International Journal on Engineering Technology (InJET)

www.kec.edu.np/kec-journal/
Volume 3, issue no. 1, Dec 2025, Page 279 - 288
Received Date: Jul 13, 2025
Accepted Date: Aug 10, 2025
ISSN: 3021-940X (Print)
DOI: https://doi.org/10.3126/injet.v3i1.87073

Comparison of Seismic Parameter in RC Building using NBC 105:2020, IS 1893:2016 and ASCE 7-22

Abhinesh Khatri[1*], Gokaran Singh Chaisir[2], Amit Kumar Yadav[3], Gautam Kumar Sah[4], Kishor Chaulagain[5], Navraj Khanal[6], Bimal Ojha[7]

[1]*Department of Civil Engineering, Kantipur Engineering College, Institute of Engineering, Tribhuvan University, Nepal,* abhineshkhatri@kec.edu.np
[2]*Department of Civil Engineering, Kantipur Engineering College, Institute of Engineering, Tribhuvan University, Nepal,* chaisirgokaran283@gmail.com
[1]*Department of Civil Engineering, Kantipur Engineering College, Institute of Engineering, Tribhuvan University, Nepal,* ay434880@gmail.com
[1]*Department of Civil Engineering, Kantipur Engineering College, Institute of Engineering, Tribhuvan University, Nepal,* sahgautam538@gmail.com
[5]*Department of Civil Engineering, Kantipur Engineering College, Institute of Engineering, Tribhuvan University, Nepal,* kishorchaulagain417@gmail.com
[6]*Department of Civil Engineering, Kantipur Engineering College, Institute of Engineering, Tribhuvan University, Nepal,* navrajkhanalaofficial@gmail.com
[7]*Department of Civil Engineering, Thapathali Campus, Institute of Engineering, Tribhuvan University, Nepal,* bimalojha@tcioe.edu.np

Abstract

This study presents a comparative evaluation of seismic response parameters of reinforced concrete (RC) buildings analyzed according to three major seismic design codes: NBC 105:2020 (Nepal), IS 1893 (Part 1):2016 (India), and ASCE 7-22 (USA). Five RC building models ranging from G+2 to G+6 storeys, representing typical low- to medium-rise structures in Nepal, were modeled and analyzed using ETABS. The seismic parameters compared include fundamental time period, base shear, and lateral displacement. Results indicate that the fundamental time period values predicted by NBC 105:2020 are consistently higher than those obtained from IS 1893:2016 and ASCE 7-22, with an average difference of about 20–25% and 15–20%, respectively. The base shear calculated using NBC 105:2020 (at ULS condition) is the highest among the three codes, followed by ASCE 7-22 and IS 1893:2016. The difference in base shear between NBC 105:2020 and IS 1893:2016 ranges from 45% to 78%, while NBC 105:2020 and ASCE 7-22 differ by approximately 5–10%, with discrepancies becoming more pronounced for taller buildings.

Similarly, NBC 105:2020 predicts the highest lateral displacements in both X and Y directions, followed by ASCE 7-22, with IS 1893:2016 yielding the lowest. The average displacement difference between NBC 105:2020 and IS 1893:2016 is 35–60%, while the difference between NBC 105:2020 and ASCE 7-22 is 10–20%. This trend suggests that NBC 105:2020 adopts a more conservative approach, potentially leading to safer yet costlier designs.

The comparative analysis demonstrates that NBC 105:2020 generally prescribes more conservative seismic demands across all response parameters, aligning closely with ASCE 7-22 in design philosophy, while IS 1893:2016 tends to provide comparatively lower seismic demands. These findings emphasize the importance of adopting code provisions that balance safety, economy, and regional seismicity. The results are in good agreement with recent studies conducted on Nepalese RC buildings, confirming that NBC 105:2020 yields higher response parameters than previous versions and other regional codes.

