A COMPARATIVE STUDY BETWEEN THE ITALIAN AND MEXICAN DESIGN CODE FOR SEISMIC ASSESSMENT OF OLD RC BUILDINGS

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ABSTRACT
In this research a comparison among the Italian and Mexican regulations for seismic assessment of old RC buildings is performed. The procedures indicated into the two design code are applied to a case study, an existing RC building constructed in Italy in the '70s and designed only for vertical loads. The comparative study mainly regards the definition of the seismic action through the response spectra, the modeling methods and verification criteria of primary RC elements. The paper concludes with a critical discussion of the obtained results.

1. INTRODUCTION

The seismic effects that can occur during the useful life of a structure can affect its stability and resistance to the same. The damage in seismic action can be accelerated or increse also when it was made An inadequate design of the elements.

The structure which is the subject of this study dates back to the 1970's and was not designed with seismic code but only reffer to the vertical load.

The purpose is the study for the evaluation of the structural safety of the buildings located in Via Lamarmora in the city of Irsina. The evaluation has been done with Italina code NTC-08 and Mexican code MXNTC-2004. Then, the results have been compared.

In the present article the necessary tests were conducted to the aim to know the material strenth. The geometry has been also identified. The the finite elements with the help of software (SAP2000) v.18 was carried out.

The seismic response of the structure was evaluated using the response spectrum , of the most commonly used methods to simulate seismic effects. This method uses the seismic spectrum to establish the maximum acceleration that a structure would experience depending upon its vibrating modes.

The seismic spectra is different for each country. The study points out the difference methods. The subject structure is located in Irsina, province of Matera, Italy. To make an appropriate comparison of the seismic behavior of the structure, the spectrum of the Irsina area will be taken into account, and compared to the structure as if it were located in Mexico City.

The objective is to obtain the behavior of the structure and compare the different seismic norms and to review the performance of the structure in each city as a comparison of values obtained, the required parameters, and the processes utilized, so the results were obtained and the conclusions.

Firstly, it was necessary to understand the realization of the spectra in each norm, and with this identify similarities and differences.

Both codes are currently concerned with the safety of the community.

In the paper have been discussed the Iitalian and Mexican codes. Then, with spectrum metodh approach has been evaluated and campared the seismic response of the building by using mexican and italian codes.

For the realization of these spectra each norm takes into account diverse factors as they are mentioned next.

2 DESIGN CODES

2.1 Mexican Design Code (MXNTC-04,2004)

The Mexican spectrum has different characteristics for its realization depending upon two (2) general factors. One is the study area, which is divided into three (3) zones. The third zone is divided into four (4) sub-zones. The seismic coefficient oscillates between 0.16 and 0.30 (Table 1). Secondly, the importance of the construction (Table 2), I considered to give a degree of conventional safety, the seismic behavior of the building (Q) which in turn gives the ductility characterization of the structure, which is associated also with the construction, deterioration, and the effect that can be balanced mainly of the resistant capacity that is provided by the ductility.

There are different types of seismic coefficients which depend principally on the materials, which make up the structure, which are in this norm from Q1=1 to Q=4, where the highest two have ductile behavior and are used in these seismic zones, thus reducing the value of the spectral ordinates as design intent.

Table 1. Parameters for calculating the acceleration spectra

Zone	C (--)	a_o (g)	T_a (sec)	T_b (sec)	r (--)
I	0.16	0.04	0.20	1.35	1.00
II	0.32	0.08	0.20	0.35	1.33
III_a	0.40	0.10	0.53	1.80	2.00
III_b	0.45	0.11	0.85	3.00	2.00
III_c	0.40	0.10	1.25	4.20	2.00
III_d	0.30	0.10	0.85	4.20	2.00

Table 2. Mexican Classification of importance of the building.

