Evaluation and Assessment of Existing Design Codes and Standards for Building Construction: A State of the Art

Diman N. Abdulqader and Dawood S. Atrushi

Department of Civil Engineering, College of Engineering, University of Duhok, Duhok, Kurdistan Region – F.R. Iraq

Abstract—**Building design codes (BDC) are used to control the construction industry in general and building design in particular. The BDC offers the construction sector with a standard language and set of requirements. There are several BDCs developed and utilized for construction purposes throughout the world. Certain design codes are employed in structural design to assure the structure's health and safety, as well as its cost-effectiveness. It also assures that the structure is sufficiently sturdy to endure all potential climatic conditions, bear its intended load, and is integrated to ensure effective use of building materials and resources. This research aims to compare various building construction design codes to identify and explore the most appropriate standard in terms of safe design, economics, and availability of details. In Kurdistan and different parts of Iraq, many international companies have designed building structures with various codes during the past 20 years. This is a bad condition since the government has no control over the construction of the buildings, which includes both the code and the building materials. There is currently no overview of the design codes in use in Kurdistan, nor is it clear whether they are congruent with what students' study in institutions.**

Index Terms—**Building design codes, Codal comparison, Comparative analysis, Specification and standards.**

I. Introduction

There is a scarcity of land globally due to the continued usage of landmass and the expanding population. The majority of the world's population lives in major cities. When building development grows, several criteria must be met, including the capacity to safely endure earthquake loads, counteract wind loads, and preserve structural stability (O'Bannon, 1973), in other words, the structure must be in balance throughout the forces operating on it (Koti, 2017). Several international and national standards are created and implemented in general building design to ensure life safety and damage reduction. Many nations have developed seismic criteria and compared them to international counterparts to analyze and quantify the discrepancies (Nahhas, 2011; Marino, Nakashima and Mosalam, 2005; Fenwick, Lau and Davidson, 2002; Noor, Ansari and Seraj, 1997; McIntosh and Pezeshk, 1997).

Natural catastrophes such as earthquakes, landslides, tsunamis, and fires create significant damage by demolishing structures, interrupting transportation networks, and killing or trapping people and animals, among other things. Recent earthquakes in densely populated areas have revealed that existing structures built without seismic resistance are a major source of danger and the cause of the vast majority of casualties (Varum, 2003). Natural disasters like this pose a hazard to development (Ben-Joseph, 2012). Civil engineers, on the other hand, as designers, may be able to help mitigate damage by appropriately constructing structures or making other value judgments. This includes an understanding of the behavior of the construction and structural materials, of earthquakes, and the extent to which structural engineers utilize their knowledge to make appropriate decisions when constructing reinforced concrete structures (TQ and Given, 2017).

Reinforced concrete has earned a unique spot in the current construction of a variety of structures because of its numerous advantages as a composite material. It has mainly replaced prior materials such as stone, wood, and other natural elements due to its form flexibility and superior performance. It also plays an important role in structural structures such as multistorey frames, bridges, and foundations, among others. With the rapid growth of urban populations in both developed countries and emerging, reinforced concrete has become a popular option for residential construction (Bhavsar, et al., 2014).

Design strategies must merge in the era of globalization to produce structures with a constant risk of sustaining a specified level of damage or collapsing (Singh, Khose and Lang, 2012; Canisius, Baker and Diamantidis, 2011). It has been revealed that the design of high structures in seismically active areas differs significantly by region, with some countries requiring detailed performance-based studies and others requiring only a basic design based on force reduction factors. Moving on, each country has developed its own set of standards for creating safe structures according to

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Corresponding author's e-mail: diman.abdulqader@uod.ac

its own experiences with construction methods, nature, and materials since the dawn of time (Keeler and Vaidya, 2016; Australia, 2012). Buildings are constructed in accordance with the national design and seismic standards. All seismic code structural engineering designs must be based on ideal mechanics assumptions. These necessary codes must be experimentally validated, as well as rational, reasonable, and effective. These codes must be updated on a regular basis (Wagh, Narkhede and Salunke, 2018).

Structural design indicates to the precise calculation of type, size, materials, and the appropriate configuration until a comprehensive drawing is generated (Mosley, Hulse and Bungey, 2012; OBrien and Dixon, 1995) that can bear loads in a safe and serviceable manner (Oyenuga, 2011). All aspects of the structure, for example, the beam, slab, column, foundation, and roof, are designed (Nwofor, Sule and Eme, 2015). The introduction of new structural codes, design philosophies, and materials stimulates study into comparative analyses of structural design codes. Such studies give insight into the varied methods of codified structural design in various nations, indicating how much one code varies or agrees with another in terms of locally adjusted, safety, complexity, and details (Baltimore, 2009; Hitchin, 2008; Clemmensen, 2003). They are also valuable in nations where more than one code for structural design is permitted since they aid in deciding which code has a greater factor of safety than another (Tabsh, 2013; Bano, Izhar and Mumtaz,). However, most buildings across the globe have structural designs that are based on international and national norms of practice (Van der Heijden and De Jong, 2009; Liebing, 1987; Regulation, 2004). These direct the engineer's assessment of the general structural scheme, detailed analysis, and design (Allen and Iano, 2019; Billington, 1985). The codes of practice are essential tools created by knowledgeable engineers and related professionals that provide a framework for resolving concerns of structural safety and serviceability (Nwofor, Sule and Eme, 2015; Cheng, 2013; Franklina and Mensahb, 2011). Prescriptive and performance requirements are the two types of requirements that are commonly found in codes (Al-Fahad, 2012; Meijer and Visscher, 2008; Bartlett, Halverson and Shankle, 2003; Melkers and Willoughby, 1998). Differences, at times significant, might be found between the codes in the data provided for actions, in the requirements for assessing section resistance, as well as other code requirements for details, durability, and so on (Bakhoum, Mourad and Hassan, 2016).

A code is a legal document that governs a set of laws (Vaughan and Turner, 2013). A building code is a document that contains standardized rules that determine the minimum acceptable level of safety for both buildings as well as nonbuildings. Safety standards, as well as product standards, are two categories of codes (Dollet and Guéguen, 2022; Cote and Grant, 2008; Listokin and Hattis, 2005). These algorithms are based on engineers' experience, unique situations, behaviors, and experimental work. They safeguard the structures from numerous threats such as fire and structural collapse, as well as amenity concerns such as lighting, sanitation, moisture, sound insulation, and ventilation. Furthermore, codes are important instruments for accomplishing societal aims, for example, sustainability and energy efficiency, as they cover all areas of building, for instance, the use of construction materials, seismic design, electrical, structural integrity, plumbing, and safe exits. Building codes categorize structures by applying and utilizing numerous criteria; for instance, schools and business buildings are classified as separate occupation groups with varying performance requirements (Standard, 1986).

Disputes on recent construction projects frequently include extremely technical problems, complex factual scenarios, and legal problems. The ancients were interested with how the environment can be affected back thousands of years. The modern civil justice system is based on biblical principles and reflects a four-thousand-year evolution of opinions and construction knowledge that began with the development of western civilization. The Code of Hammurabi covers the earliest known principles of construction law. Hammurabi was Babylon's sixth king, reigning from 1792 BC to 1750 BC. The Hammurabi Code contained 282 laws inscribed on twelve stone tablets that were displayed in public. One of the initial written legal codes in recorded history solves construction-related problems (Heady, Currie and Llp, 2012).