Keywords: Seismic code comparison, NBC 105:2020, IS 1893 (part 1) :2016, ASCE 7-22, Base shear, Time period, Displacement, RC building, ETABS

1. Introduction

Nepal lies within one of the most active seismic regions in the world, positioned along the Main Himalayan Thrust (MHT), where the Indian Plate subducts beneath the Eurasian Plate at an approximate rate of 18 mm/year (Bilham, 2019). This tectonic activity has produced a series of large earthquakes, such as those in 1934, 1988, and the catastrophic 2015 Gorkha earthquake (Mw 7.8), all of which exposed the vulnerability of Nepal's built environment and underscored the urgent need for effective seismic design regulations (Dixit et al., 2015; Gautam et al. 2018).

The formulation of building codes in Nepal began in the early 1990s following the 1988 Udaypur Earthquake (Mw 6.6), which caused extensive damage to buildings in eastern Nepal. This event prompted the government to initiate the Nepal Building Code (NBC) project under the Department of Building, now Department of Urban Development and Building Construction (DUDBC), with technical assistance from the United Nations Development Programme (UNDP) and the United Nations Centre for Human Settlements (UNCHS). In 1994, the first edition of the Nepal National Building Code (NBC 105:1994) titled "Seismic Design of Buildings in Nepal" (Bureau of Nepal Standards, 1994) was introduced which was adapted primarily from Indian Standard IS 1893:1984 (Bureau of Indian Standards,1984) and UBC 1988, with certain modifications to account for local materials, workmanship, and construction practices. Although the development of first ever seismic design code in Nepal was a milestone for Nepal's seismic safety framework but its implementation remained limited for decades due to poor enforcement and lack of technical capacity (Kingdom of Nepal Final Report, 2002) Following the 2015 Gorkha earthquake, the need to update the building code became evident. As a result, the revised version, NBC 105:2020 (Bureau of Nepal Standards, 2020) was officially released by DUDBC in 2020.

Seismic design codes practiced in various countries have been taken as reference to develop this code whose seismic risk is similar to our country. Despite the modernization of NBC 105:2020, there remains uncertainty regarding how its seismic parameters compare with those from internationally recognized standards such as IS 1893 (Part 1):2016 and ASCE 7-22. Design of different types of reinforced concrete structures has been done in Nepal using both NBC 105:2020 and IS 1893 (Part 1):2016 (Ojha et al. 2025; Khatri et al., 2025). The Indian Standard IS 1893:2016 is relevant due to shared tectonic characteristics and historical influence on Nepal's earlier codes (Bureau of Indian Standards, 2016). Meanwhile, ASCE 7-22, representing U.S. seismic design practice, provides a risk-targeted, performance-based framework with rigorous ground motion parameters and site-specific provisions (Reston, VA, 2021). Comparing these three codes—NBC 105:2020, IS 1893:2016, and ASCE 7-22—provides critical insight into their differences in design base shear estimation, spectral acceleration parameters, and response modification factors. Such analysis helps determine whether the Nepalese code provides adequate conservatism and safety margins in representing seismic demands for RC buildings within Nepal's context.

2. Objectives

The objectives of the study are as follow:

- To evaluate the seismic provision as per NBC 105:2020, IS 1893 (Part 1):2016, and ASCE 7-22.
- To compare and evaluate the seismic design parameters like (base shear, time period, displacement etc) of RC buildings as per NBC 105:2020, IS 1893 (Part 1):2016, and ASCE 7-22.

3. Overview of Seismic Provision

Seismic design codes establish the framework for evaluating earthquake-induced forces and designing buildings capable of withstanding such demands. Although NBC 105:2020, IS 1893:2016, and ASCE 7-22 share the same underlying objective — ensuring structural safety and serviceability under seismic actions — they differ significantly in seismic zoning, response spectra formulation, site classification, and base shear computation. These differences arise from variations in regional seismic hazard assessment, design philosophy, and level of sophistication adopted by each code.

3.1 Seismic Zonation and Hazard Representation

Table 1. Seismic Zonation and Hazard Representation specified in various design codes

Code	Basis of Seismic Hazard	No. of Seismic Zones	Zone factor/ Maximum Spectral Acceleration
NBC 105:2020	Probabilistic Seismic Hazard Analysis (PSHA) for 10% exceedance in 50 years (475-year return period)	4 Zones	0.25-0.4
IS 1893 (Part 1):2016	PSHA with reference to Indian seismicity (10% in 50 years)	4 zones (II–V)	0.10-0.36

ASCE 7-22	Risk-Targeted Maximum Considered Earthquake (MCER) based on 2% exceedance in 50 years (2,475-year return period)	Continuous hazard map (site-specific Ss, S1)	S_g = 0.25-1.5 g

NBC 105:2020 and IS 1893:2016 are based on uniform hazard spectra for 475-year events, while ASCE 7-22 uses risk-targeted ground motions corresponding to 2,475-year events, resulting in higher base accelerations. Therefore, ASCE 7-22 is generally more conservative and safety-oriented in terms of seismic hazard.

