Research Article

Building Irregularities According to Regulations of Different Countries

Aslı Akdemir[1], Tuğba İnan Günaydın[2]

[1] Graduate Student, Niğde Ömer Halisdemir University, Faculty of Arch., Department of Arch., Niğde, Türkiye.
[2] Assoc. Prof. Dr., Niğde Ömer Halisdemir University, Faculty of Arch., Department of Arch., Niğde, Türkiye.

Abstract

As earthquakes are natural disasters that can occur anywhere in the world, many countries have tried various measures to minimize the damage caused by them. They have imposed certain restrictions on architectural designs and adopted earthquake regulations appropriate to their own social and economic conditions, the seismic activity of the region and its proximity to active fault lines, architectural design traditions and technological developments in the construction sector, with the aim of designing earthquake-resistant structures.

Some underdeveloped or developing countries implement the regulations created by developed countries within their countries. Many countries have approached the concept of structural irregularity, which is one of the issues that most affects the architectural design process in earthquake regulations, from different perspectives. In this study, in addition to the current Turkish Building Earthquake Regulation in force in the country, the perspectives of other countries such as America, Mexico, India, and Argentina on the concept of structural irregularity in earthquake regulations were examined. These countries provide explanations with special visuals in their regulations, allowing designers to understand the subject more easily and simply. The major earthquakes and destruction that occurred in these countries and their neighbouring countries played an active role in the preparation process of the regulation. As a result, the approaches of countries to structural irregularity in earthquake regulations were compared, and the effects of geographical conditions on architectural design were examined.

Keywords: Earthquake Resistant Design, Earthquake Regulation, Structural Irregularity, TBDY 2018.

Corresponding Author: tinan@ohu.edu.tr
Received: 01.05.2025 **- Accepted:** 22.08.2025

Cite: Akdemir, A., & İnan Günaydın, T. (2025). Building irregularities according to regulations of different countries. *DEPARCH Journal of Design Planning and Aesthetics Research*, *4*(2), 112-138.
https://doi.org/10.63673/DepArch.2025.43

Araştırma Makalesi

Farklı Ülkelerin Yönetmeliklerine Göre Yapı Düzensizlikleri

Aslı Akdemir[1], **Tuğba İnan Günaydın**[2]

[1] Lisansüstü Öğrencisi, Niğde Ömer Halisdemir Üniversitesi, Mimarlık Fakültesi, Mimarlık Bölümü, Niğde, Türkiye.
[2] Doç. Dr., Niğde Ömer Halisdemir Üniversitesi, Mimarlık Fakültesi, Mimarlık Bölümü, Niğde, Türkiye.

Özet

Deprem afeti dünyanın her yerinde meydana gelebilecek bir doğal afet olduğundan, birçok ülke bu afeti daha az zararla atlatabilmek, mimari tasarımlarda bazı sınırlamalar yapabilmek ve depreme dayanıklı yapılar tasarlayabilmek için kendi sosyal ve ekonomik koşulları, bölgenin sismik hareketleri ve aktif fay hatlarına yakınlığı, mimari tasarım gelenekleri ve inşaat sektöründeki teknolojik gelişmeler doğrultusunda deprem yönetmeliklerini kabul etmiştir. Bazı az gelişmiş veya gelişmekte olan ülkeler, gelişmiş ülkeler tarafından hazırlanan yönetmelikleri kendi ülkelerinde uygulamaktadır. Deprem yönetmeliklerinde mimari tasarım sürecini en çok etkileyen konulardan biri olan yapısal düzensizlik kavramına birçok ülke farklı açılardan yaklaşmıştır. Bu çalışmada ülkemizde yürürlükte olan mevcut Türk Bina Deprem Yönetmeliği'nin yanı sıra Amerika, Meksika, Hindistan, Arjantin gibi ülkelerin deprem yönetmeliklerinde yapısal düzensizlik kavramına bakış açıları incelenmiştir. Bu ülkeler yönetmeliklerinde özel görsellerle açıklamalara yer vererek tasarımcıların konuyu daha kolay ve basit bir şekilde anlamasına olanak sağlıyor. Bu ülkelerde ve komşu ülkelerde meydana gelen büyük depremler ve yıkımlar yönetmeliğin hazırlık sürecinde etkin rol oynamıştır. Sonuç olarak ülkelerin deprem yönetmeliklerinde yapısal düzensizliklere yaklaşımları karşılaştırılarak coğrafi koşulların mimari tasarım üzerindeki etkileri incelenmiştir.

Anahtar Kelimeler: Depreme Dayanıklı Tasarım, Deprem Yönetmeliği, Yapısal Düzensizlik, TBDY 2018.

Sorumlu Yazar: tinan@ohu.edu.tr
Alınma Tarihi: 01.05.2025 - **Kabul Tarihi:** 22.08.2025

Atıf: Akdemir, A., & İnan Günaydın, T. (2025). Building irregularities according to regulations of different countries. *DEPARCH Journal of Design Planning and Aesthetics Research*, *4*(2), 112-138.
https://doi.org/10.63673/DepArch.2025.43

INTRODUCTION

The earthquakes experienced on the earth due to the fractures in the earth's crust have caused many earthquake zones in the world.When the earthquakes that occurred in the world and in Türkye analysed, it is understood that most of them are tectonic earthquakes. Although Turkey is a country that covers only 0.5% of the world's territorial integrity, it has been exposed to many of the major earthquakes that have occurred since the 1900s due to its location in the second largest earthquake zone. It ranks fourth among the countries that have experienced the most earthquake disasters (Bıçakçı & Karakayalı, 2022). Table 1 The location, date, magnitude and number of fatalities of the ten largest earthquakes in the world are listed. Our region is also an area with both active and inactive volcanic mountains (Euronews, 2024)

When structures that suffered heavy damage after an earthquake are analysed, the unsuccessful design of the structure without complying with certain criteria during the architectural design phase causes heavy loss of life and property under earthquake forces. The load-bearing system design is the most important part of the structure's design process regarding earthquakes. Designing the structure in an earthquake-resistant manner is much more economical than activities such as reinforcement, which are methods of compensating for incorrect designs later on. Earthquake regulations present the design criteria and necessary calculations to the designer in this sense (İlerisoy, 2019).

Table 1. Ten major earthquakes in the world

History	Place	Size	Loss of Life
January 31, 1906	Ecuador	8.8	1,000
August 15, 1950	Assam /Tibet	8.6	1,500
November 4, 1952	Kamchatka / Russia	9.0	None
May 22, 1960	Valdivia/Chile	9.5	1,655
March 28, 1964	Prince William Sound/ Alaska	9.2	128
February 4, 1964	Rat Islands/Alaska	8.7	None
December 26, 2004	Sumatra / Indonesia	9.1	230,000
March 28, 2005	Sumatra / Indonesia	8.6	1,400
February 27, 2010	Bio-bio /Chile	8.8	500
March 11, 2011	Sendai/ Japan	9.1	19,000

In the developing world, multi-storey buildings are becoming more widespread and preferred, and high-rise buildings are frequently included in urban planning and architectural designs. With high-rise buildings, the significance of not only vertical loads but also horizontal loads such as earthquake loads increases. Since earthquakes are unpredictable and unpreventable disasters, necessary precautions should be taken and implemented during the design phase of buildings. In recent years, many countries have been trying to adopt and implement some criteria and standards for earthquake-resistant building design in their regulations. With the development of technology, calculations of earthquake loads have also been detailed. Individuals with professional competence and responsibilities are expected to apply the standards in these regulations during the design and implementation phase of the building (Karasu, 2015).

To predict how a structure will behave during an earthquake, it is very important that the design of the load-bearing system is suitable for the structure and the physical conditions of the region where it is located. The load-bearing system elements should show ductile behaviour under earthquake loads and transfer the horizontal loads acting on the structure to the ground in a regular manner. In the regulations, many factors such as soil properties, the structure's usage function, rigidity and ductility properties, building material, and load-bearing system design are taken into consideration in earthquake calculations (Darılmaz, 2014). Especially in reinforced concrete structures, the calculation of earthquake loads and the implementation of designs in line with these calculations are of great importance. Earthquake load is the most dangerous and damaging load type that a structure can encounter (Döndüren & Nakipoğlu, 2016).

In the study, firstly, the major earthquakes that occurred in the world were examined, and the world earthquake map was included. Some countries located in different continents were selected, and the earthquake regulations of these countries were investigated. The earthquake regulations prepared by the countries in accordance with the conditions of their regions have different characteristics as well as common characteristics. Five countries located in different earthquake zones were selected from the countries listed in the world earthquake regulations on the website of the International Association of Earthquake Engineers (IAEE) and were examined and analysed in terms of their perspectives on structural irregularities in earthquake regulations (Figure 1) (IAEE, 2024). The structural irregularity section of the regulations TBDY-2018 for Turkey, ASCE 7-22 for America, NTC-2023 for Mexico, BIS, 2002 for India, and INPRES-CIRSOC 103 for Argentina were examined. Finally, the situations accepted as irregularities by these countries, which expressed the irregularity types in tables and visual forms, were compared.

TBDY-2018 (TÜRKIYE BUILDING EARTHQUAKE REGULATION)

The Turkish Building Earthquake Regulation entered into force on January 1, 2019, and it was decided that the structures to be designed from that date onwards must comply with the standards specified in this regulation. The new regulation has been prepared at a more advanced level than the regulations used in previous years with its comprehensiveness and detailed calculation methods. The regulation includes topics such as earthquake calculations, earthquake ground motion spectra, building performance levels, and structural irregularities, which guide designers for earthquake-resistant building design (TBDY, 2018).

In the regulation, the subject of structural irregularity is conveyed by defining irregularities in a tabular form and using explanatory visuals for some irregularity types. According to TBDY 2018, there are six types of structural irregularities, three of which are irregularities in the plan and three of which are irregularities in the vertical (Table 2).

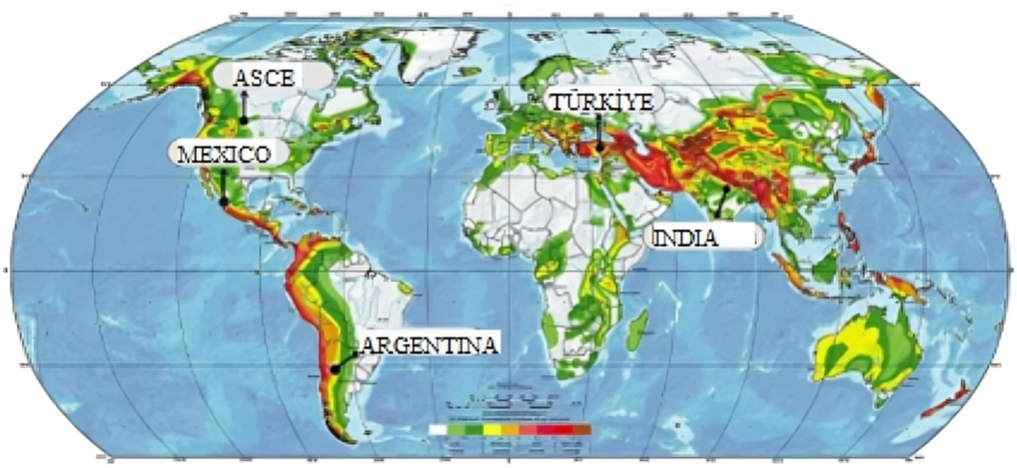


Figure 1. World earthquake map and countries whose earthquake regulations are examined (URL 1).