A +	Structures of "great importance", or Group A +, are structures in which an extreme degree of security is required.
A	Structures in which a high degree of security is required. Constructions whose structural failure would cause the loss of a large number of lives or economic or cultural losses of an intense or exceptionally high magnitude, or which constitute a significant danger of containing toxic or flammable substances.
B	Structures in which a code degree of safety is required. Constructions whose structural failure would cause moderate losses

The characteristics we are able to determine in which zone the structure is located: hills (zone I) to lacustrine deposits (zone III) with (zone II) being an intermediate between both. With this one obtains the seismic coefficient, the maximum acceleration of the terrain (a) and the characteristic periods of the structure (Ta and Tb) and also the parameter (r) which controls the fall of the spectral ordinates. To obtain the accelerations for the seismic design applied as a fraction of gravity, the following equations are used:

$$\left[a = a_0 + (c - a_0)\frac{T}{T_a}; \quad si\, T < T_a \right] \qquad (1)$$

$$\left[a = c; \quad si\, T_a \le T \le T_b \right] \qquad (2)$$

$$\left[a = q \cdot c; \quad si\, T \succ T_b \right] \qquad (3)$$

$$\left[q = \left(\frac{T_b}{T}\right)^r \right] \qquad (3^*)$$

Where a_0 is the acceleration coefficient of the ground, C is the seismic coefficient of the horizontal shear force, which is considered to act at the base of the building due to the earthquake effect, T natural vibration period of the structure, where Ta and Tb are the characteristic periods of the design spectra.

The Mexican code indicates the factor of reduction of the seismic forces which are admitted by the ordinates since they are defined by the seismic behavior. This reduction is obtained from the following equations:

$$\left[Q' = Q; \text{If do not know T, or} \geq T_a\right] \quad (4)$$

$$\left[Q' = 1 + \left(\frac{T}{Ta}\right)(Q-1); orT \prec T_a\right] \quad (5)$$

This reduction factor is multiplied by an irregularity factor which was obtained depending on the different irregular characteristics and might be 0.9 and does not meet one of the requirements to 0.7 if it is strongly irregular. This is how the maximum response is expressed in terms of acceleration produced by maximum acceleration.

2.2 Italian Design Code (NTC-08,2008)

In the Italian Code for determinating the spectrum, it is necessary to know the basic seismic threats where the seismic risk is defined with reference to the probability of P_{VR} in a reference period V_R (eq. 6) these obtained according to the nominal life (V_N) which depends upon the type of construction, use class (Table 3) and the coefficient of use that is obtained from the Table that can be 0.7, 1, 1,5, or 2 according to the respective class.

Table 3. Type classification of the construction

CLASS I	The buildings with the only occasional presence of people.
CLASS II	It offers normal crowds, no dangerous content for the environment and no essential public and social functions.
CLASS III	Greater use of them provides severe exclusion. Industries with hazardous activities for the environment.
CLASS IV	Buildings with public functions or of strategic importance, including with reference to the management of civil protection in the event of a disaster. Industries Particularly hazardous activities for the environment.

$$V_R = V_N \cdot C_u \quad (6)$$

Obtaining the P_{VR} probability depends upon determining what type of service limits that are required and the probability of an earthquake occurring according to the return period. It should be noted that in the Italian code there are two service limits states and the Ultimate Limit State. The first one is subdivided into State Limited of Operation (SLO) and State Damage Limit (SLD) in which, after a seismic event happens, the structural elements must not be damaged or if they are, they must not affect their capacity of resistance and rigidity to actions.

In the case of the Ultimate Limit State, it is subdivided into the State Limit of life safety (SLV) and Collapse Prevention (SLC) in which through a seismic event the building results damaged in its components and structural installations, including loss of rigidity but even with the damage the structure is able to maintain a margin of safety for vertical and horizontal actions before it will collapse.

As previously mentioned, a revision of an already existing structure was undertaken. The code indicates that it is necessary in the verification to use a design for the spectrum with the ultimate limit state, which must at least be verified (SLV), and which according to the code has an excess probability of 10%.

The Mexican code, this one takes into account the area where the structure is located with the difference that to know the spectral ordinates of the mentioned zone, it was necessary to know the currently seismic risk in order to have a reference range. These data are provided by the Istituto Nazionale di Geofisica e Vulcanologia (INGV, s.f.) which supported us to obtain the project actions, accelerations and the spectral form defined in a reference rigid horizontal site and as function of three (3) essential parameters which are: horizontal maximum acceleration (a_g), maximum amplification value of the horizontal acceleration (F_o), and (T^*_C) the start period of the constant velocity of the horizontal acceleration spectrum.

The above parameters, we proceeded to know the categories of the subsoil. They are divided from category A (rigid soils) to the category E (fine grain soils). Also considered is the topography, which is divided into four (4) categories from T1 to T4 depending on the soil level and the slope of the land. These are necessary to evaluate the effect of analysis of response and other coefficient are considered SS and CC which are calculated as function of F_0 and T^*_C (Table 4). Depending on the topographic category, a ST topographic coefficient of 1, 1,2, 1,2 and 1,4 is respectively required.