The history of every organization reflects the beliefs and actions of prearranged groups inside it. These operations were a modification to suit changing conditions, and they resulted in the formation of the American Concrete Institute (ACI) (ACI, 2002). ACI's history is intertwined with the evolution of concrete technology (Committee, 2008). The joint committee on reinforced concrete was formed in 1904 and generates many drafts of the concrete code (Institute, 2011). ACI 318 criteria became the only document in the United States dealing with concrete design in 1930 (Nowak and Szerszen, 2003). The American Concrete Institute (ACI) Committee 318 Building Code Criteria for Structural Concrete (ACI-318) (Nowak and Rakoczy, 2012) specifies the design requirements for special moment frames. ACI 318 is the major document for the design of concrete buildings in the United States, and it contains the unique criteria for inspection, structural construction concrete, and design materials (Poston and Dolan, 2008; ACI Committee, 2005). It also provides the resistance parameters, load factors, and design resistance. The code applies to both prestressed and precast concrete, as well as prestressing and reinforcing steel (Standard, 2011). Furthermore, regulations apply to diaphragms and frame components that are not specified as part of the seismic force-resisting system. The multiple interconnected criteria are covered in some parts of ACI 318 (Standard, 2011), which are not always presented in a logical arrangement, making application difficult for all except the most experienced designers. The code was accepted and made legal by the IBC. The ACI 318 code is revised every 3–4 years to reflect changes in the engineering sector (Moehle, Hooper and Lubke, 2016).

According to our present understanding and information, the great majority of structures in earthquake-prone locations in Europe built before the 1980s are seismically weak. Furthermore, before the implementation of contemporary seismic-oriented design philosophies, a substantial percentage

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of extant reinforced concrete building structures were constructed before the 1970s using plain reinforcing bars (Rodrigues, et al., 2013; Rodrigues, Varum, and Costa, 2010). From 1971 through 1990, the code committee worked to acquire a draft of technical documents designated as an international investigation (Athanasopoulou, et al., 2018). For a limited number of years, this comprehensive set of coordinated Eurocodes (EC) for the geotechnical and structural design of buildings and civil engineering works was at first presented as Euronorme Voluntaire (ENV) standards, anticipated for use in conjunction with national application documents (NADs) as an alternative to national codes, for example, British code (BS8110 1997). Subsequently, Euronorme (EN) versions have approximately replaced these, with each member state of the European Union adopting a National Annex (NA) with domestically decided parameters to apply the ECs as a national standard (Reynolds, Steedman and Threlfall, 2007). Before the establishment of the Eurocodes, the British standard codes of practice were used to perform the same role as the Eurocodes, raising several problems about the disparities in building infrastructure (Nwofor, Sule and Eme, 2015). The Eurocodes are a brand-new collection of European structural design codes for buildings and all civil engineering projects. The Eurocodes were created as part of a broader European coordination process, rather than to simply replace any national codes (Shodolapo and Kenneth, 2011; Marpal, 2010; Liew, 2009; Jawad, 2006; Bond, et al., 2006; Moss and Webster, 2004; Institution, 2004).

The Eurocode framework, which includes 58 standard documents, is depicted in Fig. 1. The European code is based on the concept of limit states and contains standards for both serviceability and strength. Resistance and load factors design are the terms used to represent them. Also specified in the code are material strength reduction factors (Al-Taie, Al-Ansari and Knutsson, 2014). The relevant standards in the design of concrete structures are EC0: Basis of structural design (Gulvanessian, Calgaro and Holicky, 2012; Standard, 2002; Gulvanessian, 2001), EC1: Actions on structures (Gulvanessian, Formichi and Calgaro, 2009; Standard, 2006; Eurocode, 2006; Gulvanessian and Holický, 1996), and EC2: Design of concrete structures (Walraven, 2008; Code, 2005; Beeby and Narayanan, 2005; Standard, 2004). The goals of these ECs are to establish universal design standards and methodologies for meeting the stipulated requirements for stability, fire resistance, and mechanical resistance, regulating the construction industry as well as features of durability and economy. Furthermore, they facilitate a shared knowledge of structural design among users, owners, and operators, as well as contractors, designers, and producers of construction materials. Furthermore, they allow the trade of construction services across European Union member states and act as a single platform for construction-related research and development. Furthermore, they promote the operation of the single market by reducing impediments caused by nationally defined procedures. Furthermore, enhance the European building industry's competitiveness (Wimo, et al., 2011). The ACI and BS limit state concepts (Ultimate Design Method) are also used by EC2 (Jawad, 2006). EC2, or more specifically BS EN 1992, governs the design of structures and civil engineering works made of precast, prestressed, reinforced, and plain concrete was released in 2004 (Bisch, et al., 2012; Marpal, 2010; En, 2004). Since April 2010, EC2 has become the standard code for the design of reinforced concrete structures in the United Kingdom, and the previous BS8110-1997 (Higgins and Rogers, 1998) has been phased out (Mosley, Hulse and Bungey, 2012; Reichert, 2005).

Most Iraqi civil engineers, particularly those in the Kurdistan area, are aware of the ACI code; although, it is vital to educate them on the other recent British and European codes. Before Eurocode 2 and BS 8110 become heavily engaged in our design lives, most engineers will need to be confident that they can be used as a practical design tool. Knowledge must be expanded to include all facets of each component, as well

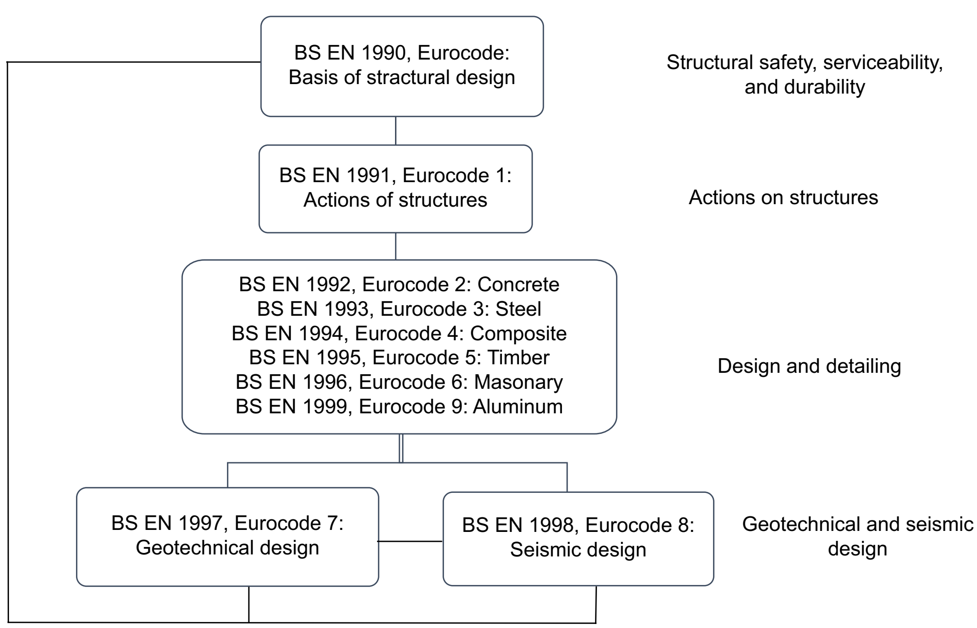

Fig. 1. Eurocodes structure, (Produced from Al-Taie, Al-Ansari and Knutsson, 2014).

as the economic and conservative outcomes. A conservative design is that design in which the designer focuses more on the loads and other predictable problems, and so makes more preventative decisions, basically to add a higher design factor of safety. Because the majority of the nations mentioned have approved and followed European Standards in the design and analysis of their structures. The objective of this paper is to explore and survey the feasibility of the existing different design codes which are utilized in the construction sector for the building purpose. By collecting data and making a review and comparison between some published works. Since the building codes affect the structure properties, materials selection, the area, natural, and economic aspects.