Table 2. Structural irregularity according to TBDY 2018 standards.

Structural Irregularities in the Plan	Vertical Structural Irregularities
A1 -Torsional irregularity	B1 - Strength Irregularity Between Adjacent Floors (Weak Floor)
A2 - Floor discontinuities	B2 - Stiffness Irregularity Between Adjacent Floors (Soft Floor)
A3 - Presence of protrusions on the plan	B3 -Discontinuity of Vertical Elements of the Carrier System

Structural Irregularities in the Plan (Horizontal)

The structural irregularities in the plan in the regulation are torsional irregularities, floor discontinuities and the presence of recesses and protrusions in the plan, which are included as Group A irregularities. The main factors in irregularities in the plan are the design of the mass and rigidity centres far from each other, designs that will cause sudden rigidity decreases by designing gaps large enough to affect rigidity in the plan and the creation of recesses and protrusions long enough to allow free oscillation in the structure (TBDY, 2018).

Torsional irregularity

Torsional irregularity occurs when the maximum floor drift in one of the two perpendicular earthquake directions at any floor of the structure is 1.2 times greater than the average floor drift (Figure 2). After the necessary calculations are made in a structure, if the torsional irregularity is greater than 1.2 in the number of floors, the structure is considered irregular. The numerical formulation of irregularity is given in Formula 1(TBDY, 2018).

$$(\Delta i)^{(x)}\ ort = 1/2\left[\Delta i^{(x)} maks + \Delta i^{(x)} min\right] \quad (1)$$

Floor discontinuity

This irregularity is defined in the regulation in 3 different cases for the floor on any floor. In the structures where these situations are present, a structural irregularity called floor discontinuity is observed (Figure 3). In structures with floor discontinuity, torsional irregularity is usually observed together.

1. It is the situation where the spaces on the floor, including the staircase and elevator shafts, which are called the core of the building, are more than 1/3 of the total gross area on the floor.

2. While earthquake loads are transferred smoothly by the vertical carrier systems of the building, there are floor gaps that make this difficult or prevent it.

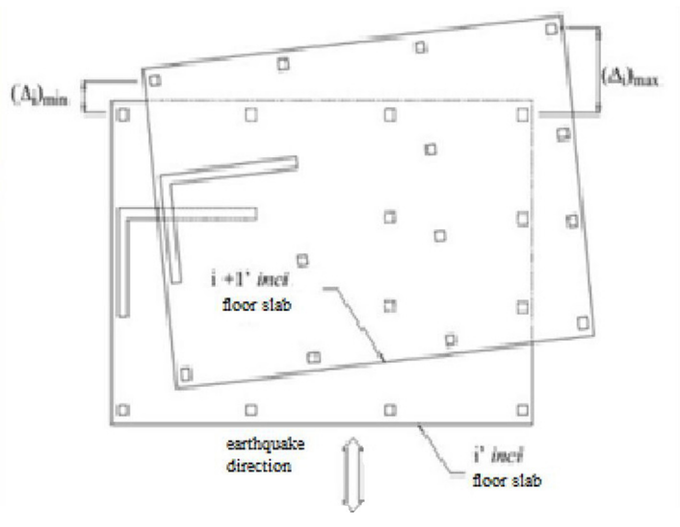


Figure 2. Torsional irregularity (TBDY, 2018).

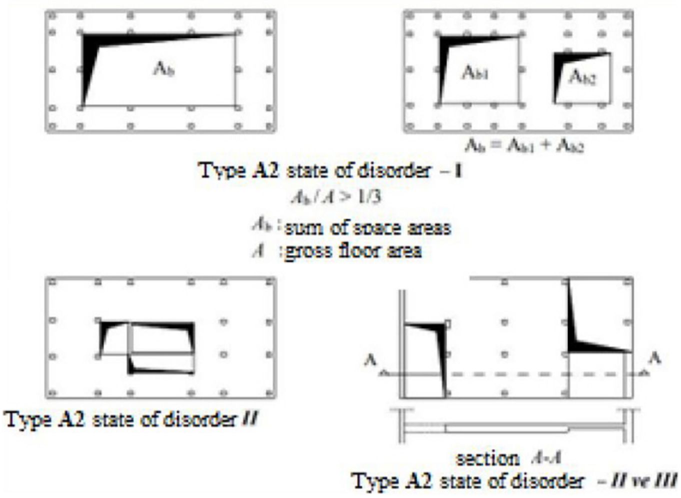


Figure 3. Floor discontinuity (TBDY, 2018).

3. This is the situation where the in-plane rigidity and strength decrease due to the hollow or thinner design of the slab (TBDY, 2018).

Presence of protrusions in the plan

The definition of this irregularity is described as the dimensions of the protrusions in the plan of the structure in the perpendicular directions to the two axes, both of which are more than 20% of the total dimensions of that floor in the same directions (Figure 4) (TBDY, 2018). The simple or complex nature of the building forms is quite important in the controlled transmission of earthquake loads. Since unbalanced oscillation movements occur during an earthquake in complex building forms, the damage and destruction rates they receive are higher compared to simple building forms.

Vertical Structural Irregularities

Vertical structural irregularities are included as group B irregularities. Strength irregularity between adjacent floors is expressed as B1, rigidity irregularity between adjacent floors is expressed as B2, and discontinuity of the vertical element of the carrier system is expressed as B3 irregularity. The main reasons for irregularities in the vertical plane are unbalanced mass distribution between floors, failure to maintain continuity of the carrier system elements on all floors, sudden rigidity changes between floors, and failure to provide vertical symmetry of the structure. Among the vertical structural irregularities, soft storey irregularity (B2) is the most common type of irregularity.

Weak floor irregularity

The first of the vertical structural irregularities in the earthquake code is commonly known as B1 weak floor irregularity. The definition in the code is that the ratio of the total effective shear area on any floor to the total effective shear area

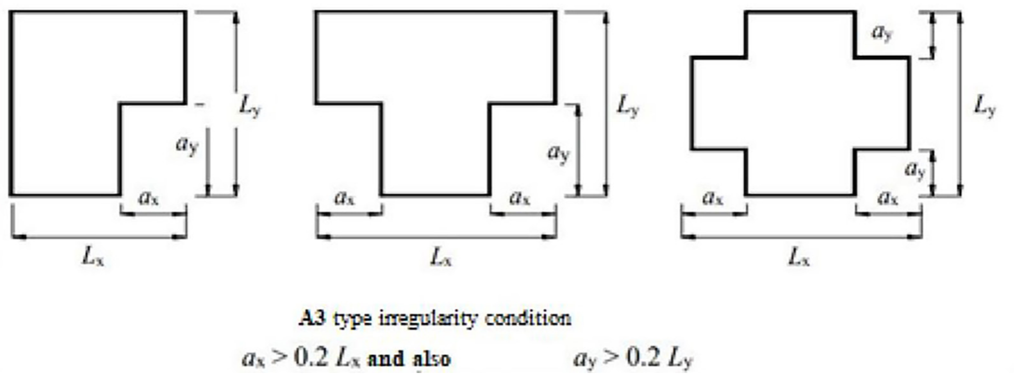


Figure 4. Presence of protrusions in the plan (TBDY, 2018).

on the upper floor in one of the earthquake directions on the two axes of the structure is less than 0.8. This ratio is called the strength irregularity coefficient and is shown as ci (TBDY, 2018). The numerical calculations of this irregularity are calculated according to the formula in the 2 relation (Formula 2). In the formula , represents the total effective shear area on a given floor. The formula for calculating this total effective shear area is explained in the code.

$$\eta_{ci} = \left(\sum A_e\right)_i \Big/ \left(\sum A_e\right)_{i+1} < 0.8 \quad (2)$$

The strength irregularity between adjacent floors is usually caused by the removal of walls to convert the ground floor of the building to a different usage function, such as a shop, market, etc. The entrances to the building can be designed at different levels on sloping terrain. Removing walls to create more transparent areas such as car parks and gyms on the mezzanine floors results in the effective cutting area on these floors being lower than that on other floors. This ultimately leads to weak floor irregularity.

Soft floor irregularity

It is commonly known as B2 soft storey irregularity. This irregularity is defined as the ratio of the average relative storey drift at any floor, excluding the basement, divided by the ratio of the average relative storey drift at the floor above or below it, for one of the two perpendicular axes of the structure, being greater than 2. The coefficient of rigidity irregularity is shown as η Ci and for a regular building design this value should be less than 2. The coefficient of rigidity irregularity is calculated according to the relation in 3 (Formula 3) (TBDY, 2018).

$$\eta \mathrm{ki} = \left(\Delta \mathrm{i}^{(\mathrm{x})}/\mathrm{hi}\right)_{\mathrm{ort}} \Big/ \left(\Delta_{\mathrm{i}\pm1}{}^{(\mathrm{x})}/\mathrm{h}_{\mathrm{i}\pm1}\right)_{\mathrm{ort}} > 2 \quad (3)$$

The rigidity of the structure is very important for the behaviour of the structure during an earthquake. If the vertical and horizontal loads are distributed evenly in the structure, the level of damage to the structure will be less. For this, the floor heights of the structure should be equal on each floor, the dimensions of the vertical load-bearing elements should be designed equally from the foundation, and the rigidity of the structure should be maintained by ensuring the continuity of the partition walls.

Discontinuity of vertical elements of the structural system

The definition of irregularity in the regulation is defined as the situation where the columns and curtain elements, which are vertical carrier system elements, are interrupted at some floors and placed on the gusseted columns or beams. Placing the curtain elements on the columns also causes this irregularity (Figure 5) (TBDY, 2018).

Vertical carrier systems are the most important elements of the structure. The continuity of these elements, which transmit the horizontal and vertical loads affecting the structure to the foundation, must be uninterrupted. In areas where continuity is interrupted, excessive stress and displacement occur, causing damage. It is forbidden to place the columns of the building on gussets or console beams. It is possible to place the columns of the building on columns supported at both ends if the necessary earthquake calculations are made. However, it is a situation that significantly reduces the rigidity of the structure. While the curtain elements of the building must come to the foundation without interruption, it is forbidden to place them on column elements according to regulations. It is forbidden to place the curtain elements of the building on beams supported at both ends.