Table 4. Classification of building class

Subsoil category	SS	CC
A	1	1
B	$1.00 \leq 1.40\text{-}0.40 \cdot F_o$* ag/g ≤ 1.20	$1.10 \cdot (T^*c)^{-0.20}$
C	$1.00 \leq 1.70\text{-}0.60 \cdot F_o$* ag/g ≤ 1.50	$1.05 \cdot (T^*c)^{-0.33}$
D	$0.90 \leq 2.40\text{-}1.50 \cdot F_o$* ag/g ≤ 1.80	$1.25 \cdot (T^*c)^{-0.50}$
E	$1.00 \leq 2.00\text{-}1.10 \cdot F_o$* ag/g ≤ 1.60	$1.15 \cdot (T^*c)^{-0.40}$

For the calculation of the response spectrum in acceleration with the horizontal components, the following formulas are taken into consideration:

$$S_e(T)=a_g \cdot S \cdot \eta \cdot F_0\left[\frac{T}{T_B}+\frac{1}{n+F_0}\left(1-\frac{T}{T_B}\right)\right] 0 \leq T \prec T_B \quad (7)$$

$$S_e(T)=a_g \cdot S \cdot \eta \cdot F_0 \; T_B \leq T \prec T_c \quad (8)$$

$$S_e(T)=a_g \cdot S \cdot \eta \cdot F_0 \cdot \left(\frac{T_c}{T}\right) \; T_c \leq T \prec T_D \quad (9)$$

$$S_e(T)=a_g \cdot S \cdot \eta \cdot F_0 \cdot \left(\frac{T_c * T_D}{T^2}\right) \; T_D \leq T \quad (10)$$

Where T is the vibration period, T_B the corresponding period to the constant acceleration interval, T_C and T_D are the beginning of the constant speed interval. To obtain them the following equations are required:

$$T_B=\frac{T_c}{3} \quad (11)$$

$$T_c=Cc \cdot T^*_c \quad (12)$$

$$T_D=4.0 \cdot \frac{a_g}{g}+1{,}6 \quad (13)$$

We take S the multiplication of the soil categories (SS and ST) and η which is a factor that is taken into account for the damping this is considered in both codes which is considered at a value of 5% because it must not be less according to the two codes.

The factor of calculation (q) reduces to the ordinates where it is considered as the factor that depends on the structure type, its ductility (q_0) and the irregularity factor (K_r) which has a value of 1 when the buildings are irregular, 0.8 when the structure is not regular in height and 0.7 if it considered a strongly irregular structure.

In summary, both spectra are based on the seismic zoning with periods of return of intense earthquakes and they consider the soil type, structure type and its level of importance. The use of these are made so that the structure is able to withstand the intense earthquakes without suffering damage. In Italy the use of inelastic spectrum is proposed where the reduction of forces is applied assuming that it surpasses the elastic range and dissipates energy in which requires sufficient ductility of the building.

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3 CASE STUDY

The case study is based on the comparison of two international codes (Italian and Mexican), in which there is an existing RC structure in the town of Irsina, has 4 levels with support of slabs working in a single direction, is made RC with smooth reinforcing bars, the access at different levels is through a concrete slab ladder.

The dimensions of said structure viewed in plan are described with a size of 28.65 m X 16.73 m and with a height from the solid base of construction of approximately 13.75 m counting each level with 3 m between them.

Based on the information obtained, it is estimated that the building was built in the late 60's and 70's.

The main characteristics of the building were taken including: the type of use in its life span to which it was designed, the dimensions of the structural elements that make it up (designed by columns and reinforced concrete beams). Samples were extracted from the concrete and steel of the building too, with the objective to identify how the materials used behaved. This was done on the basis of non-destructive and destructive tests as marked by codes (UNI 12504-1:2002), (UNI 12504-4:2005), (UNI 9944:1992) and (UNI 12504-2:2001)the tests carried out in order to obtain the mechanical properties of the materials and when combining them obtain more precise results, considering the Son-Reb method with the support of the sclerometer test realized through a steel bar (piston) which receives the impact of a steel piece driven by a spring (Figure 1). Such impact is transmitted to the concrete surface and due to its resistance the piece bounces and it is recorded by a linear scale in the body of the instrument. The resulting estimation of the resistance was between 10 and 70 N/mm2, with the test accuracy of approximately 10%. The ultrasonic test showed us the estimates of acoustic propagation velocity in the conglomerate with the purpose of evaluating the homogeneity and the compaction of the concrete and determine if there were cracks or cavities that may affect the value of the velocity of the propagation of the impulses (Figure 2). These tests were performed with a hammer (Shmidt N) and a (Proceq Tico) with a transducer of 54 kHz. (D'amato, Laterza, & Gigliotti, 2007)