II. Statement of Problem

Most countries require the structural design to adhere to a single code or guideline. Reinforced concrete design, for example, is carried out by the ACI 318 code (ACI318M-11 2011) (Standard, 2011) in the United States, the CAN/CSA CSA-A23.3 (2004) (Association, 2004) standard in Canada, the Eurocode-EC2 (2002) (Beeby, Narayanan and Narayanan, 1995) in Europe, and AS3600 (2009) (Gilbert, Mickleborough, and Ranzi, 2016) in Australia. Some countries around the world, however, accept structural design based on one of several codes. The Kurdistan Region of Iraq (KRI) is one of these regions, and it allows the reinforced concrete design of building structures to adhere to either the ACI 318, the BS 8110 code (1997), or the Turkish code. Although the British Standard is being phased out in the UK owing to the introduction of Eurocode EC2, this is not the situation in the KRI, where BS 8110 is still widely utilized by a large number of consultants. The importance of the study is that for the past 20 years, many international companies have designed building structures in Kurdistan and different parts of Iraq with various codes. This is an unfortunate situation because the government has no control over the building structures, taking into account both the code and the building materials. At present, there is no overview concerning the design codes used in Kurdistan, and whether it is consistent with what students learn at the universities. Therefore, the uniqueness of this study is that this inadequate condition will be clarified by identifying the most appropriate construction design code for the region that has not been investigated yet. For reinforced concrete design, it is expected that both ACI 318 and EC2 are about equally followed. Because the design requirements of the ACI 318 and EC2 codes differ, it is necessary to analyze the structural demand in the two codes and decide which one has a greater factor of safety for a particular limit condition. Furthermore, the construction community has limited knowledge of and interest in the newly developed Eurocodes. It will take effort and time to learn how to use the new Eurocode 2. As a result, applying programming approaches to new design aspects will aid designers in the transition to new code adaptation. However, it is not obvious which design code fits the most; consequently, the research will focus on this problem, by studying this gap in design codes in the Kurdistan region.

III. Methodology

In this paper, a comprehensive literature review was done for the findings of the 43 studies of previous research relating to the comparison of building construction design codes. The researchers are taken from different websites and journals, for example, World Conference, Journal of Structural Engineering, Nigerian Journal of Technology, Journal of Engineering, Asian Journal of Civil Engineering and Applied Sciences, Structures and Materials Journal, IJCIET, Journal of Engineering and Development, IJERT, International Journal of Engineering Technology and Sciences and more. Taken from databases such as Google Scholar, Elsevier, MDPI, IEEE explore, Science Direct, Semantic scholars, Academia, and more. That their duration varied from 1992 until 2021.

There are various building construction design codes to explore and survey. Since some countries build and design their standards whereas others use international codes such as ACI, UBC, IBC, and EC. But this study aims to find out the most appropriate design code for the Kurdistan Region by reviewing and evaluating the various existing design codes as shown in Table I, and probably the need for a unified design code in Kurdistan. Furthermore, in the next section which is the result and discussion, there will be a comparison between these standards and their effect on the analysis and design process.

As shown in Table I, the review covers various design codes such as North American design codes for instance ACI (Committee, 2008), UBC (Conrad and Winkel, 1998), IBC (Code, 1997), ASCE (Vesilind, 1995), AISC (Muir and Duncan, 2011), NBC (Canada, 2015; Code, 1990), and CSA (Association, 2005), South American codes, for example, NBR (NBR, 2006), NSR (Galíndez and Thomson, 2007), CEC (Canchig Cola, 2016), and NCh (Guendelman, Saragoni and Verdugo, 2012), Asian codes such as IS (Haldar and Singh, 2009), BSLJ (Itabashi and Fukuda, 1999), NZS (Authority, 1992), BNBC (Islam, et al., 2011), NBC India (de León, 2010), NSCP (Deepshikha and Basu, 2011), ICS (Habibi and Asadi, 2013), TEC (Şengöz, 2007), OSC (Al-Sayed and Waris, 2017), ISC (Amer, Sobaih and Adel, 2016), and SBC (Shuraim, et al., 2007), European codes like EC (Gulvanessian, Calgaro and Holicky, 2012), BS (Arya, 2018), African codes such as ECP (Committee, 2007), RPA (Belazougui, 2017), and Australian code AS (Menegon, et al., 2018). The proportion of the applying building design codes of the researchers that have been studied in their researches is illustrated in Fig. 2.

Moreover, a comparison based on some parameters will be prepared, such as the details, economic aspect, base shear which is an estimate of the maximum predicted lateral stress on the structure's base as a result of seismic activity, as it is computed by using the soil material, building code lateral force, and seismic zone formulas (Davidson, 2008; Balendra, et al., 2002; Mehrabian, 1996). The displacement that is known as the lateral displacement of the story relative to the base is indicate to as story displacement. The lateral force-resisting system can reduce the building's excessive lateral displacement. Typically, the story drift ratio around the

TABLE I
A Summary of Some Findings of Previous Research Relating to the Comparison of Building Construction Design Code

S. No.	Reference	Source	Design codes	Origin	Typical model	Software used	Parameters studied	Findings of the study
1	Bose, Dubey and Yazdi, 1992	Earthquake Engineering Tenth World Conference	BSLJ, IS, NBC, NZS, UBC	Japan, India, Canada, New Zealand, United States	10-storey framed buildings	-	Details	The ratio for structural behavior coefficient of ductile performance is greatest in IS and lowest in NZS. The NZS does not offer the necessary data about the seismic hazard, hence the distribution of base shear for UBC, NBC, and NZS is more accurate.
2	Shkoukani, 1993	The First Palestinian Engineering Conference	ACI, EC	Palestine	RC rectangular beam	-	Economic	The quantity of shear reinforcement estimated by the ACI Code is less than the EC calculates. The elastic analysis moment and partial safety factors used in the EC code for loads and materials were less than those used in the ACI code.
3	Atique and Wadud, 2001	The Eighth East Asia-Pacific Conference on Structural Engineering and Construction	BNBC, UBC, NBC India	Bangladesh	A series of multistorey concrete buildings 10, 15, 20, and 25 stories	-	Base shear, Conservative	The BNBC provides the lowest value for base shears for both types of structures. BNBC and NBC-India are the least conservative, with nearly identical base shear. UBC is more conservative than both these codes. UBC is 2.61 times more conservative than the BNBC in general.
4	Fenwick, et al., 2002	Bulletin of the New Zealand Society for Earthquake Engineering	NZS, Draft NZ/Australian Loadings Standard, UBC, IBC, EC	New Zealand	A series of multistorey concrete frame buildings of 6, 12, 18, and 24 stories	SAP2000	Base shear	The required strength levels determined by the New Zealand Loadings Standard and the draft NZ/Australian Standard were significantly lower than those determined by the UBC and IBC codes of practice, and significantly lower than the comparable values in EC, but EC has the least amount of deflection. EC requires over 4.0 times and the UBC and IBC over 1.9 times, the base shear required by the NZS.
5	Moss and Webster, 2004	Journal of Structural Engineering	BS, EC	United Kingdom	-	-	Details	EC was less prescriptive and had a wider scope than BS. As a result, the use of EC would allow designs that would not ordinarily be permitted in the United Kingdom and would allow designers to profit from the significant improvements in concrete technology that had occurred.
6	Faizian and Ishiyama, 2004	World Conference on Earthquake Engineering	BSLJ, IBC, ICS	Japan, United States, Iran	-	-	Details	Although the ICS is quite close to the IBC, the BSLJ differs significantly from the other two codes. The significance of a building is addressed in the ICS and IBC but not in the BSLJ.
7	Jawad, 2006	Journal of Engineering and Development	ACI, BS, EC	Iraq	Rectangular beam section	-	Details, Economic	EC is more liberal in terms of strength design and partial safety factors than the ACI Code. In terms of design methodology, EC and BS are not very different from ACI code, but the EC and ACI Codes are more comprehensive than the BS. The ACI Code outcomes diverge on the less economical side.
8	Doğangün and Livaoğlu, 2006	Journal of Seismology	TEC, IBC, UBC, EC	Turkey	6 and 12 storey RC buildings	SAP2000	Details, Displacement, Base shear	The EC's recommendations are equally critical for the Turkish community. Even though all domains of the response spectrum are defined differently in the EC, they are not defined differently in the UBC or TEC. The maximum lateral displacement values for the buildings are given by EC, whereas the lowest values are given by UBC. For equivalent ground types listed in other codes, EC often delivers the larger base shear.