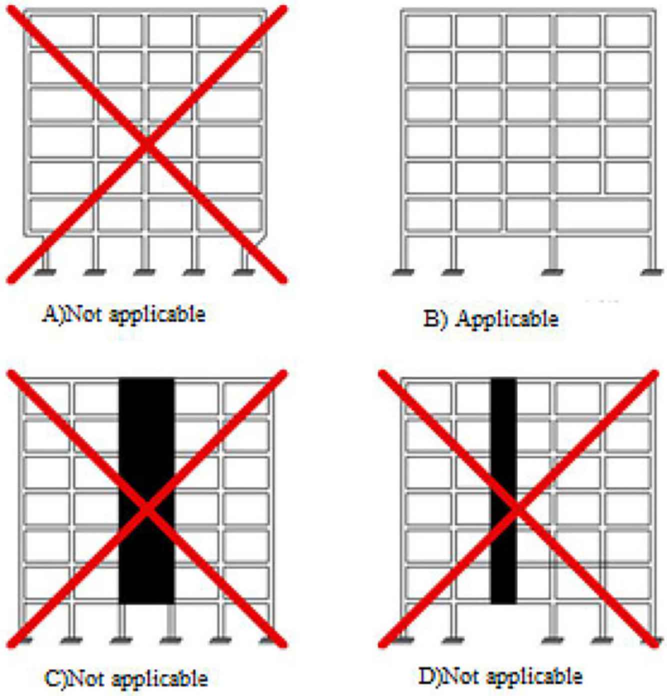


Figure 5. Discontinuity of vertical elements of the structural system (TBDY, 2018).

STRUCTURAL IRREGULARITIES IN EARTHQUAKE REGULATIONS OF DIFFERENT COUNTRIES

ASCE 7-22 (American Society of Civil Engineers) - American Code of Minimum Design Loads for Buildings and Other Structures

The ASCE/SEI 7-22 Standard, published by the Structural Engineering Institute of the American Society of Civil Engineers in 2022, has replaced ASCE 7-16 and has become the most up-to-date regulation. It has been prepared in a very comprehensive and detailed manner. It specifies the design decisions to be taken for disasters such as floods, tsunamis, fires, and earthquakes; load combinations in numerical calculations; and material standards. In the United States, FEMA (Federal Emergency Management Agency) was established in 1979 by order of the presidency. It performs the duties of AFAD (Disaster and Emergency Management Presidency) in Türkiye and is also an institution similar in mission and vision. NEHRP (National Earthquake Hazards Reduction Program), prepared by FEMA according to the criteria in ASCE, aims to reduce the risks that may arise from earthquake disasters (FEMA, 2020).

In the American earthquake code, the concept of a regular building is used for structures designed to oscillate regularly during an earthquake, with the distribution of the mass, strength and stiffness of the structure. In regular structures, the energy of the earthquake is distributed equally throughout the structure, causing less damage. In irregular structures, on the contrary, the energy is concentrated in one or a few areas, causing excessive damage or collapse (FEMA P-749, 2022).

Structural irregularities included in ASCE/SEI 7-22 Standards are divided into two groups. Horizontal structural and vertical structural irregularities are included in the regulation in tabular form with their explanations (Table 3). Numerical calculations of irregularities are formulated, and some irregularities are conveyed with figures. A total of five horizontal irregularities and five vertical irregularities are defined. Since three irregularities create excessive irregularity according to the value range in the calculations, torsional irregularity, soft-storey irregularity and weak-storey irregularity are considered with two different conditions (ASCE, 2022).

Table 3. Structural irregularity according to ASCE, 2022 standards.

Horizontal Structural Irregularities	Vertical Structural Irregularities
1a. Torsional Irregularity	1a. Stiffness-Soft Story Irregularity
1b. Excessive torsional irregularity	1b. Stiffness-Excessive Soft Story Irregularity
2. Indented Corner Irregularity	2. Weight (Mass) Irregularity
3. Diaphragm Discontinuity Irregularity	3. Vertical Geometric Irregularity
4. Out-of-Plane Offset Irregularity	4. In-Plane Discontinuity Irregularity in Vertical Lateral Force Resisting Element
5. Non-Parallel System Disorder	5a. Discontinuity in Lateral Strength - Weak Story Irregularity
	5b. Discontinuity in Lateral Strength - Extremely Weak Floor Irregularity

Horizontal structural irregularities

Torsional irregularity: Torsional irregularity is defined as the situation where 75% of the lateral strength at any floor in the structure is located outside the centre of mass or the maximum story drift in one axis of any floor in the structure is 1.2 times greater than the average story drift in two axes (Figure 6) (ASCE, 2022).

***Excessive torsional irregularity*:** Excessive torsional irregularity is defined as the situation where the maximum story drift in one axis of any floor of the structure is 1.4 times greater than the average story drift in two axes (Figure 6) (ASCE, 2022).

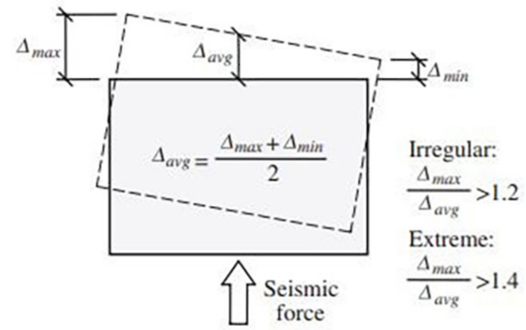


Figure 6. Torsional irregularity (ASCE, 2022)..

***Indented corner irregularity*:** Recessed corner irregularity occurs due to a recessed corner configuration in the building's plan. If the length of one side of the recess in this corner is greater than 0.15 when compared to the length of the same side on the building plan, recessed corner irregularity is observed in those buildings (Figure 7) (ASCE, 2022).

Diaphragm discontinuity irregularity: This irregularity resulting from diaphragm discontinuity is the irregularity seen in the structure when there is more than 50% of the total floor area in a floor plan. In addition, if the ratio of the floor rigidity on any floor to the floor rigidity on the neighbouring floors is less than or more than 50%, then diaphragm discontinuity irregularity is observed in that structure (Figure 8) (ASCE, 2022).

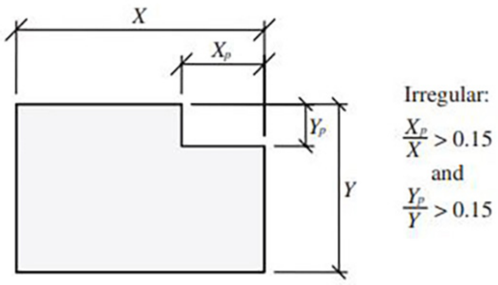


Figure 7. Indented corner irregularity (ASCE, 2022)(TBDY, 2018).

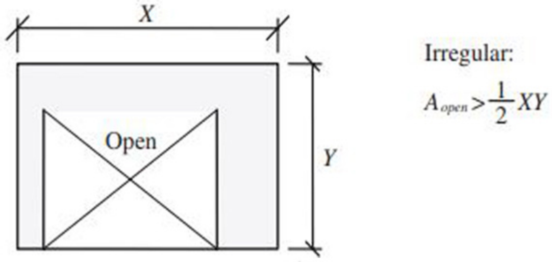


Figure 8. Diaphragm discontinuity irregularity (ASCE, 2022).

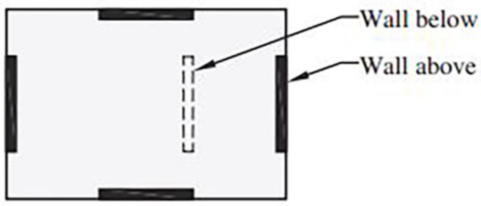


Figure 9. Out-of-plane distance irregularity (ASCE, 2022).

Figure 10. Non-parallel system disorder (ASCE, 2022).

***Out-of-plane distance irregularity*:** This irregularity, called out-of-plane distance irregularity, occurs because the vertical load-bearing elements in a floor plan are designed in different positions on adjacent floors. This type of irregularity creates difficulty in resisting lateral forces (Figure 9) (ASCE, 2022).

***Non-parallel system disorder*:** Non-parallel system irregularity is defined as the failure to design parallel axes in the plan geometry of the structure. The aim should be to position the structural system elements of the structure parallel to their main orthogonal axes (Figure 10) (ASCE, 2022).

Vertical structural irregularities

Soft floor irregularity: Soft story irregularity is defined as the situation where the ratio of the lateral stiffness of any floor in the structure to the lateral stiffness of its neighbouring floors is less than 70% or the ratio of the lateral stiffness of any floor to the average lateral stiffness of the 3 floors above is less than 80% (Figure 11) (ASCE, 2022).

Excessive soft floor irregularity: Excessive soft storey irregularity refers to situations where the rates of soft storey irregularity increase. Excessive soft storey irregularity is defined in the code as the situation where the ratio of the lateral rigidity of any floor in the building to the lateral rigidity of its neighbouring floors is less than 60% or the situation where the ratio of the lateral rigidity of any floor to the average lateral rigidity of the 3 floors above it is less than 70% (Figure 11) (ASCE, 2022).

***Weight (mass) irregularity*:** Mass irregularity is defined in the regulation as the ratio of the mass of any floor of the building to the mass of any of the adjacent floors being more than 150%. Attics are excluded in this irregularity (Figure 12) (ASCE, 2022).

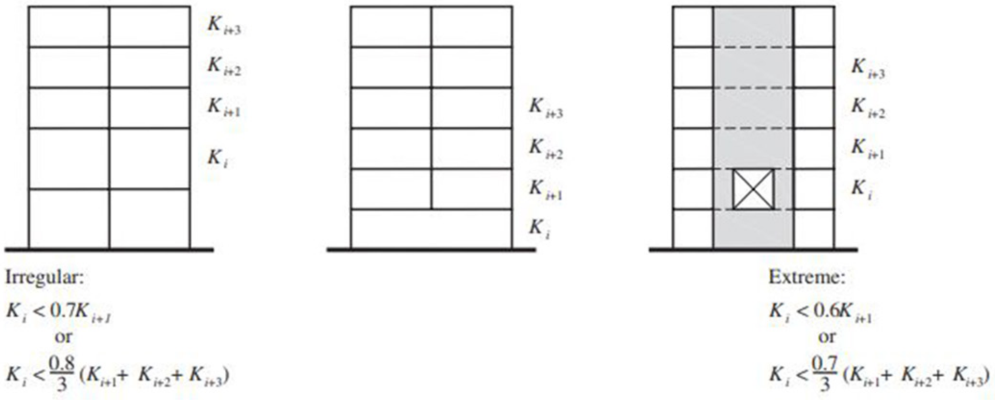


Figure 11. Soft story irregularity (ASCE, 2022).

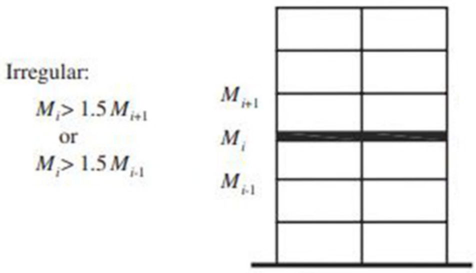


Figure 12. Weight (mass) irregularity (ASCE, 2022).

