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Cross-Border Seismic Code Comparison along the Himalayan Front: NBC 105:2025, IS 1893:2016/2023 (Draft), BNBC 2020 and GB 50011-2010

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Abstract
Despite sharing a unified seismic environment along the Himalayan front, Nepal, India, China, and Bangladesh each prescribes independent seismic design codes. Consequently, design demands for structurally identical buildings may vary significantly across international borders in this region. This study presents a comparative analysis of the latest seismic codes of these four nations—NBC 105:2025 (Nepal), IS 1893:2016 and IS 1893:2023 Draft (India), BNBC 2020 (Bangladesh), and GB 50011-2010 (China)—applied to a single four-story reinforced concrete (RCC) residential structure. To ensure comparability, the analysis employs a standardized structural system: a Special Moment-Resisting Frame (SMRF) or its equivalent within each code, with force-reduction factors of R = 6 (NBC 105:2025), R = 5 (IS 1893:2016/2023 Draft), R = 8 (BNBC 2020), and direct application of the seismic influence coefficient (GB 50011-2010). The seismic weight is determined from dead load alone (W = 2372.68 kN) to eliminate the variable effects of different code-specific live-load reduction factors. As the actual design forces arise from load-combined values, this study compares factored design horizontal acceleration coefficients rather than un-factored code values. The analysis encompasses two geographically defined regional sub-studies along the Northeast and Northwest borders, revealing that the factored design horizontal acceleration coefficient ranges from 0.029 (BNBC 2020, Nawabganj) to 0.318 (GB 50011-2010, South Tibet) across surveyed locations.

Keywords: NBC 105:2025; IS 1893:2016; IS 1893:2023 Draft; BNBC 2020; GB 50011-2010; SMRF; factored design horizontal acceleration; load combination; response-reduction factor; border-region comparison

1. Introduction

The collision between the Indian and Eurasian tectonic plates has generated the Himalayan mountain range and established a high-seismic-hazard zone spanning Nepal, India, China (Tibet), Bhutan, and Bangladesh. Numerous significant seismic events have occurred in this region—including the 1934 Bihar-Nepal earthquake (M 8.0), the 1950 Assam earthquake (M 8.6), the 1976 Tangshan earthquake (M 7.8), and the 2015 Gorkha earthquake (Mw 7.8)—each contributing lessons that have informed the development of national building codes [1], [2], [3]. Despite this shared geological and seismic context, each nation has independently formulated its own seismic design code: NBC 105:2025 in Nepal [4], IS 1893:2016 and the proposed Draft IS 1893:2023 in India [5], [6], BNBC 2020 in Bangladesh [7], and GB 50011-2010 in China [8].

Seismic hazards transcend political boundaries, and hence the design seismic demands prescribed by adjacent national codes for geometrically similar sites across an international border should, in principle, be reasonably consistent. In practice, however, significant variations arise in the prescribed peak ground acceleration (PGA), response-spectrum shape, response-reduction factor (R), importance factor (I), and load-combination factors applied to seismic actions. These divergences collectively influence the magnitude of base shear and member forces in structurally identical buildings, which forms the central focus of this investigation. This comparison builds on the author's earlier bilateral code studies [9], [10].

In limit-state design, the actual design force imposed on structural members is determined only after load combinations are applied. Consequently, the un-factored design coefficient (Cd, Cs, or α) does not represent the actual design load; rather, the factored value—obtained by multiplying the un-factored coefficient by the applicable load-combination factor on seismic action—governs the design process. For this reason, the present study compares only the factored design horizontal acceleration coefficients and corresponding factored base shears; un-factored code values are referenced solely to compute factored values and are not directly compared.

Two critical modeling assumptions are adopted to ensure a rigorous cross-code comparison. First, the seismic weight is determined from dead load alone (W = 2372.68 kN), excluding live load. This approach is necessary because the codes employ disparate procedures for incorporating live-load contributions to seismic weight (e.g., 25% in IS 1893 versus 50% in GB 50011-2010 for storage floors), and including live load would introduce a confounding variable unrelated to the seismic spectra themselves. Second, a Special Moment-Resisting Frame (SMRF) or its equivalent is consistently applied across all codes, as this is the only structural system uniformly prescribed by all five codes for residential RCC buildings in high-seismicity zones. The corresponding response-reduction factors employed are: $R\mu \times \Omega u = 4 \times 1.5 = 6$ (NBC 105:2025), R = 5 (IS 1893:2016/2023 Draft), R = 8 (BNBC 2020), and direct application of the seismic influence coefficient without an explicit R-factor (GB 50011-2010, with ductility ensured through seismic-grade classification and detailing requirements). These code-specific reduction factors are detailed in Table 2 (Section 3) and incorporated throughout all subsequent calculations.

Given the extensive geographic extent of the Himalayan border zone, the analysis is organized into two regional sub-studies. This structure ensures that sites within each sub-region are geographically proximate (generally within tens of kilometers), and thus share a coherent seismic environment:

- Northeast India region — Nepal-India-Bangladesh sites along the Mechi - Banglabandha trijunction zone, plus a Chinese-side site at the Arunachal-South Tibet border.
- Northwest India region — Nepal-India-China sites along the Mahakali / Humla front (Darchula - Garbyang and Hilsa - Xieerwa).