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TABLE I
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S. No.	Reference	Source	Design codes	Origin	Typical Model	Software used	Parameters studied	Findings of the study
9	Ng, Loo and Bong, 2006	6th Asia-Pacific Structural Engineering and Construction Conference (APSEC)	BS, EC	Malaysia	RC rectangular beam	-	Conservative	Both standards provide nearly identical flexural strength for reinforced beams. The requirement for ductility in beams is stricter in EC, where the maximum allowable neutral axis depth is lower than in BS. In general, BS demonstrated greater flexural strength.
10	Parisi, 2008	Practice Periodical on Structural Design and Construction	ASCE, EC	Italy	-	-	Details	By demonstrating the design philosophy, the EC aims at understanding ideas and holding up resolutions, whereas the ASCE code appears more user affable and exercise-oriented, executing the design process with comprehensive information.
11	Hawileh, Malhas and Rahman, 2009	Structural engineering and mechanics journal	ACI, EC	UAE	-	-	Conservative, Economic	The EC flexural requirements are a little more conservative, with only a slight practical variation from the ACI standards. The EC provisions have a higher safety factor than the ACI.
12	Mourad and Hassan, 2009	13th International Conference on Structural and Geotechnical Engineering (ICSGE)	ECP, EC, UBC	Egypt	Rectangular beam sections	-	Details	ECP has a lower maximum ground acceleration than UBC and EC. This might be related to the fact that EC and UBC cover an extensive variety of seismic zones that vary along a large region, but ECP lacks seismic detail. Furthermore, it may be concluded that EC limitations are stricter than UBC limits.
13	Marpal, 2010	International Journal of Engineering Technology and Sciences	BS, EC	Malaysia	RC slabs	Microsoft Excel Spreadsheet	Details	BS is usually used to influence the design of constructions in Malaysia. It has long been assumed that the design process will not change as a result of the use of EC. Also, demonstrate that this program serves the research aims of developing software to assist designers in the use of BS and EC.
14	Franklina and Mensahb, 2011	Journal of Basic and Applied Scientific Research	BS, EC	South Africa	4-storey RC building	PROKON 32	Economic	There was a virtually slight difference between BS and EC in terms of the difficulty of the calculations required or the conclusions achieved. In a continuous beam, the maximum span moments, the EC moments, are less than the BS values.
15	Imashi and Massumi, 2011	Asian Journal of Civil Engineering	ICS, IBC	Iran	12-storey building	-	Details	The findings demonstrate the importance of reviewing the Iranian seismic code and developing more suitable relations to achieve economic and functional goals. In the Iranian seismic code, shear force values are higher than in IBC.
16	Adewuyi and Franklin, 2011	Journal of Engineering and Applied Sciences	BS, EC	Nigeria	Simply supported beam	PROKON 32	Economic	The results demonstrate that the EC moments are lower than the BS values. BS estimations are usually greater in the shear force envelopes.
17	Singh, Khose and Lang, 2012	15th World Conference on Earthquake Engineering	ASCE, EC, NZS, IS	India	8-storey RC frame building	SAP2000	Base shear	The codes also differ greatly in terms of minimum design base shear. The design base shear required by EC is similar to that required by NZS but IS outcomes in the lowest design base shear for a given hazard.

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S. No.	Reference	Source	Design codes	Origin	Typical Model	Software used	Parameters studied	Findings of the study
18	Santos, Lima and Arai, 2012	Structures and Materials Journal IBRACON	EC, ASCE, South American codes (NSR, CEC, NCh, NBR)	United States	10-storey RC building	SAP2000	Displacement	In the EC consideration, the displacements achieved with this code are much lower than those produced with the other codes.
19	Xiaoguang, et al., 2012	12th World Conference on Earthquake Engineering, Lisbon.	Korea, Japan, China, Nepal, India, Indonesia, Iran, Turkey code	Korea, Japan, China, Nepal, India, Indonesia, Iran, Turkey	4-storey RC building	-	Details	The degree of seismic fortification in China and Japan is high, whereas it is lower in Turkey and Korea. Except for Korea, the seismic design code of construction has reflected the influence of site conditions. Because there is no design seismic response spectrum material in Korea's building seismic design code.
20	Landingin, et al., 2013	The Open Construction and Building Technology Journal	NSCP, EC, IBC	Portugal	4-storey RC building	SAP2000	Safe, Conservative, Details	The EC provisions were seen to be safer. According to the findings, EC was shown to be more conservative than NSCP and IBC. The EC examined the consequences of seismic activities in both directions, whereas the NSCP and IBC standards do not.
21	Tabsh, 2013	Structural Engineering and Mechanics journal	ACI, BS	UAE	Beams, slender, and columns cross-sections	-	Economic	The ACI code outcomes in larger cross-sections and higher reinforcement ratios. ACI code has a lower shear strength than BS code.
22	Alnuaimi, Patel and Al-Mohsin, 2013	Practice periodical on structural design and construction	ACI, BS	Oman	Rectangular beam sections	-	Economic	For the same design load, the BS code needs less reinforcement than the ACI code. The ACI code requires a higher minimum area of flexural reinforcement than the BS code. The minimum area of shear reinforcement needed by the ACI code is less than that required by the BS code.
23	Bhavsar, et al., 2014	International Journal of Scientific and Research Publications	IS, EC	India	8-storey RC building	ETABS	Economic	The infrastructures of Gulf nations are typically impressive since they generally follow EURO standards for building development. In EC, the area of reinforcement required in the column is less than in IS. This is due to the greater modulus of elasticity in EC. As a result, in EC, column ductility is regulated by the modulus of elasticity but IS is controlled by the area of reinforcement.
24	Itti, Pathade and Karadi, 2014	Structural Engineering Forum of India (SEFI)	IS, IBC	India	10-storey RC building	ETABS	Base shear, Displacement	IS Code buildings have a greater base shear and higher displacements than the IBC design code. The base shear of IS buildings is higher than that of IBC buildings by 26.10%. Displacements of IS are higher than that of IBC by 11.00%.
25	Chebihi and Laouami, 2014	2nd European Conference on Earthquake Engineering and Seismology	RPA, UBC, EC	Algeria	10-storey RC building	SAP2000	Base shear, Displacement	RPA results are close to those of UBC, but EC provides smaller base shears and displacements than RPA and UBC.
26	Al-Taie, Al-Ansari and Knutsson, 2014	Engineering Journal	ACI, EC	Iraq	Foundation element	STAAD Pro V8i, SAFE	Details	Eurocode allows the user additional freedom to adopt their standards. EC is preferable since it contains all design and construction standards for all types of buildings, as well as modern and traditional materials. It also includes national annex national defined parameters NDPs. As a result

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TABLE I
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S. No.	Reference	Source	Design codes	Origin	Typical Model	Software used	Parameters studied	Findings of the study
								of these factors, the Eurocode is the best international code. In the design, EC employs three ways. Materials characteristics, action loads, and soil resistance are examples of these. In addition, the code incorporates the British standards and code that are well-known in several nations throughout the world.
27	Nandi and Guha, 2014	International Journal of Engineering Research & Technology (IJERT)	IS, BS, EC	India	Slab, beam, column, and foundation element	-	Economic	The IS code allows for a larger slab area of steel than the BS and EC codes. The maximum steel beam area permitted by the EC code is greater than that permitted by the IS and BS codes. The maximum area of steel for a column is specified by the BS code rather than the IS and EC codes. Minimum steel is required for foundations following the EC regulation.
28	Nwofor, Sule and Eme, 2015	International Journal of Civil Engineering and Technology (IJCIET)	BS, EC	Nigeria	RC beam cross-section	Microsoft Excel Spreadsheet	Economic, Conservative	The EC requires less reinforcement at the spans and supports than the BS, showing that the BS requires more shear reinforcement. In comparison to EC, the BS code applies larger partial safety factors to loads at the ultimate limit state, whereas the EC is more conservative regarding partial safety factors for loadings. EC provides a more economical design with the necessary margin of safety.
29	Karthiga, et al., 2015	International Journal of Research in Engineering and Technology (IJRET)	IS, EC, ASCE, BS	India	11-storey building	STAAD Pro V8i, SAFE	Economic, Displacement	The EC standards were the most economical, whereas the Indian norms were the least economical. IS had the highest shear value during the pushover analysis. The minimum displacement as it is derived from the displacement data. In comparison to the IS, the percentage rise for EC is 22%, the ASCE percentage increase is 20%, and the BS percentage increase is 19%. As a result, buildings constructed following the IS are more rigid, attracting larger seismic forces.
30	Bakhoum, Mourad and Hassan, 2016	Journal of Advanced Research	ECP, ASCE, ACI, AISC, EC	Egypt	Beams and columns considering steel, concrete, and composite materials	-	Economic	In comparison to the EC, ACI defines lower values for the ultimate dead load factor. ECP and AISC require larger sections than EC, which is more economic by 2–10% depending upon the resistance of steel and the reinforcement ratio. In comparison to ACI and ECP, the findings reveal that for the same section dimensions, EC produces the highest axial strength.
31	Koti, 2017	International Journal for Innovative Research in Science & Technology (IJIRST)	IS, ASCE, EC	India	25-storey RC building	SAP2000	Economic	EC has more reinforcement area than other codes, therefore it is clear that the structure analyzed for IS is more rigid, whereas the structure analyzed for EC is more ductile. The drift ratio exceeds the intended limitations in the case of an IS design building due to gross section stiffness in design.
32	Nahhas, 2017	Open Journal of Earthquake Research	UBC, SBC	Saudi Arabia, USA	10-storey building	ETABS	Base shear	It is discovered that SBC base shear is higher in most sites, and the same is true for overturning moments. SBC seismic maps may be inaccurate.