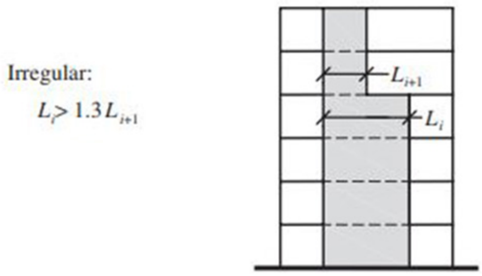


Figure 13. Vertical geometric (ASCE, 2022).

***Vertical geometric irregularity*:** Vertical geometric irregularity is defined as the ratio of the dimensions of the vertical load-bearing elements on any floor of the building to the dimensions of the vertical load-bearing elements on one of the adjacent floors being more than 130% (Figure 13) (ASCE, 2022).

***Discontinuity of vertical elements*:** This irregularity, which is caused by the discontinuity of the vertical carrier system elements, occurs when the column and wall elements are not designed continuously from the foundation to the top floor of the structure. It is irregularity that occurs when the dimensions of the vertical carrier elements increase or decrease (Figure 14) (ASCE, 2022).

Weak floor irregularity: Weak storey irregularity is defined as the situation where the ratio of the lateral strength of any storey of the structure to the lateral strength of the storey above is less than 80%. The lateral strength calculation is the sum of the strengths of all the resisting elements sharing the storey shear in that direction in the structure (Figure 15) (ASCE, 2022).

Extremely weak floor irregularity: Extremely weak storey irregularity is defined as the situation where the lateral strength of any storey of the structure is less than 65% of the lateral strength of the storey above it. The lateral strength calculation is the sum of the strengths of all the resistant elements sharing the storey shear located in that direction in the structure, in the same way as the method in weak storey irregularity (Figure 15) (ASCE, 2022).

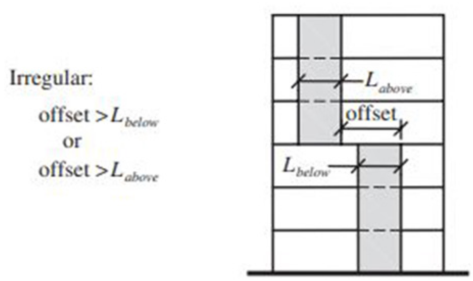


Figure 14. Discontinuity and irregularity of vertical elements (ASCE, 2022).

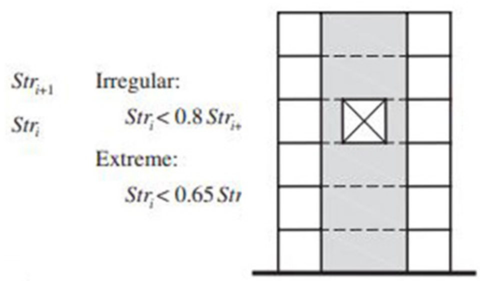


Figure 15. Weak floor irregularity (ASCE, 2022).

Mexico NTC-2023 (Norma Técnıca Complementarıa Para el Dıseño Por Sismo) Complementary Technical Standard for Earthquake Design

In Mexico, where major earthquakes occurred in 1957, 1985 and 2017, the earthquake code standard has been prepared in detail. The aims of the prepared earthquake code are to emphasise the importance of actions and possible effects affecting the structure for structural design purposes, to determine the necessary safety measures and service conditions in the design process of the structure, and finally to ensure that the procedures that must be implemented in accordance with these determined conditions are followed (NTC-DCEA, 2017).

When many earthquake disasters that have occurred in the world are examined, it is seen that irregular structures are much more vulnerable to seismic movements than regular structures. This result does not change in the earthquake disasters that occurred in Mexico. The more irregularities there are in the structure, the more damage the structure receives because of the earthquake. The Mexican code attracts attention with different definitions and different solution proposals regarding structural irregularities. The Mexican code, which initially adopted 13 different irregularity types, has defined 8 different irregularity types in its current form. 5 of these irregularity types are irregularities in plan and 3 are irregularities in the vertical (Table 4) (NTC-DCEC, 2023).

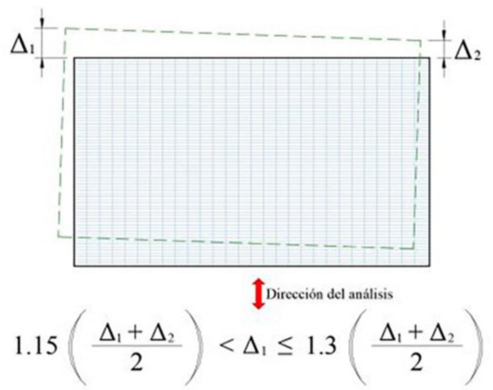
Table 4. Structural irregularity according to NTC-PDPS, 2023 standards.

Horizontal Structural Irregularities	Vertical Structural Irregularities
1. Torsional Irregularity	1. Geometric Discontinuity Irregularity in Vertical
2. Strong Torsional Irregularity	2. Irregularity Due to Sudden Decrease in Lateral Stiffness
3. Irregularity of Geometric Shape in Plan	3. Strong Irregularity Due to Sudden Decrease in Lateral Stiffness
4. Irregularity Due to Excessive Flexibility in the Diaphragm	
5. Disorder Due to Discontinuity in the Diaphragm	

In the structural irregularities section of the Mexican regulation, in addition to the definition of the situations that create irregularities, it also defines the boundary deteriorations that should be taken into consideration in the design. It is mentioned in the regulation that the irregularity of the structure is not only caused by the rigidity of the structure, connection types and analysis models, but also by the effects of the partition and adjacent wall designs, stairs and prefabricated facade designs, which are often overlooked and not taken into consideration (NTC- PDPS, 2023).

Horizontal structural irregularities

***Torsional irregularity*:** Torsional irregularity occurs as a result of the distance (eccentricity) between the centre of lateral stiffness (rigidity) and the centre of mass of the structure (Figure 16). The structure is exposed to rotational motion caused by this distance under earthquake load. This resulting rotational motion does not have the same amplitude in every region of the structure. One end of the structure may show more translational motion while the other end may have less translational motion, which causes lateral deformations in the structure. If the displacement at any point in the structure is 15% more than the average lateral displacement, there is torsional irregularity in the structure (NTC- PDPS, 2023).



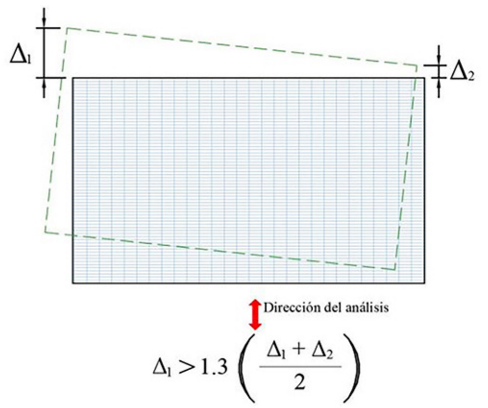


Figure 16. Torsional irregularity (NTC- PDPS, 2023).

Figure 17. Strong torsional irregularity (NTC- PDPS, 2023).

Strong torsional irregularity: Strong torsional irregularity occurs due to the factors that cause the same torsional irregularity. Designing the centre of gravity and the centre of rigidity of the structure at points far from each other is a type of irregularity caused by the rotation and translation movements that occur in the structure during seismic movements (Figure 17). Torsional irregularity is called strong torsional irregularity when its rate is very high. If the displacement at any point in the structure is 30% more than the average lateral displacement, there is strong torsional irregularity in the structure (NTC- PDPS, 2023).

Irregularity of geometric shapes in plan: Geometric irregularity in plan is a type of irregularity resulting from the excessive dimensions of the recesses and protrusions in the plan plane of the structure (Figure 18). The points where these recesses and protrusions meet in the structures are very likely to be damaged under seismic movements. If the dimensions of the recesses and protrusions created in the structure plan exceed 40% when compared to the dimensions of the floor plan in the parallel direction of the structure, geometric irregularity is observed in the plan (NTC- PDPS, 2023).

Excessive flexibility disorder in the diaphragm: Irregularity due to excessive flexibility in the diaphragm is caused by the structure's diaphragm being too flexible and therefore causing some parts of the structure to experience very large lateral deformations compared to other parts (Figure 19). Different lateral deformations in different parts of the structure cause the structure to suffer heavy damage in an earthquake. When calculating irregularity due to excessive flexibility in the diaphragm, two different structural models are created that are considered infinitely rigid with the existing flexibility of the diaphragm in its own plane. Irregularity due to excessive flexibility occurs in the diaphragm when the displacement ratio at the same point in the structure exceeds 30% (NTC- PDPS, 2023).

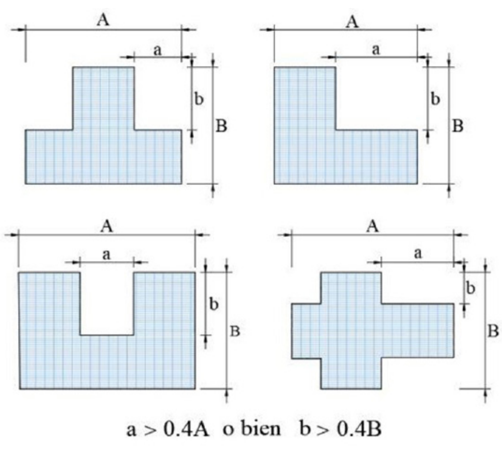


Figure 18. Irregularity of geometric shape in plan (NTC- PDPS, 2023).

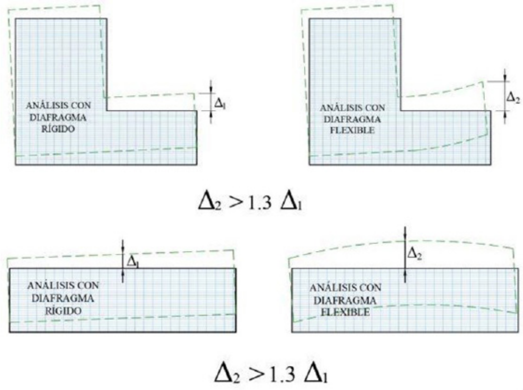


Figure 19. Hyperelasticity and irregularity in the diaphragm (NTC- PDPS, 2023).

Discontinuity irregularity in the diaphragm**:** Irregularity due to discontinuity in the diaphragm is defined as the situation where the ratio of the diaphragm space in any floor of the structure to the existing diaphragm area in the plan plane is more than 40% (Figure 20). In a structure exposed to horizontal loads in an earthquake disaster, these loads are first transferred to the diaphragm and then from the diaphragm to the vertical carrier elements. In this transfer process, the fact that the openings in the diaphragm are too many negatively affects the transfer to the vertical carrier elements (NTC- PDPS, 2023).