Samples of the concrete were extracted in order to obtain the estimated resistance between the nondestructive tests. The measurement that was obtained of the extracted elements had a value of 17.79 MPa. The steel sample observed was an element of smooth type with a diameter of 1ø10 and 2ø6. These were taken from the first and second floor of the building from the breaking test samples. The values of resistance and yield elongation were determined consistent with steel category A.SPe. circular A MLLPP.1957. In this way the mechanical properties of the structure were known and with this, a better approximation of the behavior of the structure was obtained.

Figure 1. Sclerometer test performed to column 24.

Figure 2. Ultrasonic test performed to column 16.

The building has 31 columns and 33 beams working to transmit loads on each floor. According to the slab system the weights obtained per square meter and linear meter are multiplied by the length of influence since it is a slab system that handles the structure is in a single direction , that is, it rests on the long edges and in Its short edges remain loose from any support (Figure 3) (Anónimo). The detailed review only considered the beams and columns that receive the most load in the specific area of columns 10 to 6 and the beams 10-09, 09-08 and 07-06. This area was observed according to each normative.

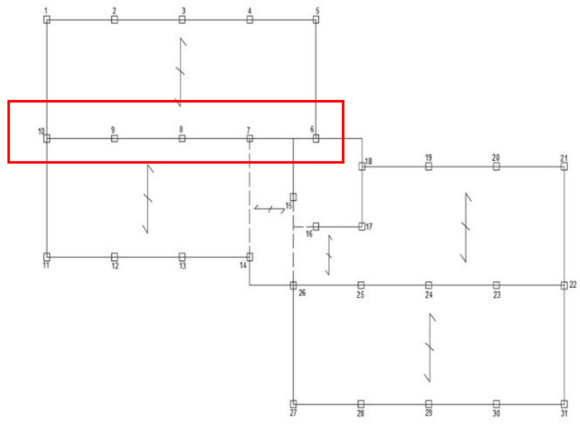


Figure 3. Building plant.

4 FEM MODEL E ANALYSES

The behavior of the structures were modeled using a three-dimensional model of the elements modeled as frames elements subjected to the spectrum corresponding to the normative in question (Figure 4). These loads were calculated according to the elements and materials that were used. (Table 5) it shows the dimensions of the columns and beams also shows the diameter and area of steel that is counted in these elements. Permanent loads and nonstructural loads presented in the building were calculated according to the different parameters of each code. The weight obtained did not vary greatly because the same weight values of specific materials of the slab system were used. (Table 6) .

Table 5. Existing dimensions and steel in columns (c) and beams (b)

LEVEL	COLUMNS (cm)	BEAMS (cm)	STEEL (Diam-cm^2)
ALL LEVELS	30X30	30X21	ϕ10-0.79 ϕ12-1.13
	25X30	70X21	ϕ14-1.54 ϕ16-2.01

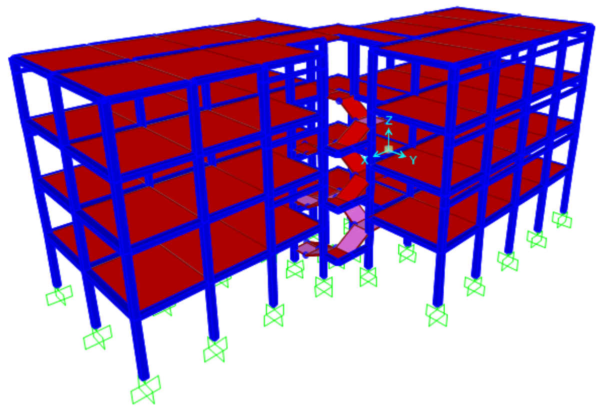


Figure 4. Three-dimensional model of the construction (above).