(Contd...)

TABLE I
(Continued)

S. No.	Reference	Source	Design codes	Origin	Typical Model	Software used	Parameters studied	Findings of the study
33	Waris, Al-Jabri and EL-Hussain, 2017	World Conference on Earthquake (16WCEE)	OSC, UBC, IBC	Oman	Three buildings of 4, 10, and 14, storey	ETABS	Base shear, Conservative, Economic	UBC base shear values were 7.6, 4.1, and 3.2 times higher and IBC offered base shear values that were 6.3, 3.3, and 2.6 times higher than those from OSC. As compared to OSC, both UBC and IBC give relatively conservative seismic loads on structures. OSC enhances the economics of earthquake design.
34	Nwoji and Ugwu, 2017	Nigerian Journal of Technology (NIJOTECH)	BS, EC	Nigeria	2-storey building	CSC Tedds	Economic, Safe	The EC values are lower than the BS values in terms of column load and moments. The EC is more flexible, safer, and easier to use than the BS, and it will give more economical sections and is technologically more advanced.
35	Taha and Hasan, 2018	Eurasian Journal of Science and Engineering (EAJSE)	ISC 2014, ISC 1997	Kurdistan Region/Iraq	RC building consists of 5, and 15 storey	ETABS	Base shear	The ISC 2014 requirements result in a significant rise in base shear forces. As observed, ISC 1997 simply analyzes the important class of the building, but ISC 2014 bases the selection on the building irregularity and height, which is more sensible, because the dynamic behavior of the structure is connected to these two elements.
36	Wagh, Narkhede and Salunke, 2018	International Journal of Science Technology and Engineering (IJSTE)	IS, EC, NZS	India	25-storey RC frame building	ETABS	Base shear, Displacement	When compared to the EC and NZS Codes, the IS has the lowest base shear, as calculated according to EC is higher than IS by 79% whereas according to the NZS is higher than IS by 44%. The story displacements and drifts for EC are the lowest as compared to IS and NZS. The IS provides no modeling rules, leaving it up to the capabilities of individual designers.
37	Donduren and Omeed, 2018	Journal of International Environmental Application and Science	TEC, ACI, EC	Turkey	Masonry building properties	-	Details	The Turkish Code's material selection is similar to those of other standards. As observed in the Turkish code, the requirements are based on the seismic zone of the building according to its seismic location. The ACI and EC, on the other hand, base their masonry construction guidelines on the materials available for usage in the structure.
38	Gadade, et al., 2018	Resincap Journal of Science and Engineering	BNBC, ICS, EC, IS, NSCP, IBC	India	-	-	Conservative, Base shear	In comparison to other standards and procedures, BNBC is the least conservative. The Iranian seismic code is quite similar to the American code, whereas the Japanese code differs significantly from the other two codes. It was discovered that EC is more conservative than NSCP and IBC. IS Code buildings have a greater base shear than IBC Code.
39	Izhar and Dagar, 2018	International Journal of Civil Engineering and Technology (IJCIET)	IS, BS, EC, ACI, CSA	India	11-storey building	STAAD Pro V8i	Economic	Shear and flexural reinforcement are the least from the IS code and the most from the CSA. The longitudinal reinforcement for columns is the minimum from EC and the most from CSA. The longitudinal and transverse reinforcing of the slab is the least for EC and the most for ACI.

(Contd...)

TABLE I
(Continued)

S. No.	Reference	Source	Design codes	Origin	Typical Model	Software used	Parameters studied	Findings of the study
40	Al-Obaidi, Jokhio and Abu-Tair, 2019	IEEE Asia-Pacific Conference on Computer Science and Data Engineering (CSDE)	American (ASCE), Australian codes (AS)	UAE	Two buildings 70-storey RC building	ETABS	Economic, Conservative, Safe, Base shear, Details	The Australian code is considerably more economical than the American code, but because the American code is more conservative, it is more commonly used internationally among engineers. ASCE in the base shear results, which demonstrates more than AS by 15%. The ASCE is more detailed than the AS, whereas the AS is more generic, with just one time-history equation, making the Australian code safer because the structure is subject to more earthquake time.
41	Pacheco, et al., 2019	Journal of Structural Engineering	EC, ACI	Portugal	RC beams	-	Conservative, Safe	There were no major variations in the bias of the ultimate moment between the two comparison vectors of ACI versus EC requirements or recycled versus natural coarse aggregate. ACI and EC produce similar bias.
42	Rajeev, Meena and Pa(llav, 2019	Journal of Infrastructures	IS, BS, EC	India	4-storey RC framed building	SAP2000	Displacement, Economic	IS is a more secure design principle with more reserve strength. When compared to the BS and EC codes, the Indian code has a higher displacement capacity, the IS provides a 19% and 26% increase in displacement capacity compared to the BS, and EC, correspondingly. The IS appears to give more steel than the BS and EC. The quantity of steel required to comply with the IS is 40.6% and 35.1% more than the BS, and EC, correspondingly.
43	Arezoumandi, et al., 2021	Journal of Structural and Construction Engineering (JSCE)	ACI, EC, AS, BSLJ	Japan	-	-	Conservative	According to the findings of this study, ACI, EC, AS, and JSCE regulations are conservative for shear strength values of 88, 78, 95, and 100%, respectively. This demonstrates that the Japanese code relations are conservative for all data.

ACI: American Concrete Institute, EC: Euro Code, BS: British Standards, IS: Indian Standards, UBC: Uniform Building Code, IBC: International Building Code, ASCE: American Society of Civil Engineers, BSLJ: Building Standard Law of Japan, NBC: National Building Code of Canada, CSA: Canadian Standards Association, AS: Australian Standards, NZS: New Zealand Standard, BNBC: Bangladesh National Building Code, NBC India: National Building Code of India, NSCP: National Structural Code of the Philippines, ICS: Iranian Seismic code, TEC: Turkish Earthquake Code, OSC: Oman Seismic Code, ISC: Iraq Seismic Code, SBC: Saudi Building Code, ECP: Egyptian Code of Practice, RPA: Algerian Seismic Code, NBR: Brazilian National Standards, NSR: Colombian Standard, CEC: Ecuadorian Standard, NCh: Chilean Standard, AISC: American Institute of Steel Construction

building's middle level is more essential than that at the top (Lian and Wang, 2006; Pekau, Zielinski and Lin, 1995). The final parameter to be compared is the conservative parameter. Accordingly, Fig. 3 depicts the percentage of utilizing of these parameters in different research.

The studies are taken from several destinations and countries throughout the world for taking different aspects and circumstances as much as possible; their origin is illuminated in Fig. 4.

IV. Results and Discussion

For the construction, design, and operations of buildings, common language and requirements are prepared in the form of codes and standards. These documents provide the necessary guidelines for designing and constructing buildings that are safe, secure, healthy, energy-efficient, and accessible. There are several building design codes that have been produced and are in use around the world. Some conclusions can be drawn by comparing different design codes.