Vertical structural irregularities

Geometric discontinuity irregularity in vertical: Geometric discontinuity irregularity in the vertical is defined with different ratios depending on the location of the geometric discontinuity in the structure (Figure 21). When geometric discontinuity occurs on the upper floors after any floor of the structure, if the width of the upper floors is designed more than 40% of the width of the lower floors, irregularity occurs in the structure. When geometric discontinuity occurs on the lower floors before any floor of the structure, if the width of the lower floors is designed more than 25% of the width of the upper floors, irregularity occurs in the structure. When geometric discontinuity occurs as a void in the interior of any floor of the structure, if the width of this empty space is designed more than 25% of the width of the structure, irregularity occurs in the structure (NTC- PDPS, 2023).

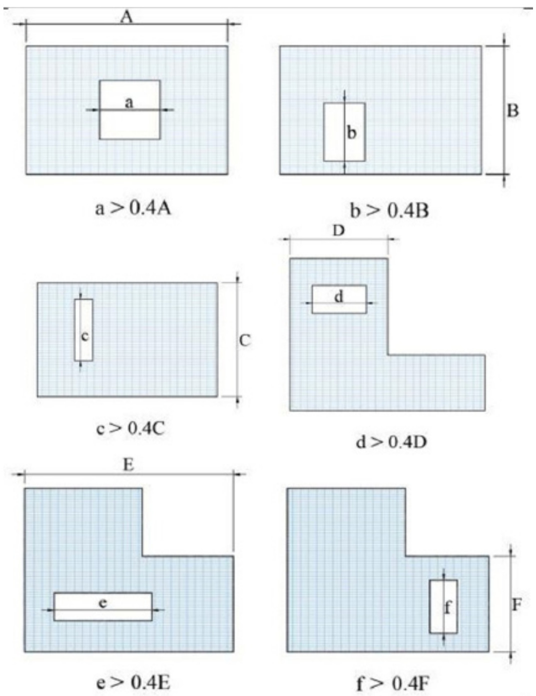


Figure 20. Irregularity due to diaphragm discontinuity (NTC- PDPS, 2023).

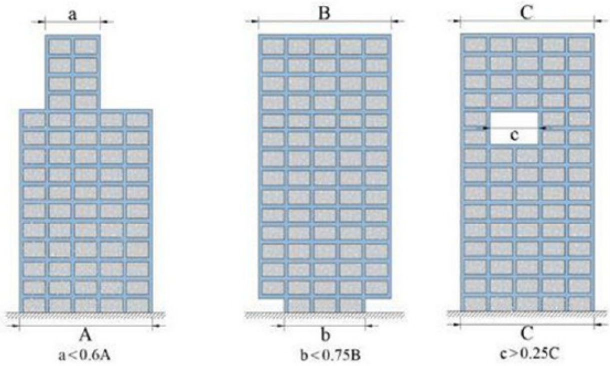


Figure 21. Vertical geometric discontinuity irregularity (NTC-PDPS, 2023).

***Irregularity due to sudden decreases in lateral rigidity*:** It is a situation where the rigidity of any floor of the structure is much more or less than the rigidity of the neighbouring floors (Figure 22). This type of irregularity is observed in the structure when any floor is 15% less rigid than the rigidity of the floor above it or 30% more rigid than the rigidity of the floor above it (NTC- PDPS, 2023).

***Strong irregularity due to sudden decreases in lateral rigidity*:** In the type of strong irregularity related to stiffness, if the ground floor of the structure has 50% less rigidity than the other floors, strong irregularity is observed (Figure 23). In addition, in the event of a sudden decrease in rigidity in any of the intermediate floors of the structure, if the average rigidity of the lower floor and the upper floor of the intermediate floor is taken and the rigidity is found to be 50% less than this value, there is strong irregularity in the structure (NTC- PDPS, 2023).

India BIS 2002 Regulations (Criteria for Earthquake Resistant Design of Structures)
The Indian Standard, which contains the criteria for earthquake resistant design of structures for India, was prepared with the approval of the committees of earthquake engineers and civil engineers. It came into force after its acceptance by the Bureau of Indian Standards (BIS, 2002).

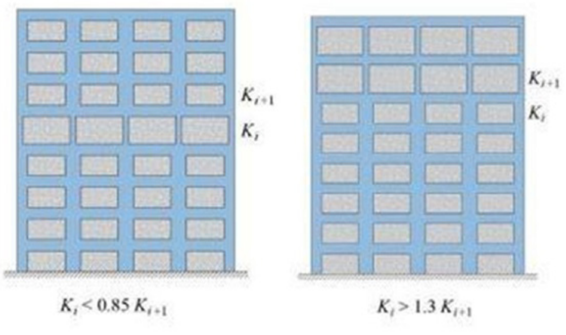


Figure 22. Irregularity due to sudden decreases in lateral rigidity (NTC- PDPS, 2023).

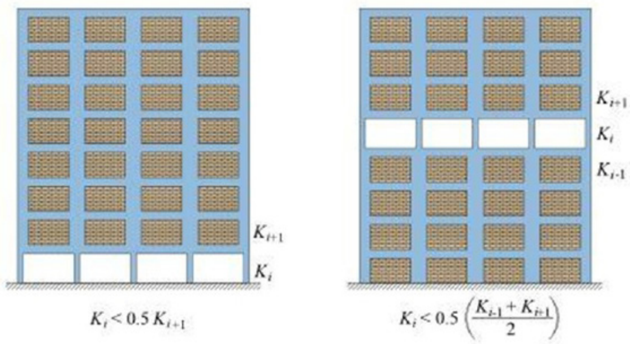


Figure 23. Strong irregularity due to sudden decreases in lateral rigidity (NTC- PDPS, 2023).

The Indian Peninsula is in a geological area where destructive and large earthquakes occur. Regions such as the Indo-Gangetic Plain, the Himalayas, Western India and Kutch have geological features that can cause earthquake disasters. Earthquake regulations in India were first published and put into effect in 1966. The regulation was adopted to minimise damage in earthquake disasters and to establish criteria for earthquake-resistant building design (BIS, 2002). The current version of the regulation has been revised 5 times. While preparing the regulation; the perspectives of countries such as America and New Zealand on earthquake regulations were adopted. In the new revision, torsional irregularity and irregular structures were taken into consideration (BIS, 2002). The regulation was divided into 5 sections, making it easier to understand. In the first section, general provisions regarding earthquake-resistant structural design and design criteria for buildings are conveyed.

According to BIS 2002 standards, structural irregularities are defined by creating a table in the relevant section of the regulation, like ASCE/SEI 7-22 standards. According to Indian Standards, there are 5 types of horizontal structural irregularities and 5 types of vertical structural irregularities (Table 5). These irregularity types are expressed with figures to make understanding easier.

Table 5. Structural irregularity according to BIS-2002 standards.

Horizontal Structural Irregularities	Vertical Structural Irregularities
1. Torsional Irregularity	1a.Soft Floor Irregularity
	1b.Excessive Soft Floor Irregularity
2. Indented Corner Irregularity	2. Mass Irregularity
3. Diaphragm Discontinuity Irregularity	3. Vertical Geometric Irregularity
4. Out-of-Plane Discontinuity	4. Vertical In-Plane Discontinuity
5. Non-Parallel System Disorder	5. Discontinuity in Capacity - Weak Floor Irregularity

Horizontal structural irregularities

Torsional irregularity: It is accepted that torsional irregularity occurs when the maximum storey drift at one end of the transverse axis of the structure where the storey drift occurs is 1.2 times greater than the average storey drift occurring on the axis (Figure 24) (BIS, 2002).

Indented corner irregularity: It is the irregularity seen because of the corner points in the plan of the structure being designed as indented and protruding (Figure 25). It occurs when the widths of these corner points in the structure are more than 15% of the total size of the parallel axis of the structure in the same direction (BIS, 2002).

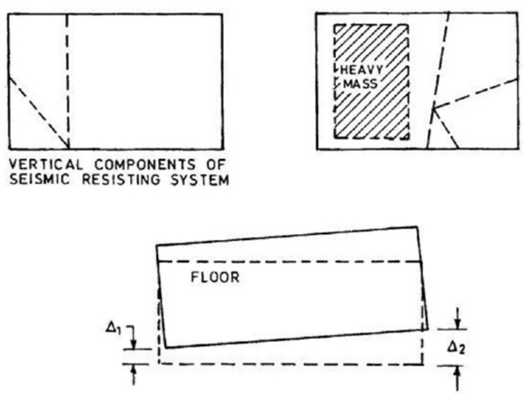


Figure 24. Torsional Irregularity (BIS, 2002).

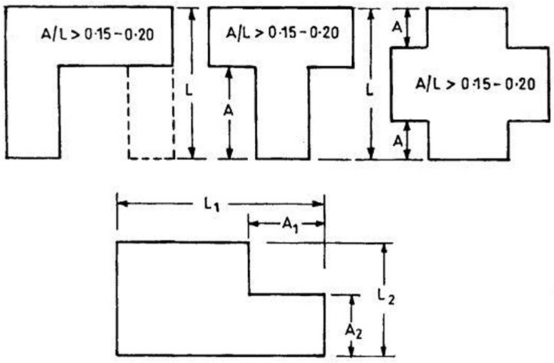


Figure 25. Indented corner irregularity (BIS, 2002).

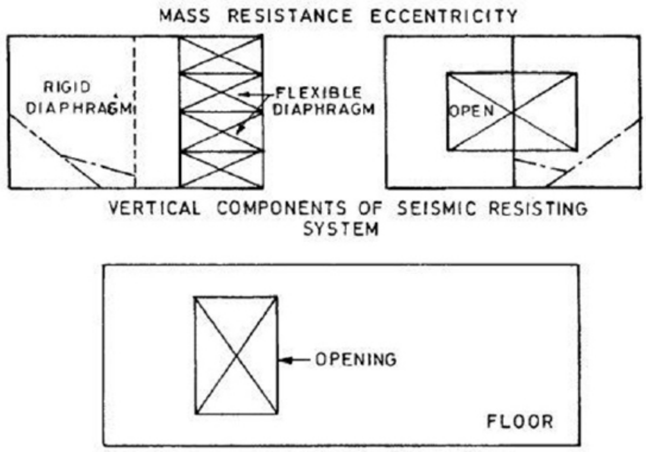
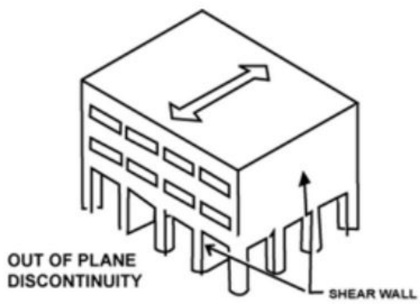


Figure 26. Diaphragm discontinuity (BIS, 2002).