3.2 Site Classification and Soil Coefficients

Table 2. Site specific soil characteristics specified in various design codes

Code	Site Classes	Basis of Classification	Site Coefficients (Fa, Fv)	Remarks
NBC 105:2020	Type A–E (Rock to Soft Soil)	Based on SPT N-values and shear wave velocity (Vs_{30})	Included for short and long period ranges	Similar to ASCE 7 provisions; considers soil amplification for local effects.
IS 1893:2016	Type I–III	Based on average shear wave velocity or SPT N-values	Simplified amplification factors	Less detailed; does not distinguish between short and long periods.
ASCE 7-22	Site Classes A–F	Based on Vs_{30}, N-values	Fa and Fv vary with Ss and S1	More comprehensive; provides site-specific response analysis option.

NBC 105:2020 adopts a hybrid approach between IS 1893 and ASCE 7-22, offering improved soil classification relative to its 1994 version. ASCE 7-22 remains the most sophisticated, emphasizing site-specific design spectra for soft or liquefiable soils.

3.3 Design Response Spectrum

Table 3. Design Response Spectrum specified in various design codes

Code	Shape of Response Spectrum	Peak Acceleration Plateau (Period Range)	Damping Consideration
NBC 105:2020	Normalized smooth response spectrum (5% damping)	0.1–0.4 sec	Standard 5% damping with modification factor for others
IS 1893:2016	Similar to NBC 105:2020	0.1–0.55 sec	5% damping standard
ASCE 7-22	Site-dependent design spectrum derived from Ss and S1	Based on mapped MCER values	Uses 5% damping; provides method for alternative damping ratios

All three codes use 5% damping spectra, but ASCE 7-22 allows site-specific and risk-adjusted modifications. NBC 105:2020's spectrum closely resembles that of IS 1893 but introduces slightly adjusted plateau ranges suitable for Nepal's soil response.

3.4 Response Modification and Ductility

Table 4. Response modification and ductility factor specified in various design codes

Code	Ductility / R Factors	Basis
NBC 105:2020	3 (Ordinary RC Frame) 5 (SMRF)	Aligned with global practice; improved over NBC 105:1994
IS 1893:2016	3–5	Based on structural system; similar to NBC 105
ASCE 7-22	3–8	More detailed; system- and configuration-specific

ASCE 7-22 provides more granularity in defining R factors for different systems, promoting performance-based design. NBC 105:2020 aligns with IS 1893 but has updated nomenclature and improved detailing requirements to ensure ductile performance.

3.5 Importance Factor

Table 5. Importance Factors Specified in various design codes

Code	Importance Factor (I)	Design Philosophy
NBC 105:2020	For ordinary structures I = 1	Life safety & post-earthquake usability
	For important structures = 1.25	
	For Critical Structures I = 1.5	
IS 1893:2016	For ordinary structures I = 1	Life safety
	For important structures = 1.2	
	For Critical Structures I = 1.5	
ASCE 7-22	For ordinary structures I = 1	Risk-targeted & performance-based
	For important structures = 1.25	
	For Critical Structures I = 1.5 (Risk Category (I, II, III, IV)	

NBC 105:2020 introduces an improvement over NBC 105:1994 by adding a graduated importance factor system, bridging between the simplified IS approach and the risk-based ASCE system. IS 1893:2016 retains a binary importance system, which may not sufficiently distinguish between moderately important and critical structures. ASCE 7-22, by linking importance to risk category and societal function, represents the most advanced and consistent framework for defining design reliability.