A. In Terms of Details

There are several outputs as a result of the obtained data. According to some research, certain existing design regulations and previously utilized standards lacked information. Bose, Dubey and Yazdi, 1992 concluded that the NZS did not give the required information regarding seismic hazards, since there were insufficient specifics in terms of seismic design and seismic zones. Mourad and Hassan, 2009 findings reveal that EC and UBC cover a wide range of seismic zones across a massive territory, whereas ECP lacks seismic detail. Furthermore, according to the conclusion of (Xiaoguang, et al., 2012), there is no design seismic response spectrum material in Korea's building seismic design code.

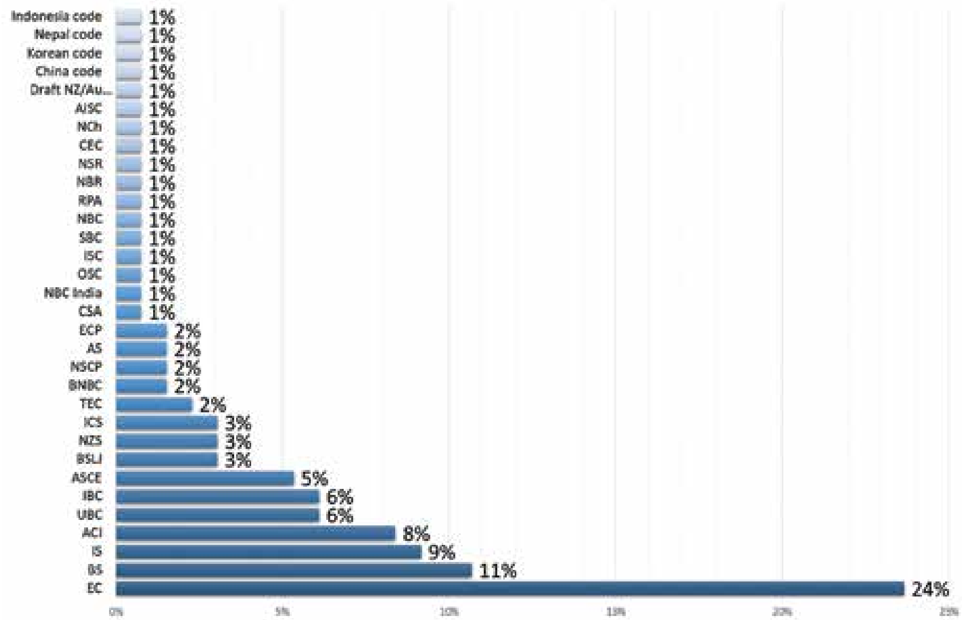

Fig. 2. The ratio of applying building design codes.

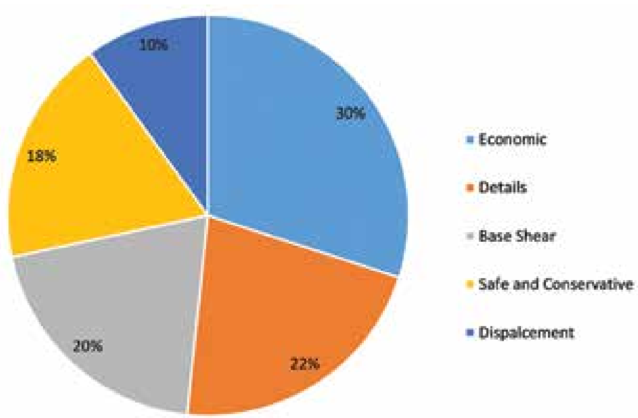

Fig. 3. The ratio of studied parameters.

Unlike (Landingin, et al., 2013) said, the EC looked at the effects of seismic events in both directions, but the NSCP and IBC regulations do not. Even though all domains of the response spectrum are defined differently in the EC, as outlined by (Doğangün and Livaoğlu, 2006) they are not defined differently in the UBC or TEC. Al-Taie, Al-Ansari and Knutsson, 2014 also argue that EC is preferable to ACI since it contains all design and construction standards for all types of buildings, as well as modern and traditional materials, and in design, EC employs three methods, including materials characteristics, action loads, and soil resistance. Donduren and Omeed, 2018 show that the EC and ACI codes' guidelines on the specifics of the materials accessible are more than TEC.

Furthermore, several studies have found that design codes, such as BS, which (Moss and Webster, 2004) presented, have a restricted reach, because EC was less restrictive and had a broader reach than BS, it allowed for designs that would not normally be authorized in the United Kingdom and allowed designers to benefit from considerable advancements in concrete technology. According to the findings of (Marpal, 2010) is frequently utilized to influence building design. In Malaysia, it is thought that BS is frequently utilized to influence construction design. It has long been considered that using EC will have little effect on the design process. Furthermore, show how this application contributes to the research goals of building tools to help designers use BS and EC. The EC and ACI codes, according to (Jawad, 2006) are more thorough than the BS. The significance of a building is addressed in the IBC and ICS, but not in the BSLJ, according to (Faizian and Ishiyama, 2004). Imashi and Massumi, 2011 findings highlight the significance of revising the Iranian seismic code and building more appropriate relationships in order to meet economic and functional objectives. And, as (Parisi, 2008) clarifies that the EC aims at understanding ideas and holding up resolutions, whereas the ASCE code appears more user affable and exercise-oriented, executing the design process with detailed information. Last of all, according to (Al-Obaidi, Jokhio and Abu-Tair, 2019) the ASCE is more detailed than the AS, whereas the AS is more general, with just one time-history equation, making the Australian code safer because the structure is exposed to greater earthquake time. Fig. 5 depicts the fraction of research lacking in details for all of these studies.

B. Economic Aspect

In terms of economics, the data demonstrate that building construction design is becoming more cost-effective. According to (Shkoukani, 1993), ACI is more economic than EC since the ACI Code estimates less shear reinforcement than the EC does. The EC codes elastic analysis moment and partial safety factors for materials and loads were lower than the ACI code. According to (Al-Obaidi, Jokhio and Abu-Tair, 2019), AS is more cost-effective than ASCE. Furthermore, according to (Koti) IS code is more economic than EC and has a larger reinforcement area than other codes. As well

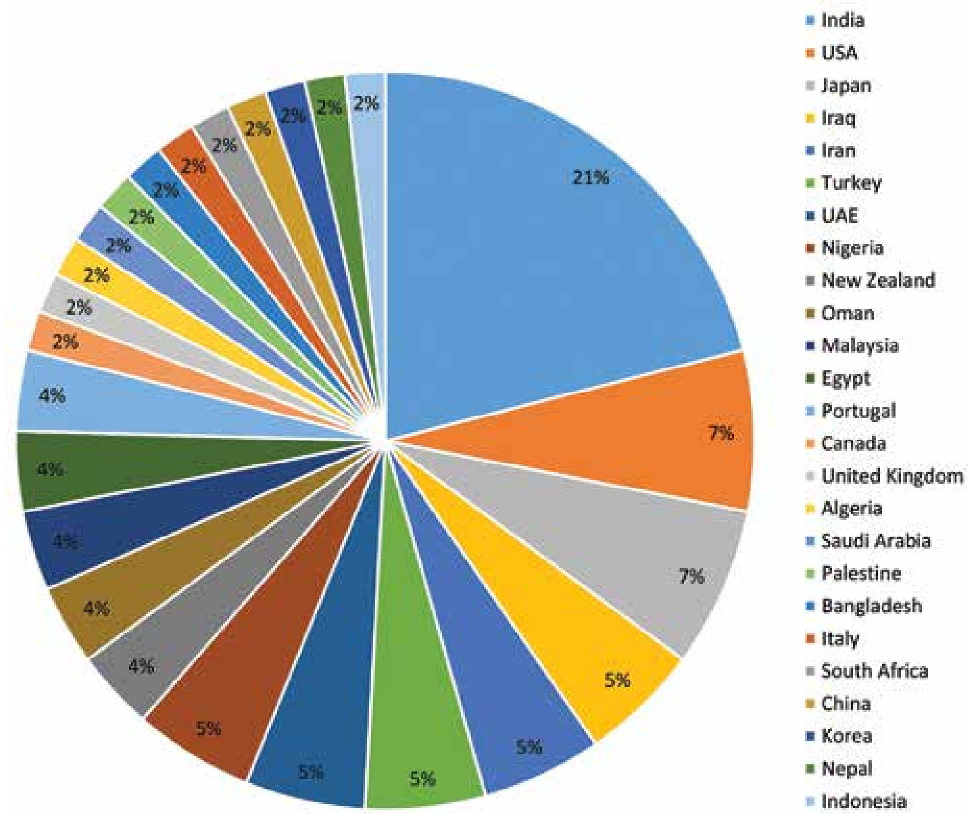

Fig. 4. The ratio of various origin.