***Diaphragm discontinuity*:** It is the irregularity seen when the total diaphragm openings of the structure are more than 50% of the size of the entire diaphragm area in the current plan (Figure 26). If there are 50% more openings on any floor of the structure compared to the other floors, sudden discontinuities and sudden rigidity changes occur in the structure (BIS, 2002).

Out-of-plane discontinuity: Out-of-plane discontinuity is the interruption of vertical elements in a structure due to displacement at any floor. It causes irregularity in the structure by reducing the resistance of the structure against lateral forces (Figure 27) (BIS, 2002).

Non-parallel system disorder: It occurs when some of the vertical elements that create resistance against horizontal loads in the structure are not designed parallel to the main orthogonal axes of the structure (Figure 28) (BIS, 2002).



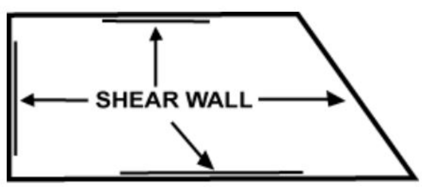


Figure 27. Out-of-plane discontinuity (BIS, 2002).

Figure 28. Non-parallel system disorder (BIS, 2002).

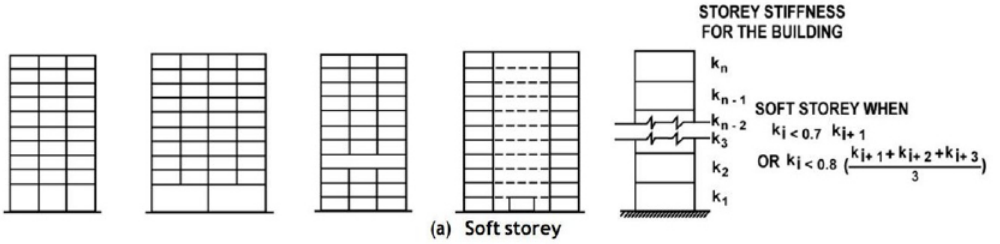


Figure 29. Soft story irregularity (BIS, 2002).

Vertical structural irregularities

Soft floor irregularity: Soft storey irregularity occurs when the lateral stiffness of any storey in the structure is 70% less than the lateral stiffness of the storey above it or 80% less than the average lateral stiffness of the three flats above it (Figure 29) (BIS, 2002).

***Excessive soft floor irregularity*:** Excessive soft story irregularity occurs when the lateral stiffness of any floor in the structure is less than 60% of the lateral stiffness of the floor above it or less than 70% of the average lateral stiffness of the three floors above it. Stilts buildings are considered in the category of buildings with excessive soft story irregularity (BIS, 2002).

Mass irregularity: Mass irregularity occurs when the weight of any floor in the building is more than twice the weight of the adjacent floors. Attics are excluded from this irregularity (Figure 30) (BIS, 2002).

Vertical geometric irregularity: In buildings where recessions and projections are seen on some floors of the building, vertical geometric irregularities are seen depending on the ratio of these recessions and projections. This type of irregularity is found in different proportions in different building forms (Figure 31). It occurs when the ratio of the horizontal dimension of the system to resist lateral forces such as earthquake forces on any floor of the building is 1.5 times greater than the ratio on the neighbouring floors (BIS, 2002).

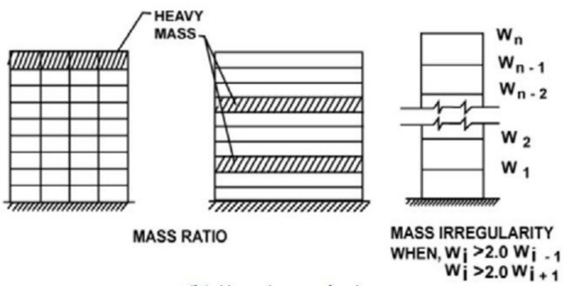


Figure 30. Mass irregularity (BIS, 2002).

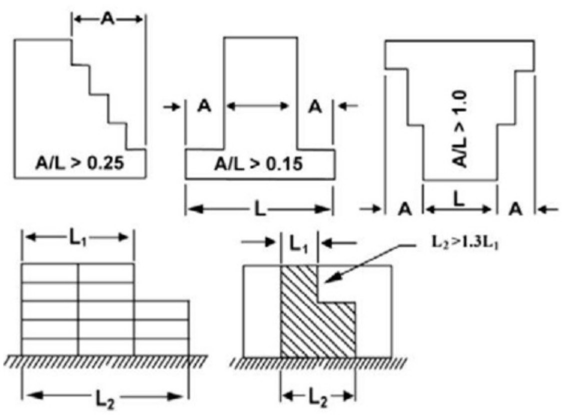
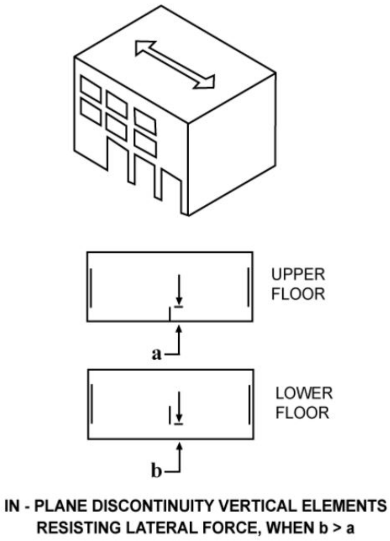


Figure 31. Vertical geometric irregularity (BIS, 2002).



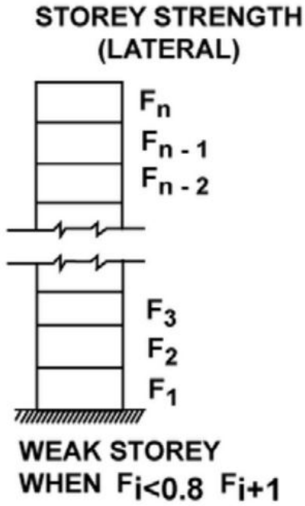


Figure 32. Vertical in-plane discontinuity (BIS, 2002).

Figure 33. Weak floor irregularity (BIS, 2002).

In-plane discontinuity in vertical: If the element resisting the lateral force on any floor of the building is displaced in-plane more than its own length on the upper floor, an in-plane discontinuity occurs vertically, creating irregularity (Figure 32) (BIS, 2002).

Weak floor irregularity: Weak floor irregularity is observed in floors where the lateral resistance strength of any floor of the building is 80% less than the lateral resistance strength of the floor above it (Figure 33) (BIS, 2002).

Argentine INPRES-CIRSOC 103 Regulation (Reglamento argentino para construcciones semi-resistantes) Argentine Regulations for Earthquake-Resistant Structures

Argentina is one of the countries located in the southernmost part of the South American continent. It is neighboring countries such as Chile, Uruguay and Brazil, and has a coastline on the Atlantic Ocean. The world's largest active volcano and some mountains with high seismic energy form the borders of Argentina and Chile. As a result of major earthquakes that occurred in both neighbouring countries and Argentina, the INPRES-CIRSOC 103 regulation was prepared and entered into force (URL 2).

As can be understood from the abbreviations in the name of the Argentine INPRES-CIRSOC 103 regulation, it was prepared by the INPRES (Instituto Nacional de Prevención Sísmica) National Institute for Seismic Prevention and the CIRSOC (Centro de Investigación de los Reglamentos Nacionales de Seguridad para las Obras Civiles) National Safety Regulations Research Centre for Civil Works, and was approved by the INTI (Instituto Nacional de Tecnología Industrial) National Institute of Industrial Technology and entered into force in 2018 (INTI, 2024).

The purpose of publishing the INPRES-CIRSOC 103 regulation is to guide designers in many areas such as the design of earthquake-resistant structures, details of controls and examinations in the implementation of projects, calculation and explanations of new design spectra, and traditional structural analysis methods. The regulation is divided into sections according to the types of materials used in structures (Table 6) (INPRES-CIRSOC 103, 2018).

Irregularities in the Plan	Vertical Irregularities
1. Torsional Irregularity	1. Stiffness Irregularity
2. Orthogonality or Symmetry of Resisting Elements	2. Mass Irregularity
3. Discontinuity of Durable Elements	3. Irregularity of Horizontal Dimensions
	4. Vertical Irregularity of Resistive Elements
	5. Lateral Strength Irregularity

Table 6. Structural irregularity according to INPRES-CIRCOS 103 standards.

Horizontal structural irregularities

Torsional irregularity: In complex structures, it is quite difficult to make the centre of rigidity coincide with the centre of mass at each level of the structure. For this reason, the sections of the structure are not subject to equal floor drifts under lateral loads. Calculations are made by taking the average of the maximum floor drift occurring at a corner point on the axis of the structure and the minimum floor drift occurring at the other corner point. If the maximum floor drift occurring in the structure is 1.2 times more than the average floor drift, irregularity occurs. If the maximum floor drift is 1.4 times more than the average floor drift, extreme irregularity occurs in the structure (Figure 34). In a regular structure, the maximum floor drift has a value less than 1.2 times the average floor drift (INPRES-CIRSOC 103, 2018).

Orthogonal and symmetric irregularity of resistant elements: In cases where the durable elements in the structure are not designed orthogonally or symmetrically in accordance with the form of the structure, it is very difficult to predict how the structure will behave under earthquake forces. If the movements of the structure in its two-way axis do not oscillate in a certain balance, the structure will cause great damage in the event of an earthquake (Figure 35). All parts of the structure should be designed to be sufficiently flexible and sufficiently rigid (INPRES-CIRSOC 103, 2018).

Discontinuity of durable elements: This irregularity occurs when the durable element located on any floor of the structure is not coplanar on other floors (Figure 36). It is the situation where the elements that should continue continuously on each floor are interrupted due to changes made in the plan of the structure for special situations. The displacements affect the ductility and rigidity of the structure. The parallel translation of the E1 element expressed in the figure by the distance d1 to its existing plane and the regression of the E2 element by the distance d2 in its existing plane are explained (INPRES-CIRSOC 103, 2018).

Vertical structural irregularities

Stiffness irregularity: In cases where the floor height level of any floor in the structure is different from the floor height level of the neighbouring floors, irregularity is observed. When the literature is examined, this concept, which was previously used as the concept of ground rigidity, was mentioned in the INPRES-CIRSOC 103 regulation as causing the static system of the structure to deform due to the

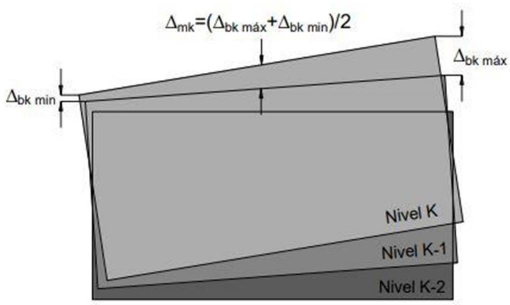


Figure 34. Torsional irregularity (INPRES-CIRSOC 103, 2018).

