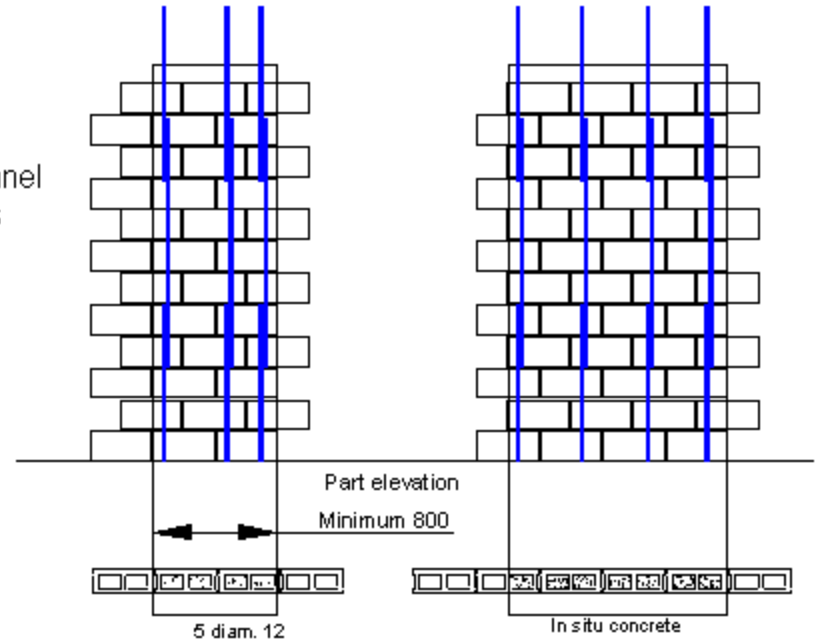
[3.2.6.1] Preamble

Wind and earthquake introduce horizontal loads in the superstructure that are transferred to the foundation. We have to consider 2 steps: a) Transfer of the horizontal load from - wind to vertical wall and roof - acceleration of mass located everywhere in the superstructure to the appropriated wall or framed structure. b) Transfer of the load from the top to the bottom of the wall or superstructure and the foundation. According to this code - horizontal transfer is done by horizontal **diaphragm** or horizontal beam - vertical transfer is one by **shear panel**, cross, or framed structure.

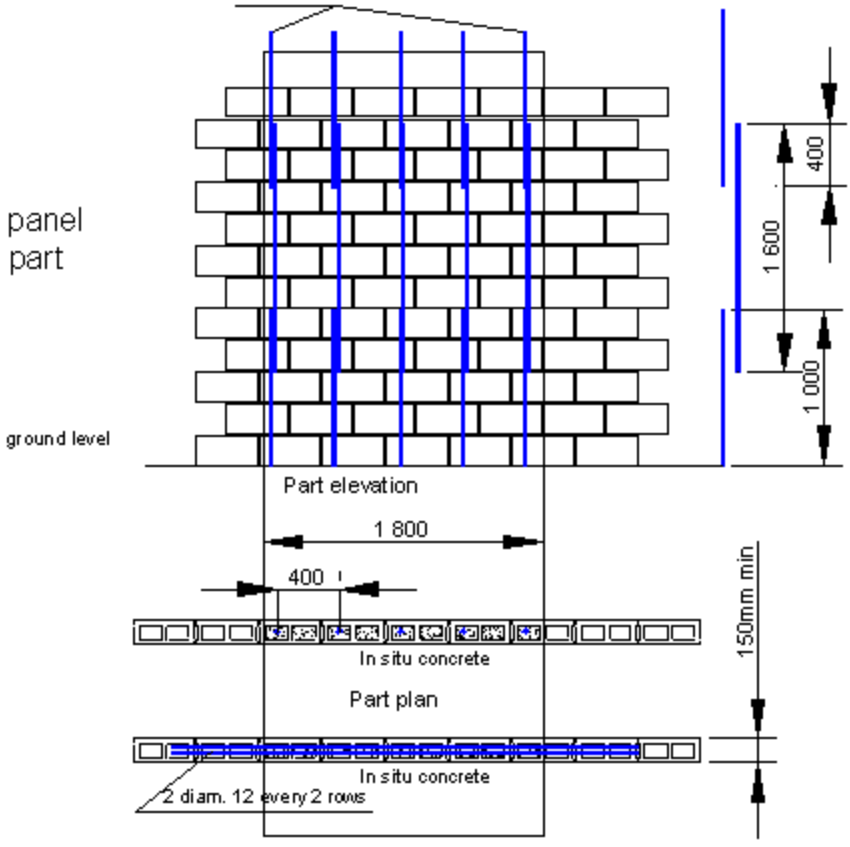
3.2.6.2 Diaphragm

Floor, roof or ceiling assemblies may be constructed with the necessary stiffness and load path continuity to distribute lateral loads (wind and earthquake) to lateral support subsystems. In this role, floor, roof or ceiling surface act as horizontal beams (also called a diaphragm) spanning lateral supports points. Use of floor, roof or ceiling assembly, as a diaphragm requires both strength and stiffness properties and development of connections to transfer the diaphragm force.