3.5 Load Combinations For Different Codes

Table 6. Load Combinations Specified in various design codes

NBC 105:2020	IS 1893:2016	ASCE 7-22
1. 1.2DL + 1.5LL	1. 1.2 (DL + LL + EQX)	1. 1.4DL
2. DL + 0.3LL + Ex	2. 1.2 (DL + LL – EQX)	2. 1.2DL+1.6LL
3. DL + 0.3LL -Ex	3. 1.2 (DL + LL + EQY)	3. 1.40DL+0.5LL+(EQ_X+0.3EQ_Y)
4. DL + 0.3LL +Ey	4. 1.2 (DL + LL – EQY)	4. 1.40DL+0.5LL+(EQ_X-0.3EQ_Y)
5. DL + 0.3LL - Ey	5. 1.5 (DL + LL)	5. 1.40DL+0.5LL-(EQ_X+0.3EQ_Y)
	6. 1.5 (DL + EQX)	6. 1.40DL+0.5LL-(EQ_X-0.3EQ_Y)
	7. 1.5 (DL - EQX)	7. 1.40DL+0.5LL+(EQ_Y+0.3EQ_X)
	8. 1.5 (DL + EQY)	8. 1.40DL+0.5LL+(EQ_Y-0.3EQ_X)
	9. 1.5 (DL – EQY)	9. 1.40DL+0.5LL-(EQ_Y+0.3EQ_X)
	10. 0.9 DL + 1.5 EQX	10. 1.40DL+0.5LL-(EQ_Y-0.3EQ_X)
	11. 0.9 DL - 1.5 EQX	11. 0.70DL+(EQ_X+0.3EQ_Y)
	12. 0.9 DL + 1.5 EQY	12. 0.70DL+(EQ_X-0.3EQ_Y)
	13. 0.9 DL - 1.5 EQY	13. 0.70DL-(EQ_X+0.3EQ_Y)
		14. 0.70DL-(EQ_X-0.3EQ_Y)
		15. 0.70DL+(EQ_Y+0.3EQ_X)
		16. 0.70DL+(EQ_Y-0.3EQ_X)
		17. 0.70DL-(EQ_Y+0.3EQ_X)
		18. 0.70DL-(EQ_Y-0.3EQ_X)

NBC 105:2020 and IS 1893:2016 adopt simplified combinations suitable for conventional RC structures, while ASCE 7-22 provides a more detailed framework emphasizing realistic multi-directional seismic demands and load interaction effects.

4. Modelling and Analysis

A linear model of the selected representative building was created in *ETABS v19* (a structural software that facilitates modelling, analysis, and design of structures). Few assumptions were made during the modelling, such as:

a) The structure was treated as fixed at the plinth level.

b) The model was constructed using a "Bare Frame" approach, which neglects the contribution of stiffness from the brick walls. The analysis involved isolating the infill walls from the frame system, thus treating the wall load as a purely dead load on the building. Consequently, the lateral rigidity of the infill wall was deemed negligible in the model.

c) The floor diaphragms are assumed to be rigid.

d) Damping is considered as 5%.

e) Dead load is calculated as per IS 875 part 1: 1987 (Bureau of Indian Standards, 1987) and live load is calculated as per IS 875 part 2: 1987 (Bureau of Indian Standards, 1987).

f) Staircase load is applied on beam.

Table 7. Building Description

Building	Type	No. of Story	Height	Structural Sections
1	Commercial	G+6 STOREY	24 m	Column: 450mm*450mm Slab: 125mm
2	Commercial	G+5 STOREY	21 m	Column: 450mm*450mm Slab: 125mm
3	Residential	G+4 STOREY	18 m	Column: 400mm*400mm Slab: 125mm
4	Residential	G+3 STOREY	15 m	Column: 350mm*350mm Slab: 125mm
5	Residential	G+2 STOREY	12 m	Column: 350mm*350mm Slab: 125mm