Table 6. Loads in the structure both codes

	MXNTC-04,2004 (K_N/m^2)	NTC-08,2008 (K_N/m^2) ($G_{K1+}G_{K2}$)
Slab	4.67	4.67
Exterior Walls (K_N/m)	7.25	7.25
Interior Walls (K_N/m^2)	1.6	1.6

A comparative analysis of the elements of the Mexican code (MXNTC-04, 2004) was carried out with the Italian code (NTC-08, 2008). Taking into account that verification was done using the Italian spectra in both regulations due to the fact that the building is in Italy, in the same way the structure was simulated in Mexico where it was desired to obtain a verification that approximates the reality of the structure. One of the first points to emphasize, is that the Mexican legislation lacks the seismic regulation for already existing structures. For this reason only the elastic spectrum is considered. By contrast the Italian legislation has a regulation for the revision of existing structures using the inelastic spectrum.

For the accomplishment of the comparison the 4 types of spectra were made as it is marked in the Italian code, and was compared with the spectrum that is realized with the Mexican code. The differences can be observed and analyzed (figure 5). Similar characteristics were observed to the zone where the building is located in Italy (Zone 1) which has a seismic coefficient 0.16, maximum ground acceleration of 0.04, characteristic periods T_a and T_b of 0.20 and 1.35 respectively and finally r, the parameter that controls the fall of the spectral ordinates, with a value of 1. The accelerations for seismic design were taken as a fraction of gravity.

We took the factor of reduction of the seismic forces defined by Q taking into account the construcution type. In this case we applied factors equal to 3 (green) and 1.5 (forest green) multiplied by the irregularity factor; and we can observe the difference when obtaining the maximum acceleration.

In the case of the Italian spectrum we have to define the probability of the reference period and the nominal life of the structure according to the type of construction and usage classification if order to determine a State Limit for existimg structures. The Italian regulation recommends that a verification must be done for the ultimate state limit (SLV) as a minimum. This resulted in a prediction of significant damage that can be presented either in fractures or collapse with a probability of 10%. With these data a calculation was made to know the spectral ordinates depending on the acceleration, amplification and the start period of the velocity component. Subsoil category B was selected due to the fact due to the fact that it is considered a thick grained or thickened soil where the topographic inclination does not exceed 15°. (INGV, s.f.)

The stratigraphic amplification was verified using subsoil category B and obtaining the coefficients SS and CC with values of 1.2 and 1.394 respectively. The topographic coefficient was assumed as a value of 1 due to the fact that the topographic category is T1. (PP) The ordinates were reduced with the value of (q) equal to 1-5 and thus the different spectra shown in (Figure 5) were obtained. It was observed that the Italian spectra has a higher maximum acceleration in the inelastic spectra (SLV and SLC). In the case of the elastic spectra (SLO and SLD) the maximum acceleration is smaller, but the duration of these are smaller than the one we obtained in the Mexican spectra since the oscillation of the structure is subjected to very long periods and the ground vibration is much slower which is the reason why the structure becomes independent and the spectrum it is very reduced. Additionally, there are different factors which also affect the results such as the damping index and the soil type. Although we tried to replicate their characteristics, the calculations continued showing variations.

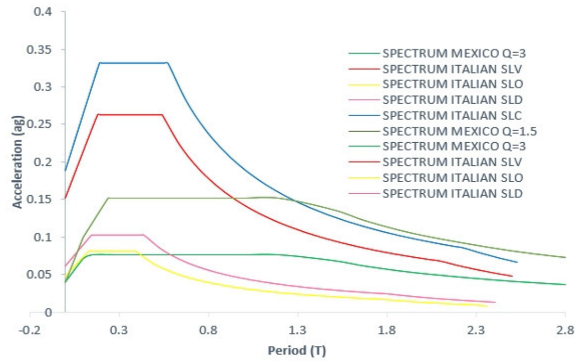


Figure 5. Spectrum comparison figure.

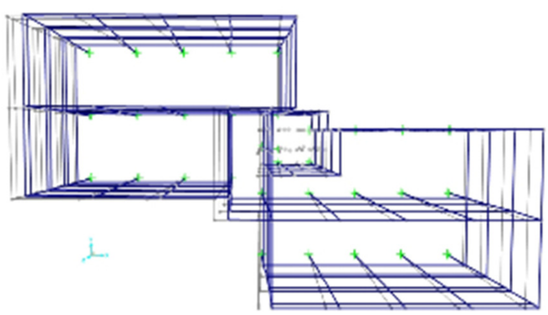
In both regulations various combinations of actions that could occur to the structure were entered as indicated respectively by what we call "envelope." In both cases, we model using finite elements of a network of significant points. nodes were connected by finite-dimensional structural parts.