Shear panel
in 2 parts



Shear panel
in one part



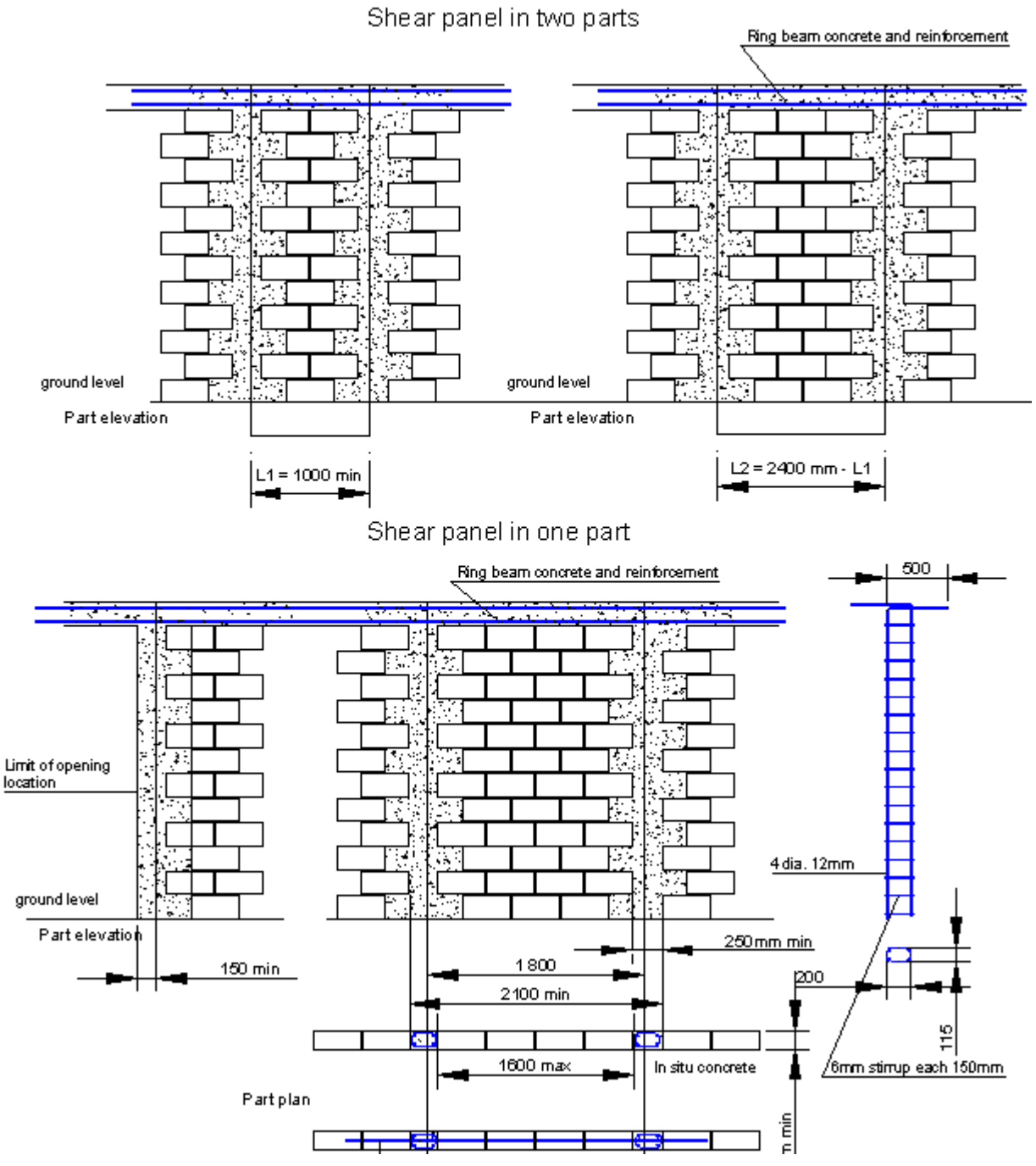


Fig B6-2 Shear panel - Horizontal core blocks

[3.2.6.3] Shear panel

[3.2.6.3.1] Concrete wall

A shear panel (see figures B-6-1 and B-6-2 Shear panel) is a portion or section of a 150mm exterior wall that performs the function of resisting lateral earthquake or wind forces.

[3.2.6.3.2] Timber

See paragraph "Wall bracing".

[**3.2.7] Load factors.**

All structures shall resist combined loads as follows;

[3.2.7.1] Gravity

1.40 D + 1.70 L

[3.2.7.2] Earthquake

a) 0.75 (1.40 D + 1.70 L +/- 1.87 E) and
b) b) 0.90 D +/- 1.43 E

[3.2.7.2.1] Shear load calculation

A simplified formula, for this code is **V = 0.05 x S x W** total shear in kN

Whereas : The **0.05** coefficient integrated the Z = ground acceleration, C = amplification factor due to structure frequency, I = Importance factor =1 in this code and Rw = Ductility factor related with respect to the column design reinforcement used in the normal practice formula. **S =** site factor S = 1 For good soil (rock, gravel) S = 1.2 For softer material (clay, fill) S = 1.5 For deep alluvial deposits S = 2.5 maximum for reclaimed land and saturated soils (due to the amplification factor) **W =** total load in kN

RECOMMENDATIONS FOR CODE DEVELOPMENT

A national building code for Trinidad and Tobago is currently being developed and in the interim, the earthquake loads are being calculated using either UBC 1997 for Zone 3 or the CUBiC provisions. It is recommended that an appropriate seismic hazard map of Trinidad and Tobago be developed as soon as possible which could then be used in conjunction with the proposed base code IBC 2000 or later edition. In addition, a Trinidad and Tobago Small Building Code is also being developed and it is recommended that its provisions should be used for small buildings in not only in Trinidad and Tobago but also in the other English-speaking countries of the Caribbean.