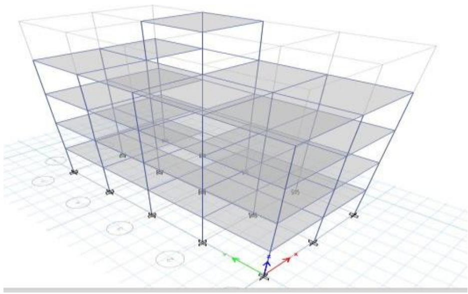

Figure 1. 3D modelling of building in ETABS

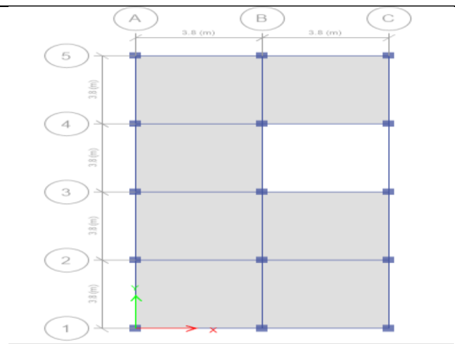

Figure 2. Typical floor plan of building

5. Results and Discussion

In this study, five reinforced concrete (RC) buildings with varying heights and occupancy were modeled in ETABS to evaluate and compare their seismic response parameters, primarily fundamental time period, displacement, base shear, percentage of reinforcement in column etc according to the provisions of NBC

105:2020, IS 1893:2016, and ASCE 7-22. The buildings ranged from G+2 to G+6 storeys, representing low-rise and medium-rise, categories typical in urban areas of Nepal.

5.1 Comparison of Fundamental Time Period

Table 8 presents the computed time periods for five RC building models designed according to the three codes — NBC 105:2020, IS 1893 (Part 1):2016, and ASCE 7-22. The fundamental time period decreases consistently from Building 1 to Building 5, corresponding to decreasing building height and mass. For all building configurations, the NBC 105:2020 gives slightly higher time periods compared to IS 1893:2016 and ASCE 7-22. The difference between NBC and IS 1893 is approximately 20–25%, while the difference between NBC and ASCE 7-22 is around 15–20%, depending on the height.

Table 8. Fundamental time periods in seconds for five different buildings according to three codes

	Fundamental Time Period (in secs)		
	NBC 105:2020	IS 1893(part 1):2016	ASCE 7-22
Building 1	1.016	0.814	0.813
Building 2	0.919	0.722	0.736
Building 3	0.819	0.628	0.655
Building 4	0.715	0.533	0.572
Building 5	0.604	0.436	0.48

The variation in time period values primarily results from differences in the empirical formulas used by the three codes:

- NBC 105:2020 uses the empirical formula $T=0.075h^{0.75}$ which generally predicts higher time periods for medium to tall RC moment-resisting frame buildings.
- IS 1893 (Part 1):2016 employs the relation $T = \frac{0.09\,h}{\sqrt{d}}$ where h is the building height and d is the base dimension of the structure in the direction under consideration. This formula gives comparatively shorter time periods because it directly accounts for plan dimensions, implying a stiffer behavior.
- ASCE 7-22 uses $T=C_t h^x$ where C_t=0.016 and x=0.9 for RC moment-resisting frames. This empirical model predicts slightly longer time periods for tall and flexible structures due to its larger exponent on height.

5.2 Comparison of Base Shear

Table 9 shows the computed base shear values for five RC building models analyzed using NBC 105:2020, IS 1893 (Part 1):2016, and ASCE 7-22. For NBC 105:2020, both Serviceability Limit State (SLS) and Ultimate Limit State (ULS) base shears are presented. NBC 105:2020 yields the highest base shear among the three codes for all buildings, particularly under ULS conditions. ASCE 7-22 results are generally lower than NBC 105:2020 but higher than IS 1893:2016 for most cases. IS 1893:2016 consistently produces the lowest base shear values, indicating a less conservative approach in terms of total seismic demand. The base shear decreases with building height in all codes, as expected, due to the increase in flexibility and corresponding reduction in design spectral acceleration.