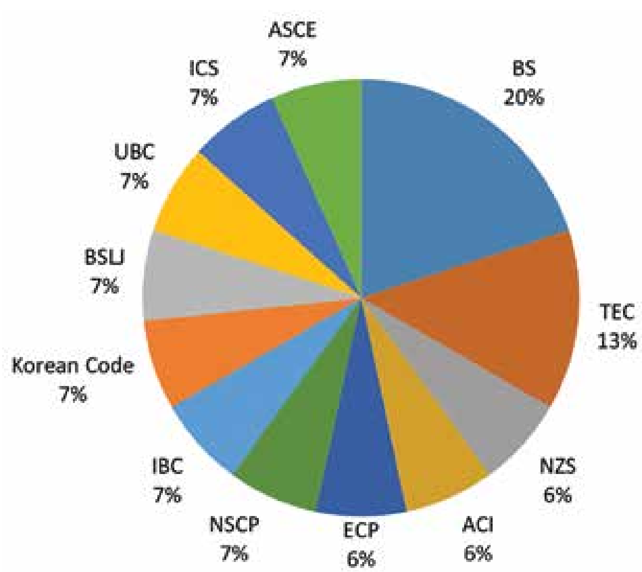

Fig. 5. The ratio of lack in details parameter.

the BS code outcomes in smaller cross-sections and lower reinforcement ratios than the ACI code as represented by (Tabsh, 2013; Alnuaimi, Patel and Al-Mohsin, 2013).

Whereas the majority of research found that EC is the most cost-effective design code. As stated by (Rajeev, Meena and Pallav, 2019; Karthiga, et al., 2015; Nandi and Guha, 2014; Bhavsar, et al., 2014). According to (Bhavsar, et al., 2014), the area of reinforcement required in the column in EC is smaller than in IS. This is owing to the fact that EC has a higher modulus of elasticity in EC. The IS code permits for a bigger slab area of steel than the BS and EC codes, whereas the EC rule requires minimum steel for foundations, as found by (Karthiga, et al., 2015; Nandi and Guha, 2014). In addition, (Rajeev, Meena and Pallav, 2019), show that the IS appears to provide more steel than the BS and EC, with the IS requiring 40.6% and 35.1% more steel than the BS and EC, respectively.

Furthermore, the results show that Eurocode is better and preferable than ACI by (Waris, Al-Jabri and EL-Hussain, 2017; Bakhoum, Mourad and Hassan, 2016; Hawileh, Malhas and Rahman, 2009; Jawad, 2006; Izhar and Dagar). Jawad, 2006 presented that the ACI Code outcomes diverge on the less economical side. According to, the EC regulations have a greater safety factor than the ACI. Bakhoum, Mourad and Hassan, 2016 illuminate that, as compared to the EC, the ECP, ACI, and AISC codes demand bigger sections than EC, which is more economic by 2–10% depending on the steel resistance and reinforcement ratio. The OSC code is based on EC, according to (Waris, Al-Jabri and EL-Hussain, 2017). As a result of both UBC and IBC, OSC improves the economics of earthquake design. Furthermore, (Izhar and Dagar, 2018) demonstrated that EC provides the least longitudinal reinforcement for columns, whereas CSA provides the highest. EC has the least longitudinal and transverse slab reinforcement, whereas ACI has the greatest. Furthermore, EC is more economic than BS as concluded by (Nwoji and Ugwu, 2017; Nwofor, Sule and Eme, 2015; Franklina and Mensahb, 2011; Adewuyi and Franklin, 2011). The EC moments are lower than the BS values as the results demonstrated by (Franklina and Mensahb, 2011; Adewuyi and Franklin, 2011). Nwofor, Sule and Eme, 2015 explain that the EC requires less reinforcement at the spans and supports than the BS, showing that the BS requires more shear reinforcement. EC provides a more economical design with the appropriate safety margin. Nwoji and Ugwu, 2017 show that in terms of column load and moments, the EC values are lower than the BS values, resulting in more economical sections. Fig. 6 depicts a summary of the most cost-effective design code.

C. In Terms of Base Shear

In terms of base shear, however, the design codes comparison yielded different findings. As a result, (Wagh, Narkhede and Salunke, 2018) indicates that the codes differ substantially in terms of minimum design base shear when compared to the EC and NZS Codes, with the IS having the lowest base shear, as determined by the EC is greater than IS by 79%, and the NZS is higher than IS by 44%. Similarly, (Singh, Khose and Lang, 2012) findings show that the codes differ significantly in terms of the minimal design base shear. EC's design base shear is identical to NZS's but IS yields the lowest design base shear for a given danger.

However, it was found by (Gadade, et al., 2018) that the IS Code buildings have a greater base shear than IBC Code. Furthermore, (Itti, Pathade and Karadi, 2014) represent that IS Code buildings have a greater base shear than IBC design code, the base Shear of IS buildings is higher than that of IBC buildings by 26.10% (Chebihi and Laouami, 2014) show that RPA outcomes are close to those of UBC, but EC provides smaller base shears than RPA and UBC. Waris, Al-Jabri and EL-Hussain, 2017 represent that UBC base shear values were 7.6, 4.1, and 3.2 times higher and IBC offered base shear values that were 6.3, 3.3, and 2.6 times higher than those from OSC which is based on EC.

The outcomes by (Doğangün and Livaoğlu, 2006) for equivalent ground types listed in other codes, EC often delivers the larger base shear. Correspondingly (Nahhas, 2017) discovered that SBC base shear is higher in most sites than UBC, and the same is true for overturning moments. SBC seismic maps may be inaccurate. Furthermore, (Taha and Hasan, 2018) observed that the ISC 2014 requirements result in a significant rise in base shear forces as compared to ISC 1997. However, (Al-Obaidi, Jokhio and Abu-Tair, 2019) stated that ASCE in the base shear results, which demonstrates more than AS by 15%. Atique and Wadud, 2001 illustrate that BNBC provides the lowest value for base shears compared to both codes UBC and NBC-India. Finally, (Fenwick, Lau and Davidson, 2002) demonstrate that EC requires up to 4.0 times, but the UBC and IBC up 1.9 times, the base shear required by the NZS.

The proportion of all these studies for the design code which provided a minimum base shear is represented in Fig. 7.

D. In Terms of Displacement

Some studies show the disparity in displacement values. As found by (Santos, Lima and Arai, 2012) in the EC consideration, the displacements achieved with this code are substantially smaller than those created with the ASCE and other South American codes such as (NSR, CEC, NCh, and NBR). As well (Chebihi and Laouami, 2014) present that EC delivers smaller displacements than RPA and UBC. Results of (Wagh, Narkhede and Salunke, 2018) display that story displacements for EC are the lowest as compared to IS and NZS. The IS provides no modeling restrictions, leaving it up to the capabilities of individual designers. However, (Itti, Pathade and Karadi, 2014) summarize that IS Code buildings have a larger displacement than IBC Code structures, with IS displacements being 11.00% higher than IBC. Apart from (Rajeev, Meena and Pallav, 2019) the Indian code IS has a larger displacement capacity than the BS and EC codes; the IS provides a 19% and 26% increase in displacement capacity, respectively, over the BS, and EC. Otherwise, (Karthiga, et al., 2015) demonstrate how the minimal displacement is calculated using displacement data. In contrast to the IS, the EC has increased by 22%, the ASCE has increased by 20%, and the BS has increased by 19%. As a result, structures built in compliance with the IS are more rigid and draw more seismic pressures. Doğangün and Livaoğlu, 2006 explain that the highest lateral displacement values for the buildings are supplied by EC, whereas the lowest values are given by UBC. Fig. 8 shows the proportion of design codes that provided minimal displacement based on all of these studies.