Thus the mechanical behavior model was obtained in mathematical terms, with the objective that the structure will have a real continuous analysis.

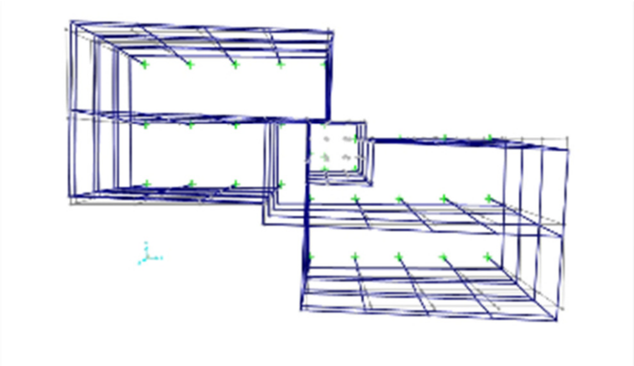
5 RESULTS E COMPARISONS

The dynamic results of modal analysis show the own modes to the roto-translation having a period of (T1 = 1.4711 sec) (a), (T2 = 1.39357 sec), (T3 = 1.01023 sec) (c) and (T4 = 0.46802 sec) (d) period (Figure 6).

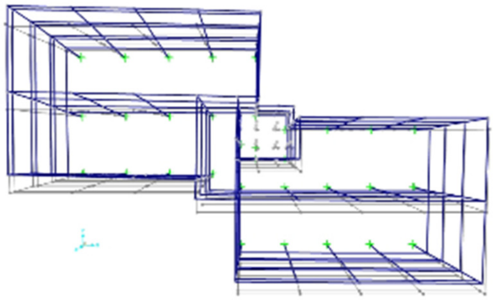
The review of columns that were only revised to vertical loads through software Sap 2000 with interaction diagrams constructed according to the characteristics of those already mentioned (Table 8). This verification made in both regulations considering that the Italian legislation is affected by the properties of the materials obtained from the testing with factors of safety and the level of knowledge of the structure from limited to detailed.



First mode of structural vibration



Sceond mode of structural vibration.



Third mode of structural vibration

Figure 6 . Results of four vibration modes

Accordingly it was defined that the resistances of the fragile and ductile mechanisms of elements is divided by the F_C = 1.35. Note that this case does not apply in the Mexican regulation.

Table 8. Revision of normative vertical loads of columns interactions ratios.

COLUMN	ITALIAN (CR)	MEXICAN (CR)
COLUMN 10	1.322	0.694
COLUMN 09	1.927	0.758
COLUMN 08	1.899	0.772
COLUMN 07	1.739	0.866
COLUMN 06	0.758	0.354

The columns are reviewed according to the capacity interaction curve in the software which has values from 0 to 1 described by a series of discrete points that are generated on the three dimensional interaction failure surface. In addition to axial compression and biaxial bending, the formulation allows for axial tension and biaxial bending considerations. A typical interaction surface is shown in (Figure 7).

The coordinates of the points in the Italian code failure surface are determined by rotating a plane of linear strain in three dimensions on the column section. The linear strain diagram limits the maximum concrete strain, ε_{cu}, at the extremity of the section to 0.0035.

In the case of the Mexican code, limits the maximum deformation of the concrete, ε_c, at the end of the section, to 0.003.

The tension in the steel is given by the product of the steel deformation and the modulus of elasticity of the steel, εs, and is limited to the elastic tension of the steel.

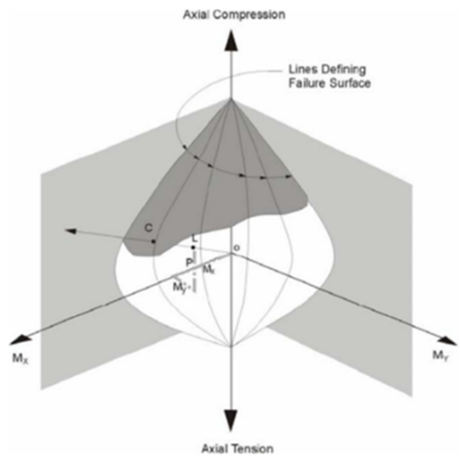


Figure 7 . Typical column interaction surface

It is assumed that the block of concrete compression tension is rectangular, with a tension the interaction algorithm provides correction to take into account the concrete area this is displaced by the reinforcement in the compression zone.