Table 9. Base Shear in kN for five different buildings according to three codes

	Base Shear (in kN)			
	NBC 105:2020		IS 1893(part 1):2016	ASCE 7-22
	SLS	ULS		
Building 1	1302.82	1354.52	758.01	1259.23
Building 2	1299.15	1350.7	684.05	1250.8
Building 3	1017.65	1058.04	598.65	1019.67
Building 4	805.38	837.34	570.88	774.38

Building 5	666.92	693.39	472.62	641.02

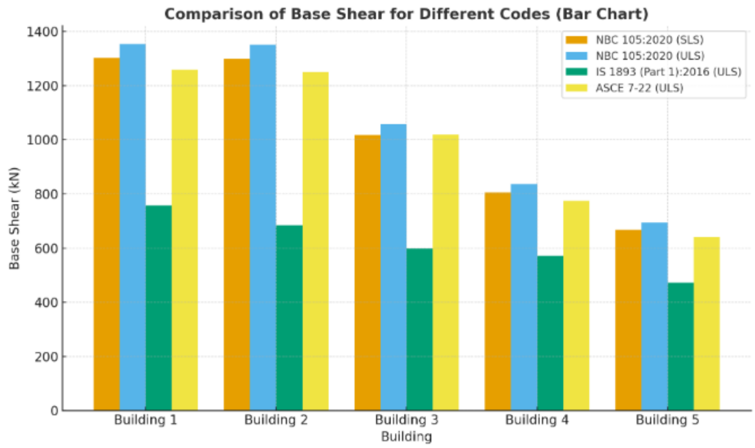

Figure 3. Graphical Representation of Variation of Base Shear in Five RC Buildings

The percentage difference between NBC (ULS) and IS 1893:2016 base shear ranges from approximately 45-78 %, while the difference between NBC (ULS) and ASCE 7-22 is around 5-10% for most models. It is clearly observed that the difference in base shear among the codes becomes more eminent for taller buildings. For instance, In Building 1 (tallest structure), the base shear as per NBC 105:2020 (ULS) is approximately 78% higher than IS 1893:2016. Conversely, for Building 5 (shortest structure), the difference between NBC 105:2020 with IS 1893:2016 it is roughly 45%. This trend can be attributed to the time period dependence of the seismic coefficient. Taller buildings have longer fundamental periods, and since the design spectral acceleration (Sa/gS_a/gSa/g) is inversely related to period in the descending portion of the response spectrum, even small differences in empirical time-period equations between the codes result in significant variation in computed base shear. Moreover, NBC 105:2020 and ASCE 7-22 both adopt site-dependent response spectra with higher spectral ordinates at shorter periods, while IS 1893:2016 provides smoother, simplified spectral shapes. Therefore, taller and more flexible structures, which fall in the longer period range, are more sensitive to how each code defines the spectral shape and reduction factors.

5.3 Comparison of Displacement

Table 10 and Table 11 presents the computed top storey displacements in X and Y directions respectively for all five buildings. The displacement values clearly vary based on the design code used. Notably, NBC 105:2020 consistently predicts the highest displacement values, while IS 1893:2016 generally yields the lowest, with ASCE 7-22 producing intermediate values in most cases.

Table 10. Top Storey displacement in X direction for five different buildings according to three codes

Displacement in X direction (in mm)				
	NBC 105:2020		IS 1893(part 1):2016	ASCE 7-22
	SLS	ULS		
Building 1	80.396	83.586	51.478	68.471
Building 2	50.01	52	29.136	48.127
Building 3	47.152	49.023	31.218	47.532
Building 4	39.99	41.576	32.35	38.34
Building 5	33.396	34.72	26.82	30.73

Table 11. Top Storey displacement in Y direction for five different buildings according to three codes

Displacement in Y direction (in mm)				
	NBC 105:2020		IS 1893(part 1):2016	ASCE 7-22
	SLS	ULS		

Building 1	70.59	66.3	42.59	68.47
Building 2	44.62	40.38	25.97	42.77
Building 3	42.95	44.65	28.43	43.32
Building 4	37.02	38.54	29.99	35.54
Building 5	30.99	32.22	24.9	28.51

