

APPENDIX A

MAIN BUILDING PRELIMINARY SEISMIC EVALUATION

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The structure of this building, without beams, does not classify in none of the four seismic resistant structural systems defined in the Chapter 5 of the seismic code COVENIN 1756-87. However, to carry out the preliminary seismic evaluation we will classify it as type I with certain limitations, particularly regarding their ductility.

1.- STRUCTURE OWN WEIGHT

a.- Flat Plate

We do not have structure drawings, therefore the slab type is not known. However, based on the inspection carried out to the hospital, we will assume that the floor slabs are flat plates of 20 cm of thickness.

Own plate weight.....	500 kg/m ²
Finish weight.....	125 kg/m ²
Total weight.....	625 kg/m ²

b.- Columns

The column sections vary with the height from 46 x 64 cm in the ground level up to 45 x 51 cm in the level 5 with a height of floor slab of 2.80 m. We will take a mean section of 45 x 60 cm for the columns.

$$\text{Own weight} = 150 \text{ kg/m}^2$$

c.- Partitions

The partitions that define the rooms, corridors and service areas are constituted by walls of concrete hollow blocks with thickness of approximately 20 cm.

$$\text{Own weight} = 150 \text{ kg/m}^2$$

d.- Service Overloads

According to the specifications of overloads for hospitals (COVENIN 2002, 1995), we will use a live load of 300 kg/m²

e.- Total weight*** Dead load**

Flat plate.....	615 kg/m ²
Walls.....	150 kg/m ²
Columns.....	150 kg/m ²
Total.....	915 kg/m ²

* Live load..... 300 kg/m²

*** Total weight**

$$WT = 1194.72 \text{ m}^2 \times (915 + 0.25 \times 300) \times 6 = 7096.63 \text{ ton}$$

2.- GEOMETRY

- * Total area : $A = 1194.72 \text{ m}^2$
- * Total height: $H = 6 \times 3.00 = 18 \text{ m}$
- * Slenderness = $78.60 \text{ m} / 15.20 \text{ m} = 5.17$

3.- MATERIALS

As we do not know the quality of the materials, we will then assume the following ones:

$$f_c = 210 \text{ kg/m}^2$$

$$f_y = 2800 \text{ kg/m}^2$$

4.- SEISMIC ANALYSIS

(Seismic Code COVENIN 1756-87)

- * Structure Type: not defined in the Seismic Code
- * Soil Type:
We have not got any soil study, therefore we will use a soil type S2
($\beta = 2.2$; $T^* = 0.6 \text{ sec}$; $p = 0.7$)
- * Seismic Zone: 2, Group A (essential buildings)

$$A_0 = 0.15 \times 1.25 = 0.19 \text{ g}$$

* Estimated Period:

$$T_a = 0.061 \times (18)^{0.75} = 0.53 \text{ sec} < T^*$$

* Design Level: 1

$$D = 2$$

* Basal Shear

$$V_o = \mu \times A_d \times W/g$$

$$\mu = 0.80$$

$$A_d = (2.2 \times 0.19 \text{ g})/2 = 0.209 \text{ g}$$

$$V_o = 0.80 \times 0.209 \times 7096.63 = 1186.56 \text{ ton}$$

* Seismic Coefficient :

$$C = V_o/WT = 0.167 > C \text{ minimum}$$

Shear force in the base of each frame in the longitudinal direction (X), V_{ox} is:

$$V_{ox} = V_o/\text{number of frames}$$

$$V_{ox} = 1186.56/4 = 296.64 \text{ ton}$$

Shear force in the base of each frame in transversal direction (Y), V_{oy} is :

$$V_{oy} = V_o/\text{number of frames}$$

$$V_{oy} = 1186.56/12 = 98.88 \text{ ton}$$

Overturn moment in each frame in the direction X, M_{vx} is:

$$M_{vx} = 2/3 H \times V_{ox}$$

$$M_{vx} = 2/3 (18) \times 296.64 = 3559.68 \text{ T-m}$$

Vertical Density : G_v

$$G_v = (Dl + Ll)/h$$

$$G_v = (915+300)/3.00 = 405 \text{ kg/m}^3$$

Bearing area for columns a_c :

n_v : specific load

$$\alpha_v = (G_v \times H)/(n_v \times f_c)$$

$$\alpha_v = (405 \times 18)/(0.20 \times 210 \times 10^4) = 0.0174$$

$$a_c = (\alpha_v \times A)/n^\circ \text{ columns} \times \text{plant}$$

$$a_c = (0.0174 \times 1194.72)/48 = 0.43 \text{ m}^2$$

Therefore, the area of the existing column type in the ground level (0,29 m²) has an insufficient bearing capacity to support the service load

In addition, it is obvious that this building without beams and columns with insufficient sections does not fulfill the displacement requirements for both directions, according to COVENIN 1756-87 in its Chapter 10. Therefore, it should be reinforced to satisfy the demand of this seismic code.

Note: We use seismic code COVENIN 1756-87 instead of the COVENIN 1756-98, because the last is still a provisional one and it has been revised for a commission ad-hoc

09-03-2001

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