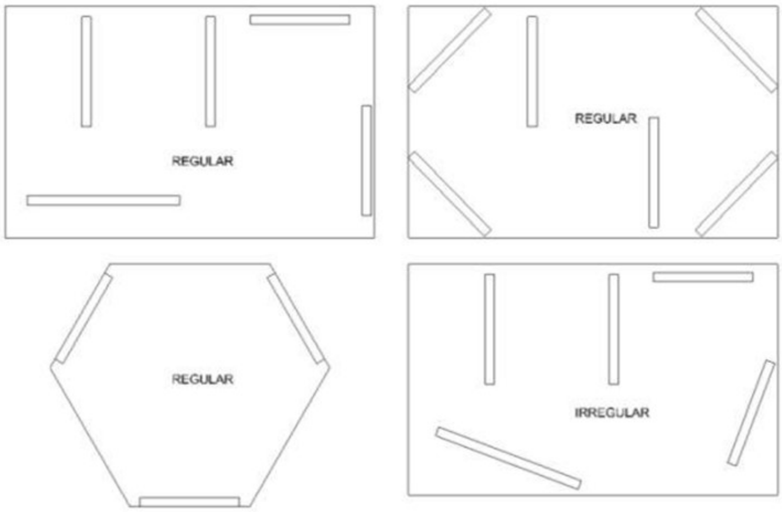


Figure 35. Orthogonal and symmetric irregularity of resistant elements (INPRES-CIRSOC 103, 2018)..

relative displacement of adjacent floors. It has been identified with these two situations. First, the system behaviour of the entire structure, not just a section, should be considered, and second, the difficulty of evaluating the rigidity of the floor element, which is a strong connection between the floors encountered in compartmental structures, which are mostly preferred in Argentina. If the ratio of the rigidity of any floor of the structure to the rigidity of the adjacent floor is more than 1.4 times, rigidity irregularity is observed in that structure. If the ratio of the rigidity of any floor of the structure to the rigidity of the adjacent floor is more than 1.7 times, excessive rigidity irregularity is observed in that structure (Figure 37) (INPRES-CIRSOC 103, 2018).

Mass irregularity: If the ratio of the mass of any floor of the building to the mass of the neighbouring floors is less than 0.7 times or more than 1.3 times, a mass irregular situation occurs (Figure 38) (INPRES-CIRSOC 103, 2018).

Irregularity of horizontal dimensions: This irregularity is due to the difference in the dimensions of the carrier system rather than the physical dimensions of the structure (Figure 39). The difference in the distances between the carrier system elements causes the structure to buckle under lateral loads. The failure to provide continuity of plan on each floor of the structure vertically causes this irregularity (INPRES-CIRSOC 103, 2018).

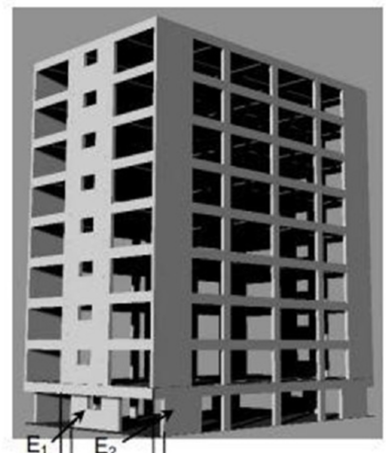


Figure 36. Discontinuity of resistant elements (INPRES-CIRSOC 103, 2018)..

DEPARCH VOL.4 ISSUE.2 | AUTUMN 2025 | DOI: 10.63673/DepArch.2025.43

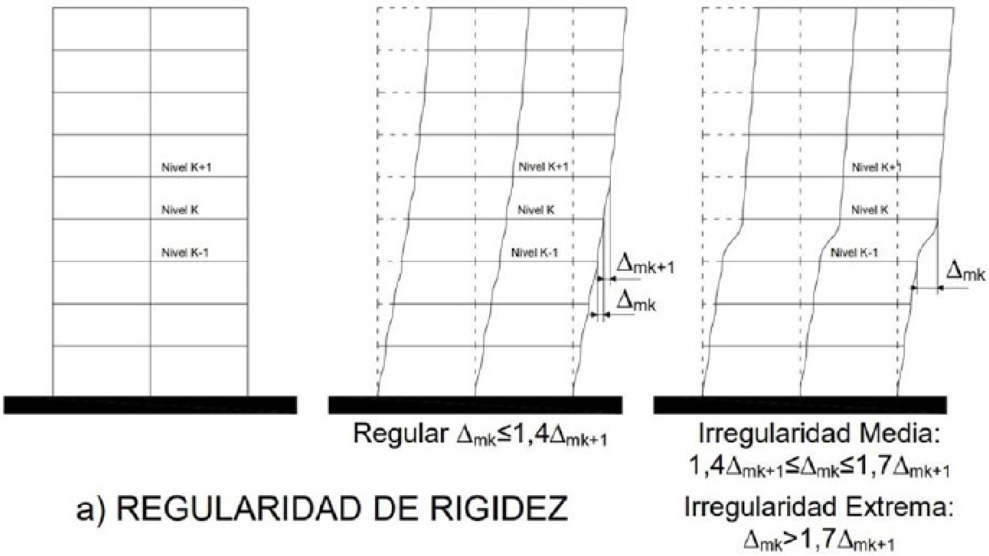
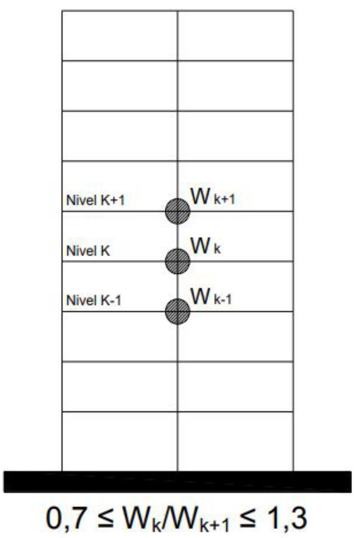


Figure 37. Stiffness irregularity (INPRES-CIRSOC 103, 2018).

Vertical irregularity of resistive elements: This irregularity is mainly due to two reasons. The first of these occurs when the dimensions of the elements considered as resistant elements do not continue in the same way in each floor plan (Figure 40). The decrease in the dimensions of these elements as they go up in the vertical direction can be accepted at certain rates, but irregularity occurs when their dimensions increase as they go up from the foundation. Another issue that creates irregularity is that the plane of the vertical elements in the plan is not designed along the same direction in each floor of the structure. If there is a translational movement in the structure greater than the length of the element itself, irregularity occurs (INPRES-CIRSOC 103, 2018).

Lateral strength irregularity: The lateral strength of the structure creates resistance to shear stress. In structures with irregular lateral strength, inflexible, weak floors and some ground problems occur (Figure 41). The lateral strength of each floor is the sum of the shear strength of the load-bearing elements. For this reason, the presence of different lateral strengths in different floors in the structure creates irregularities (INPRES-CIRSOC 103, 2018).



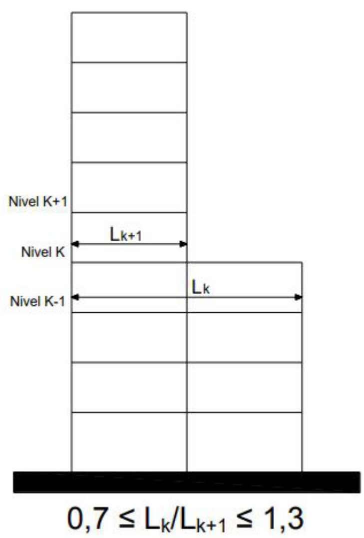
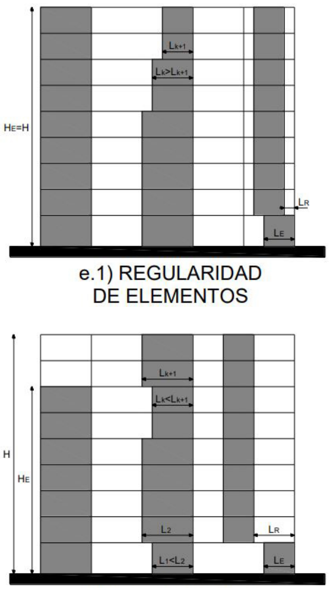


Figure 38. Mass irregularity (INPRES-CIRSOC 103, 2018).

Figure 39. Irregularity of horizontal dimensions (INPRES-CIRSOC 103, 2018).



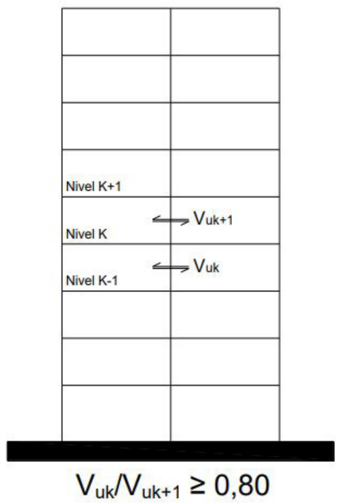


Figure 40. Vertical irregularity of resistive elements (INPRES-CIRSOC 103, 2018).

Figure 41. Lateral strength irregularity (INPRES-CIRSOC 103, 2018).

RESULTS AND DISCUSSION

In the study, the structural irregularity types included in the earthquake regulations of five countries located in different regions and different earthquake zones were examined. By selecting countries located in different earthquake zones, it was aimed to understand the approach of countries that are far from each other to structural irregularities and to easily distinguish the differences and similarities in this regard. The status of the types of irregularities in the plan (horizontal) included in the earthquake regulations of the countries is given in Table 7.

Table 7. The status of the types of irregularities in the plan (horizontal) included in the earthquake regulations of the countries.

Irregularities in the Plan	Türkiye	America	Mexican	India	Argentina
Torsional Irregularity	✓	✓	✓	✓	✓
Extreme (Strong) Torsional Irregularity	X	✓	✓	X	X
Indented Corner Irregularity	X	✓	X	✓	X
Diaphragm Discontinuity	✓	✓	✓	✓	X
Out-of-Plane Offset Irregularity	X	✓	X	✓	X
Non-Parallel Systems	X	✓	X	✓	X
Disorder Due to Excessive Flexibility in the Diaphragm	X	X	✓	X	X
Presence of Protrusions in the Plan	✓	X	✓	X	X
Resistant elements are not orthogonal or symmetrical	X	X	X	X	✓
Discontinuity of durable elements	X	X	X	X	✓

When the definitions in the earthquake codes of the countries are analysed in terms of structural irregularities in the plan, it is understood that the Indian Code BIS-2002 standards and the American Code ASCE/SEI 7-22 are more similar than the other countries. Torsional irregularity is the only irregularity type that is included in all the countries whose earthquake codes are examined. However, extreme (strong) torsional irregularity is only included in the American and Mexican codes. The status of the vertical structural irregularity types in the earthquake codes of the countries is given in Table 8.