To obtain the (table 9) the capacity ratio (CR) is basically a factor that gives an indication of the stress, condition of the column with respect to the capacity of the column.

Before introducing the interaction diagram to check the capacity of the column, the moment load factors are applied to the loads the capacity is adequate if the value obtained is within the volume of interaction, however if it is outside the volume of Interaction the column is over loaded this is achieved from the center to the point of the result that the column spreads when the value extends out cutting the surface and failure.

Table 9 . Steel required for bending moment

The relation of capacity CR <1 the point is within the volume of interaction and capacity is adequate, but if CR> 1 the point is outside the volume of interaction.

When the building was submitted to the action of the corresponding spectra and the factor of the reduction of seismic forces of both regulations, it was found that the biaxial bending stress that occurs in these columns do not have the capacity to support this force.

The structure is subject to irregularities in its ground floor which weakens it and thus is the reason why it can be prone to collapse. Because there were limitations on the amount of longitudinal reinforcement present in the beams, the integrating reinforcement was modeled by identifying and simulating the location and structural function. According to the age of the building the design indications were taken from (R.D. n. 2229 del 16/11/1939), but only considered the gravitational loads (vertical), with absence of horizontal loads. The steel area in the building was obtained which was then compared to the steel required by each of the spectra of the respective regulations.

With the software the pure presentation was obtained in the building. In (Table 9) with the dimensions and the elements that compose it, steel is presented that requires this structure to give a review if it is adequate to resist the loads and moments presented to it. Present the differences between existing steel and what it requires according to the codes and the spectrum in the graphic (Figure 8).

REGULATION / SPECTRUM	No. BEAM	JOINT BEAM (KN)	BEAM CENTER (KN)	JOINT BEAM (KN)
REGULATION ITALIAN (SPECTRUM ITALIAN)	10-.09	121.84	67.04	134.08
	.09-08	127.3	63.99	127.98
	08-.07	130.07	65.03	124.76
	07-.06	70.14	35.07	29.24
REGULATION MEXICAN (SPECTRUM ITALIAN)	10-.09	111.04	57.19	114.39
	.09-08	96.79	48.39	96.62
	08-.07	97.71	48.85	94.89
	07-.06	102.65	56.69	113.40
REGULATION MEXICAN (SPECTRUM MEXICAN)	10-.09	86.96	45.15	90.31
	.09-08	87.10	43.55	86.91
	08-.07	89.03	44.51	84.99
	07-.06	78.89	39.44	72.95

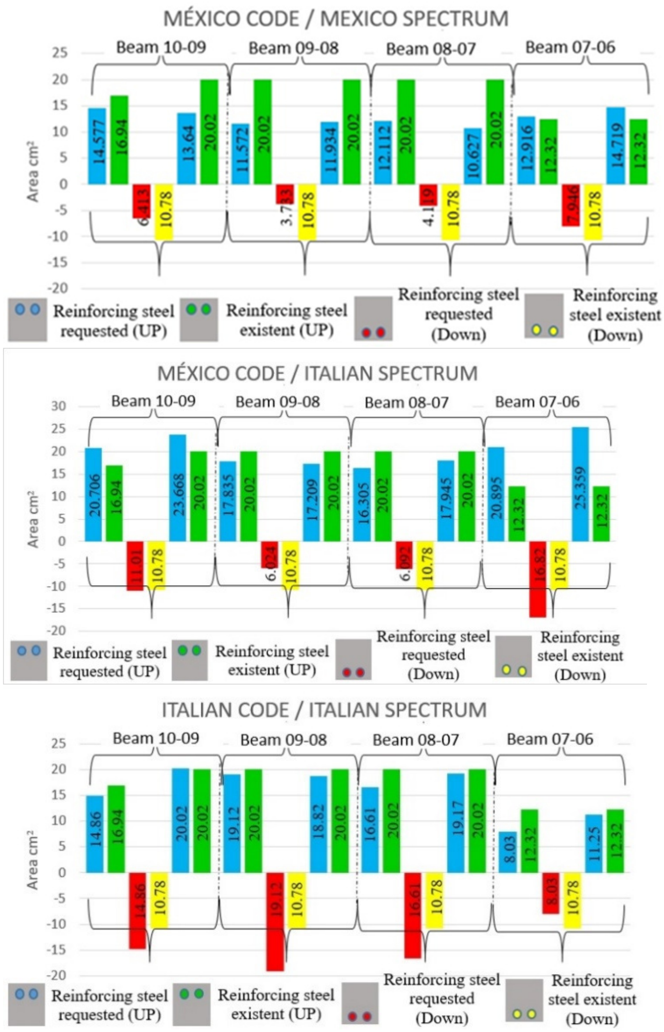


Figure 8. Comparison of required steel with existing steel according to regulations using the Mexican and Italian spectrum.