E. Safe and Conservative Aspects

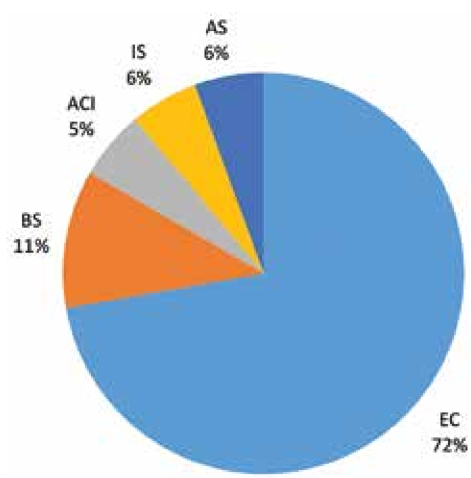

Fig. 6. The ratio of economic parameter showing the most cost-effective design code.

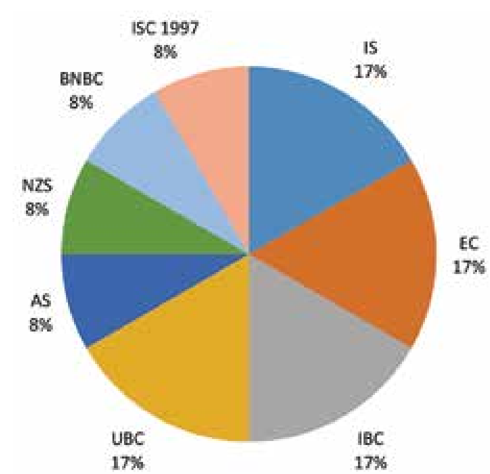

Fig. 7. The ratio of the base shear parameter.

Regarding the safe design of construction, the majority of the research concludes that Eurocode is the safest and most conservative. According to the findings of (Landingin, et al., 2013) the EC provisions were seen to be safer, and EC was shown to be more conservative than NSCP and IBC. In comparison to EC, the BS code applies larger partial safety factors to loads at the ultimate limit state, whereas the EC is more conservative in terms of partial safety factors for loadings, the EC is more flexible, the requirement for EC is stricter, and safer than the BS as discussed by (Nwoji and Ugwu, 2017; Nwofor, Sule and Eme, 2015; Ng, Loo and Bong, 2006). Likewise, (Hawileh, Malhas and Rahman, 2009) the EC code flexural requirements were revealed to be slightly more conservative, with only a little practical deviation from the ACI norms. In comparison to other standards and procedures (Gadade, et al., 2018) illuminated that BNBC is the least conservative, and discovered that EC is more conservative than NSCP, Iranian code, and IBC. In addition, (Atique and Wadud, 2001) demonstrate that BNBC and NBC-India are the least conservative, UBC is more conservative than both these codes, on average, UBC is 2.61 times more conservative than the BNBC. According to the findings of (Arezoumandi, et al., 2021) ACI, EC, AS, and BSLJ regulations are conservative for shear strength values of 88, 78, 95, and 100%, respectively. This demonstrates that the Japanese code relations are conservative for all data. But (Pacheco, et al., 2019) present that there are no major variations in the bias of the ultimate moment between the two comparison vectors of EC versus ACI requirements.

However, the results of a few of them were deduced differently. According to (Al-Obaidi, Jokhio and Abu-Tair, 2019) the American code ASCE is more conservative, and it is the most widely utilized among engineers abroad. The ASCE is more detailed and complex than the AS, whereas the AS is more generic, with just one time-history equation, making the Australian code safer because the structure is subject to more earthquake time. Finally, (Waris, Al-Jabri and EL-Hussain, 2017) add that, compared to OSC, both UBC and IBC provide structural seismic loads that are rather conservative. Fig. 9 depicts the fraction of all design codes that are the safest and most conservative.

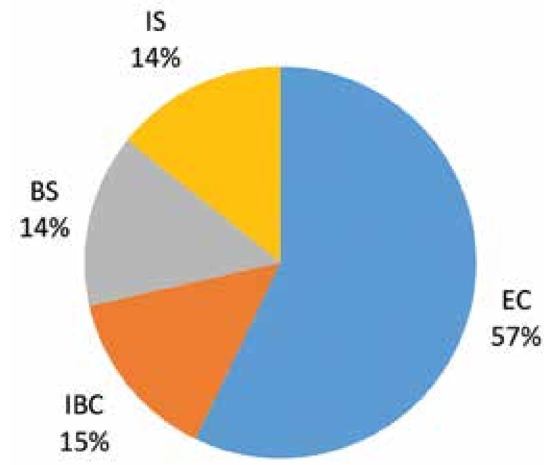

Fig. 8. The ratio of displacement parameter.

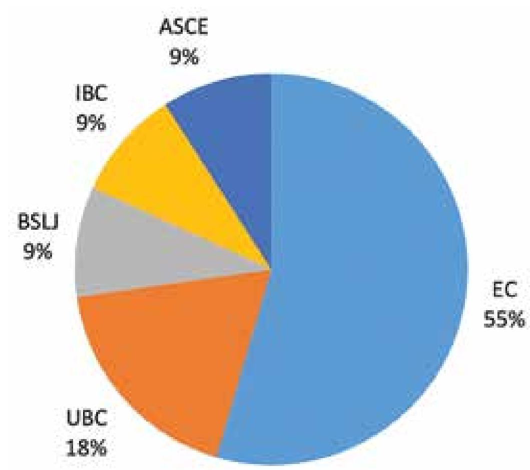

Fig. 9. The ratio of the conservative parameter.

V. Evaluation and Assessment

According to the outcomes of this study and a review of past research, this study recommends the following for future research:

1. Quality control skills should be plentiful among the stakeholders involved in any initiatives that are undertaken.
2. The site engineers must be recruited based on their understanding of the applicable design codes. Weather and environmental conditions must be taken into account, and materials must be maintained, controlled, and manufactured.
3. Defects and violations should be addressed, and appropriate social, technological, and administrative frameworks should be created and implemented.
4. The establishment of a regulatory framework is accompanied by other regulations and features. Financial, economic, and social regulations, as well as a well-functioning market and well-informed customers, are all examples. Additional research into these laws and elements may be possible.

The findings of this study would benefit the construction industry right away, allowing them to establish general properties and cost-effective solutions by utilizing the most appropriate unified construction building design code that is justified nationally and chosen as the country's most common construction regulatory. This will enable a responsive market with universal norms that protect and prioritize health and safety.

VI. Conclusion

The following conclusions were reached after extensive research on the comparison of several countries' building construction design codes:

1. There are substantial variances in construction requirements, as well as a considerable shift in structural analysis and design processes being used on structures in the KRI region. The research reported in this paper contributes to a better understanding of the significance of dealing with design codes and choosing the best one.
2. Almost every study that compared design codes in terms of detail available discovered that Eurocode is the most thorough code. Furthermore, provide all relevant information

for the analysis and design process to develop a structure in the safest and most secure manner feasible. Because it encompasses all design and construction rules for all types of buildings, as well as new and historic materials, the EC is the most sophisticated international standard and is preferred.
3. The majority of studies explored that the most economic design code is EC.
4. The findings differed in terms of the structure's base shear and displacement; however, the design codes for a minimal base shear are EC, IS, and American codes, with EC providing the smallest displacement.
5. Most of the studies show that EC is safest and most conservative compared to other codes.
6. All developments in the Kurdistan Region of Iraq (KRI) should adhere to the same national criteria. The various judgments of fault by different code enforcement authorities and organizations, or in different geographical zones, might be another field for further investigation. The Kurdistan region of Iraq is organized into four governorates; each one is using a set of building design codes randomly.

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