Vertical Irregularities	Türkiye	America	Mexican	India	Argentina
Soft Floor Irregularity	✓	✓	X	✓	X
Extreme Soft Floor Irregularity	X	✓	X	✓	X
Weight (Mass) Irregularity	X	✓	X	✓	✓
Stiffness Irregularity	X	X	X	X	✓
Vertical Geometric Irregularity	X	✓	✓	✓	X
Discontinuity/Irregularity in Vertical Bearing Element	✓	✓	X	✓	X
Weak Floor	✓	✓	X	✓	X
Extremely Weak Floor	X	✓	X	X	X
Irregularity Due to Sudden Decreases in Lateral Stiffness	X	X	✓	X	X
Strong Irregularity Due to Sudden Decrease in Lateral Stiffness	X	X	✓	X	X
Lateral Resistance Irregularity	X	X	X	X	✓
Irregularity of Horizontal Dimensions	X	X	X	X	✓

Table 8. The status of the vertical structural irregularity types in the earthquake codes of the countries.

Regulations	Country	Structural Irregularities in the Plan	Structural Irregularities in Vertical
TBDY-2018	Türkiye	A1 – Torsional Irregularity A2 – Floor Discontinuities A3 – Presence of Protrusions in the Plan	B1 – Strength Irregularity Between Adjacent Floors (Weak Floor) B2 – Stiffness Irregularity Between Adjacent Floors (Soft Storey) B3 – Discontinuity of Vertical Elements of the Carrier System:
ASCE/SEI 7-22	America	1a. Torsional Irregularity 1b. Excessive torsional irregularity 2. Indented Corner Irregularity 3. Diaphragm Discontinuity Irregularity 4. Out-of-Plane Offset Irregularity 5. Non-Parallel System Disorder	1a. Stiffness-Soft Story Irregularity 1b. Stiffness-Excessive Soft Story Irregularity 2. Weight (Mass) Irregularity 3. Vertical Geometric Irregularity 4. In-Plane Discontinuity in Vertical Lateral Force Resisting Element 5a. Discontinuity in Lateral Strength - Weak Story 5b. Excessive Discontinuity in Lateral Strength - Excessively Weak Story
NTC-2023	Mexican	1. Torsional Irregularity 2. Strong Torsional Irregularity 3. Irregularity of plan geometric shape 4. Irregularity due to excessive flexibility in the diaphragm 5.Diaphragm discontinuity	1. Irregularity resulting from geometric reductions in height 2. Irregularity due to sudden decreases in lateral stiffness 3. Strong irregularity due to sudden decrease in lateral stiffness
BIS-2002	India	i. Torsional Irregularity ii. Indented Corner Irregularity iii. Diaphragm Discontinuity iv. Out-of-Plane Offset Irregularity v. Non-Parallel System Irregularity	ia Stiffness Irregularity -Soft Story ib Stiffness Irregularity -Excessive Soft Story ii. Mass irregularity iii. Vertical Geometric Irregularity iv. In-Plane Discontinuity in Vertical Lateral Force Resisting Element v. Capacity Discontinuity-Weak Floor
INPRES-CIRSOC 103		1. Torsional Irregularity 2. Discontinuity of durable elements 3. Resistant elements are not orthogonal or symmetrical.	1. Stiffness Irregularity 2. Mass irregularity 3. Irregularity of horizontal dimensions 4. Vertical configuration of durable elements 5. Lateral resistance irregularity

Table 9. The irregular definitions in the earthquake codes.

When the definitions of countries in earthquake regulations are analysed in terms of vertical structural irregularity types, the closest regulations to each other, just like the irregularity types in the plan, are the Indian Regulation BIS-2002 standards and the American Regulation ASCE/SEI 7-22. When the earthquake code of Argentina, which is in the South American continent, is analysed, there are different definitions compared to other countries. Soft story irregularity and weak story irregularity are defined similarly in the earthquake codes of Turkey, USA and India. The types of structural irregularities in the earthquake codes of Turkey, USA, Mexico, India and Argentina are explained in detail with both tables and visuals. The irregular definitions in the earthquake codes of these countries are given in Table 9.

Some irregularity definitions are similar, and some are different in the regulations of the countries examined. These similarities and differences arise from the characteristics of the geographical regions of the countries, architectural design traditions, proximity to active fault lines in the earthquake zone, and construction technologies used. The selection of the countries whose earthquake regulations were examined, other than Turkey, was determined according to the visually descriptive expression of the subject of structural irregularities.

CONCLUSIONS

Since earthquakes are unpredictable and unpredictable natural disasters, precautions against earthquakes are of vital importance. In all countries, the institutions that prepare and supervise earthquake standards must check whether designs comply with the regulations are made in the construction sector during the implementation phase. Irregular structures should be revised as much as possible during the design process and made regular. After implementation, making the structure earthquake resistant become much more negative both economically, in terms of time loss and workload.

Structural irregularities are one of the most important issues to consider during the design phase of a structure for earthquake-resistant design. Regular structures have a lower rate of damage during an earthquake compared to irregular structures. It is often unpredictable how irregular structures will behave during an earthquake. Implementing structural designs that comply with the standards given in earthquake regulations ensures less loss of life and property. Architectural design errors cannot be corrected with numerical calculations, so it is essential to be aware of the need to design earthquake-resistant structures from the initial stages of design. Earthquake-resistant design awareness should be incorporated into architectural education, and criminal penalties should be imposed for application faults that prevent buildings from being constructed. All earthquakes that have occurred show that searching for someone to blame after buildings have collapsed and so many lives and property have been lost does not bring about a solution. What needs to be done is to take the necessary precautions in advance and impose deterrent penalties.

Conflict of Interest:
No conflict of interest was declared by the authors.

Financial Disclosure:
The authors declared that this study has received no financial support.

Ethics Commitee Approval:
Ethics committee approval was not required for this article.

Legal Public/Private Permissions:
This research does not include surveys, in-depth interviews, focus group discussions, observations or experiments.

REFERENCES

American Society of Civil Engineers (ASCE). (2022). *Minimum design loads for buildings and other structures (ASCE/SEI 7-22)*. Structural Engineering Institute.

Bureau of Indian Standards (BIS). (2002). *Criteria for earthquake resistant design of structures: Part 1 – General provisions and buildings (Fifth revision) (IS 1893 Part 1)*. Bureau of Indian Standards.

Bıçakçı, N., & Karakayalı, O. (2022). Depremler ve medikal etkileri. *Anatolian Journal of Emergency Medicine, 5*(4), 203–208. https://doi.org/10.54996/anatolianjem.1223561

Darılmaz, K. (2014). *Depreme dayanıklı betonarme binaların tasarımına giriş*. DMK Yayınları.

Döndüren, M. S., & Nakipoğlu, A. (2016). Farklı ülkelerin deprem yönetmeliklerine göre taşıyıcı sistem düzensizliklerinin karşılaştırılması. *Selçuk University Journal of Engineering Sciences, 15*(3), 15–24.

Euronews. (2024, October 10). *Dünya tarihinin en şiddetli 10 depremi nerelerde yaşandı.* https://tr.euronews.com/2023/02/28/dunya-tarihinin-en-siddetli-10-depremi-nerelerde-yasandi

Federal Emergency Management Agency (FEMA). (2020). *NEHRP recommended seismic provisions for new buildings and other structures (Vol. 1: Part 1 Provisions, Part 2 Commentary) (FEMA-2082-1)*. National Institute of Building Sciences, Building Seismic Safety Council.

Federal Emergency Management Agency (FEMA). (2022). *Earthquake-resistant design concepts: An introduction to seismic provisions for new buildings* (2nd ed., FEMA P-749). National Institute of Building Sciences, Building Seismic Safety Council.

Instituto Nacional de Prevención Sísmica (INPRES) & Centro de Investigación de los Reglamentos Nacionales de Seguridad para las Obras Civiles (CIRSOC). (2018). *Comentarios al reglamento argentino para construcciones sismorresistentes: Parte I – Construcciones en general*. Instituto Nacional de Tecnología Industrial.

Instituto Nacional de Tecnología Industrial (INTI). (2024, November 25). *CIRSOC reglamentos*. https://www.argentina.gob.ar/inti

International Association for Earthquake Engineering (IAEE). (2024, November 20). *Regulations for seismic design – A world list*. http://www.iaee.or.jp/worldlist.html

İlerisoy, Z. Y. (2019). Discussion of the structural irregularities in the plan for architectural design within the scope of earthquake codes. *Periodica Polytechnica Architecture, 50*(1), 50–62. https://doi.org/10.3311/PPar.13040

Karasu, A. (2015). *Betonarme bir yapının Türk, Avrupa ve Amerikan yönetmeliklerine göre tasarımı.* [Yüksek lisans tezi, İstanbul Teknik Üniversitesi].

NTC-DCEA. (2017). *Normas técnicas complementarias para diseño y construcción de estructuras de acero. Gaceta Oficial de la Ciudad de México*, 220 Bis, 107–371.

NTC-DCEC, (2023). *Normas Técnicas Complementarias para Diseño y Construcción de Estructuras de Concreto. Gaceta Oficial de la Ciudad de México*, 220 Bis, 372- 566.

NTC-PDPS, (2023). Normas Técnicas Complementarias para Diseño Por Sismo.

T.C. Afet ve Acil Durum Yönetimi Başkanlığı (AFAD). (2018). *Türkiye bina deprem yönetmeliği*. Afet ve Acil Durum Yönetimi Başkanlığı.

URL 1: Parlak, A. (2011, 10 Kasım). World earthquake map, https://parlakayse.wordpress.com/dunya-deprem-haritasi/ (Access Date: 10.10.2024)

URL 2: ICC (International Code Council), (2024, 20 Kasım). Codes and Standards. https://www.iccsafe.org/

BIOGRAPHY OF AUTHORS

Aslı Akdemir, started her undergraduate education in 2018 and graduated from Niğde Ömer Halisdemir University, Faculty of Architecture, Department of Architecture in 2022 as the 2nd in the faculty. In 2022, she started her master's degree in building physics at Niğde Ömer Halisdemir University. She is still continuing his education. During her education, she published papers in various national and international journals, books and congresses. Research interests: structural irregularities, earthquake resistant building design, sustainable architecture, energy efficient building design, etc.

Tuğba İnan Günaydın, graduated from the Faculty of Engineering and Architecture at Süleyman Demirel University (S.D.U) in 2007. Afterwards, she obtained a Master's degree in Architecture from İzmir Institute of Technology in 2010 and a Doctorate degree in 2016. Since 2022, she has been working as an Associate Professor at the Faculty of Architecture at Niğde Ömer Halisdemir University. She works on topics such as earthquake-resistant architectural design, structural irregularities, double-skin facades, sustainable design, and natural lighting.