Table 10. Strength resistant shear force

As can be seen in the Italian and Mexican code, the structure that has a horizontal movement with the interaction of the Italian spectrum has similarities in the area of steel required and both regulations would be insufficient, that if the movement of the simulated design spectrum is assigned in Mexico City it would be fulfilled with the steel area that the structure currently has.

In the case of shear inspection in table (10), the shear shown in the structure is shown according to each of the codes and spectra. It should be mentioned that the codes in this revision have their first difference since the reduction factor for evaluating the shear is different for the Italian code, a $F_R = 0.9$ is used while in the Mexican code they use $F_R = 0.8$ which is reflected in the results.

For the calculation of the shear according to the Italian code was obtained with equation (14)

$$0.9 \cdot d \cdot \left(\frac{steel\,area}{S} \right) \cdot f_{yd} \qquad (14)$$

In the case of the concrete we start by taking the maximum value between the equations (15) and (16).

$$\frac{0.18 \cdot k^{\frac{3}{2}} \cdot \left(\frac{100 \cdot area \cdot 100}{b \cdot d \cdot f_{ck}} \right)^{1/3}}{1.5} \qquad (15)$$

$$0.35 \cdot k^{\frac{3}{2}} \cdot f_{ck} \cdot b \cdot d \qquad (16)$$

where:
S is separation of the transverse reinforcing steel
f_{yd} is the specified yield strength of the reinforcing steel
d distance between the centroid of the tensile steel and the fiber at maximum compression
b width of a rectangular section
f_{ck} specified concrete strength in compression
k is function of height of the section

In the Mexican code, it is done in the same way but there are variations to obtain the resistance. In the case of steel it is derived by the equation (17).

$$\frac{0.8 \cdot \left(Area \cdot f_{yd} \cdot d \right)}{S} \qquad (17)$$

In the case of the concrete, the value of P is obtained by the equation (18); if the value is greater or equal than 0.015 we use the equation (19) if it is smaller we use the equation (20).

$$P = \frac{Area}{b \cdot d}. \qquad (18)$$

$$0.5 \cdot F_R \cdot b \cdot d \cdot \sqrt{f^*_{ck}} \qquad (19)$$

$$0.8 \cdot b \cdot d \cdot \left(0.2 + \left(20 \cdot P \right) \right) \cdot \sqrt{f^*_{ck}} \qquad (20)$$

where:
S is separation of the transverse reinforcing steel
f_{yd} is the specified yield strength of the reinforcing steel
d distance between the centroid of the tensile steel and the fiber at maximum compression
P amount of longitudinal tensile reinforcing steel
f^*_{ck} specified concrete strength in compression
b width of a rectangular section

With this, the shears that support the beams were obtained according to each of the regulations with the respective spectrum as shown in the (table 11).

Table 11. Strength resistant shear force

	JOINT BEAM (KN)	BEAM CENTER (KN)	JOINT BEAM (KN)
REGULATION ITALIAN	281.6	166.1	281.6
REGULATION MEXICAN	179.83	64.9	188.3

6. CONCLUSIONS.

In this paper NTC-08 (Italia) and MXNTC-04 (Mexico) codes have been used to the aim to compare the seismic vulnerability of an existing r.c. building designed in the 70's only refferd to the vertical loads. The seismic action evaluated for the case study has been based on the evaluation of the horizontal seismic effects in reference to the modal analysis that considers the structure factor q. If the design spectrum is used according to the Mexican standard differentiating with the previous one is fulfilled due to the maximum acceleration that reaches because the spectrum that was generated in the city of Mexico has a low acceleration but lasts a period greater than the Italian spectrum.The largest differences are found mainly in the combinations of different movements because with the use of the envelope in each of the codes the results obtained were varied. The Mexican code, since it does not have a rule that regulates the existing structures, provides more conservative spectra. The results show that the Italian code is more conservative than the Mexican code. The difference is mainly due to the influence of the maximum accelerations to which the structure was subjected., the combinations of load and partial factor of the material strenth. The Mexican code in future should be improved in fact it should be noted that no indications are reported for existing buildings.

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