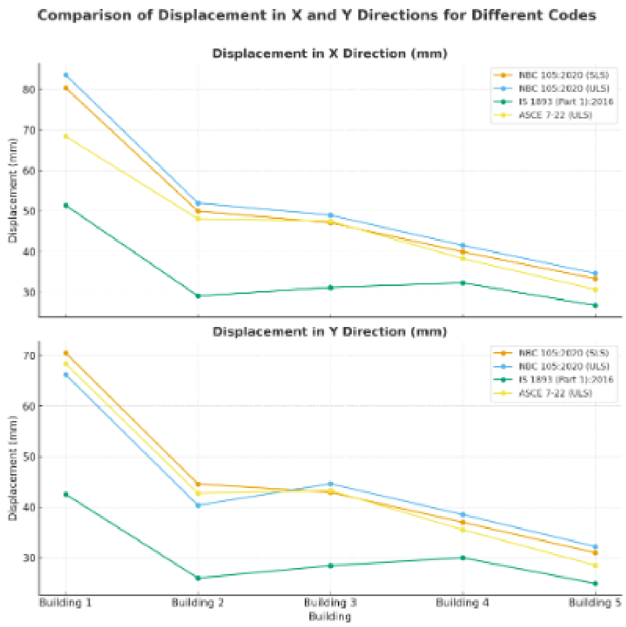

Figure 4. Comparison of Displacement in X and Y direction for different codes

NBC yields higher displacement values, with an average increase of approximately 35%–60% over IS 1893:2016 and 10-20% over ASCE 7-22. This indicates that NBC provisions are more conservative in estimating lateral deformations, potentially due to higher zone factors or lesser reduction factors. Codes with higher displacement predictions (like NBC 105:2020) may lead to more conservative structural designs, potentially increasing construction costs but providing enhanced seismic performance and safety margins. ASCE 7-22, although producing relatively lower displacements, relies heavily on accurate site-specific seismic data and advanced analysis methods, making it more suitable in contexts with reliable geotechnical and structural assessment capabilities. IS 1893:2016, while widely used, may underestimate displacement demands when compared to the other two, suggesting a need for caution or supplementary checks when used in high-seismicity areas.

Validation:

The results obtained from this research are comparable with some recent comparative studies on the seismic performance of a RCC building in Nepal using different code of practices. The studies suggested that the revised NBC 105:2020 displayed higher values for all response parameters analyzed (Sapkota et al. 2024; Bhusal and Paudel, 2021; Kunwar et al. 2024; Shrestha et al. 2021).

6. Conclusion and Recommendations

This study conducted a comprehensive comparison of seismic response parameters for five reinforced concrete (RC) buildings designed using three major seismic codes: NBC 105:2020 (Nepal), IS 1893 (Part 1):2016 (India), and ASCE 7-22 (USA). The evaluation focused on fundamental time period, base shear, and top storey displacement in both X and Y directions for buildings ranging from low-rise (G+2) to medium-rise (G+6), which are common in urban regions of Nepal.

The following conclusions can be drawn from this research:

- NBC 105:2020 produced consistently higher fundamental time periods across all building models, due to its empirical formula that emphasizes height more strongly than base dimensions.
- NBC 105:2020 produces the highest seismic demand, emphasizing safety and conservatism, suitable for Nepal's high-risk zones and construction variability.
- ASCE 7-22, with its performance-based design philosophy, provides an efficient and modern framework but requires precise input data and advanced analysis capabilities.
- IS 1893:2016, while commonly used, may underestimate seismic demands in certain cases and should be applied cautiously, especially in regions of high seismicity.

Overall, NBC 105:2020 currently provides the most conservative and contextually appropriate seismic design guidelines for Nepalese buildings, particularly for general use and life-safety-oriented construction. However, ASCE 7-22 presents a strong case for performance-based design, which could serve as a model for future code development in Nepal. IS 1893:2016, while technically robust, may require localized adaptation or supplementary safety checks to ensure its reliability in the Nepalese seismic context. Going forward, harmonizing the strength of NBC's conservatism with the flexibility of ASCE's performance-based approach could pave the way for more resilient, economical, and efficient seismic design frameworks in developing seismic-prone regions.

7. Limitations and Recommendations for Future Research

While this study provides a valuable comparative understanding of seismic response based on three design codes, some limitations remain:

- Only linear static analysis was conducted. Future studies should incorporate nonlinear static (pushover) and time-history analyses to assess inelastic behavior and collapse potential.
- Site-specific factors such as soil-structure interaction, irregularity, and torsion were not considered. Incorporating these would provide a more holistic view of code performance.
- Economic and sustainability implications — i.e., material consumption, carbon footprint, and life-cycle cost — are also important considerations in future studies.

Conflict of Interest

The Authors declare No Conflict of Interest. No Financial Aids were provided for this research.

References

Bilham R., 2019 Himalayan earthquakes: A review of historical seismicity and early 21st century slip potential. *Geological Society Special Publication*, Geological Society of London, pp. 423–482. Available at https://doi: 10.1144/SP483.16.

Dixit, A. M. *et al.*, 2015, Strong-motion observations of the M 7.8 Gorkha, Nepal, Earthquake sequence and development of the N-SHAKE strong-motion network. *Seismological Research Letters*, 86, p. 1533–1539. Available at https://doi: 10.1785/0220150146.

Gautam D., Fabbrocino G., and Santucci de Magistris F., 2018. Derive empirical fragility functions for Nepali residential buildings," *Eng Struct*, 171, p. 617–628, Available at https://doi: 10.1016/j.engstruct.2018.06.018.

Bureau of Nepal Standards, 1994. NEPAL NATIONAL BUILDING CODE: SEISMIC DESIGN OF BUILDINGS IN NEPAL Government of Nepal Ministry of Physical Planning and Works Department of Urban Development and Building Construction.

Bureau of Indian Standards,1984, IS 1893 (1984): Criteria for earthquake resistant design of structures.

THE STUDY ON EARTHQUAKE DISASTER MITIGATION IN THE KATHMANDU VALLEY, KINGDOM OF NEPAL FINAL REPORT VOLUME I SUMMARY 2002.

Bureau of Nepal Standards, 2020. NEPAL NATIONAL BUILDING CODE नेपाल भूककप तरोधी भवन नमाा ण ढाँचा (डजाइन) SEISMIC DESIGN OF BUILDINGS IN NEPAL.

Ojha, B. et al., 2025. Comparative Analysis of Structural Response of Multi-storey Reinforced Concrete Framed Building with Different Infill Wall Materials *American Journal of Civil Engineering*, 13, p. 245–256, Available at https://doi: 10.11648/j.ajce.20251304.16.

Khatri, A. et al.,2025. Seismic Analysis of Multistorey Building on Sloping Ground Using NBC 105:2020. *International Journal on Engineering Technology and Infrastructure Development*, 2, p. 247–258, Available at https://10.3126/injet-indev.v2i1.82532.

Bureau of Indian Standards, 2016. Criteria for Earthquake Resistant Design of Structures Part 1 General Provisions and Buildings (Sixth Revision), [Online]. Available at www.standardsbis.in

Reston, VA, 2021. Minimum Design Loads and Associated Criteria for Buildings and Other Structures. *American Society of Civil Engineers*. Available at https://doi: 10.1061/9780784415788.

Bureau of Indian Standards, 1987. IS 875 (Part 1)-1987: Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures. Part 1: Dead Loads--Unit Weights of Building Materials and Stored Materials (Second Revision).

Bureau of Indian Standards, 1987, IS 875(Part 2)-1987: Code of Practice for Design Loads (Other Than Earthquake) For Buildings And Structures, Part 2: Imposed Loads.

Sapkota A. *et al.,* 2024. Comparative study on the seismic performance of a typical low-rise building in Nepal using different seismic codes *Asian Journal of Civil Engineering*, 25, p. 4373–4394, Available at https://doi: 10.1007/s42107-024-01053-5.

Bhusal, B. and Paudel, S. 2021 Comparative study of existing and revised codal provisions adopted in Nepal for analysis and design of Reinforced concrete structure International Journal of Advanced Engineering and Management *Article in INTERNATIONAL JOURNAL OF ADVANCED ENGINEERING AND MANAGEMENT*, [Online]. Available: https://www.researchgate.net/publication/348558245

Kunwar S. et al., 2024. A comparative analysis of an RC low-rise building with the seismic codes of countries lying in the Himalayas: China, India, Nepal, and Pakistan. *Discover Civil Engineering*, 1, Available at https://doi: 10.1007/s44290-024-00122-7.

Shrestha, J. K. et al., 2021. Impact of Revised Code NBC105 on Assessment and Design of Low Rise Reinforced Concrete Buildings in Nepal *Journal of the Institute of Engineering*. 16, p. 1–5, Available at https://doi: 10.3126/jie.v16i1.36527.