2. Reference Building and Common Inputs

A single reference building—a regular four-story (Ground + 3) RCC Special Moment-Resisting Frame (SMRF)—is analyzed across all five codes to ensure consistent basis for comparison. Architectural and structural details are presented in Figure 1(a) and Figure 1(b), with key parameters summarized in Table 1. The building encompasses a plan dimension of 9.0 m × 11.175 m and a total height of 12.75 m. The seismic weight is established as W = 2372.68 kN (dead load only), with live load deliberately excluded to prevent confounding effects from the code-dependent live-load reduction factors.

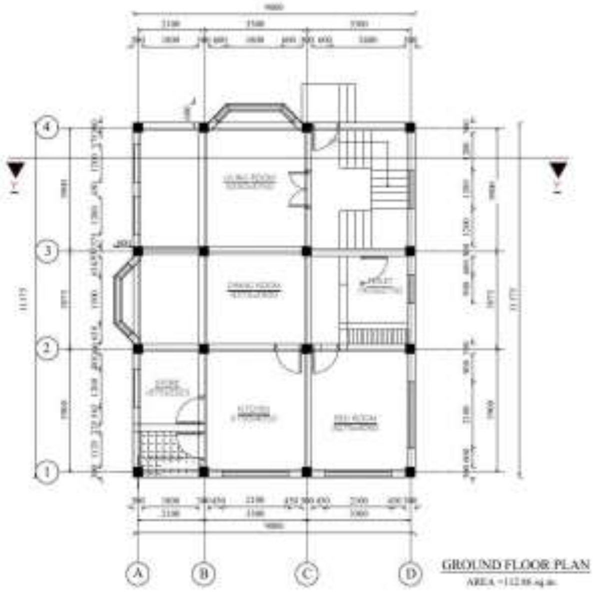

Figure 1 (a). Ground-floor plan (9.0 × 11.175 m, area ≈ 100.6 m²).

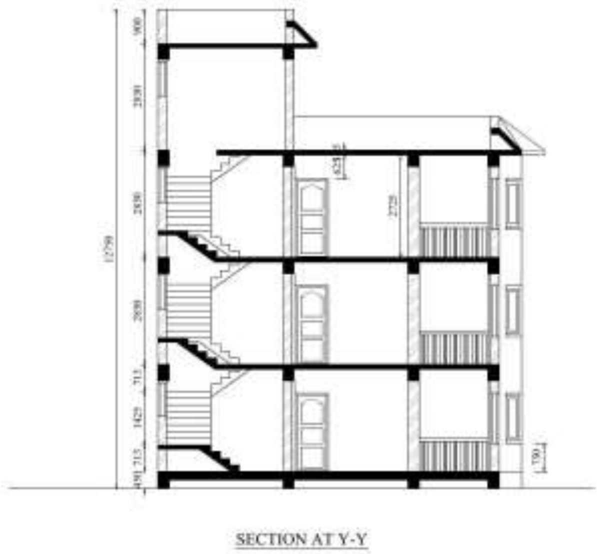

Figure 1 (b). Section Y-Y (total height ≈ 12.75 m, four stories plus stair cover).

Table 1. Reference building parameters

Parameter	**Value**
Building type	Normal residential RCC, Special / Ductile RC Moment Resisting Frame (SMRF)
Number of stories, N	4 (Ground + 3)
Plan dimension	9.0 m × 11.175 m
Plan area	≈ 100.6 m² (drawing 112.86 m² incl. overhangs)
Total height, h_n	12.75 m

Typical story height	2.85 m
Seismic weight, W (DL only)	2372.68 kN (live load excluded — see abstract / Section 1)
Importance factor, I	1.0 (residential)
Response-reduction factor, R	code-specific (see Table 2); SMRF / equivalent for all codes
Soil / Site class	Medium soil, SBC ≈ 150 kN/m² (Type II / SC / Class II / C)
Damping ratio, ζ	0.05
Approx. fundamental period T_1	≈ 0.51 s (IS / NBC); 0.46 s (BNBC); 0.54 s (GB)

3. Force-Reduction Factor R and Load Combinations

Two design parameters that strongly influence the cross-code comparison are the force-reduction factor R (or its equivalent in each code) and the load-combination factor on the seismic action E. Because the two play different roles (R reduces the elastic spectrum to the inelastic design spectrum, while the load-combination factor scales the seismic action when combined with dead and live loads), they are summarized separately.

3.1 Force-Reduction Factor R Used by Each Code

Each of the five codes prescribes its own R for the chosen structural system. To keep the comparison consistent across all codes, the Special (or equivalent Ductile) Moment-Resisting Frame is selected in every code. The values used in this paper (Table 2) are taken directly from the respective codes. No artificial normalization has been applied: the GB 50011-2010 row, in particular, does not apply any R because the Chinese code does not prescribe an explicit R-factor for force reduction; instead, ductility is ensured through detailing rules (Chapters 6 - 11) and the seismic-grade classification (Seismic Grade 1 for residential RCC at Intensity IX, providing detailing requirements broadly equivalent to a SMRF in the other codes). Direct application of αmax frequent therefore reflects the design philosophy of GB 50011-2010 itself.

Table 2. Force-reduction factor R prescribed by each code for residential RCC SMRF in highly seismic regions

Code	Structural System Considered (Special MRF in highly seismic region)	Force-Reduction Factor	Code Reference
NBC 105:2025	Ductile RC moment-resisting frame (≡ SMRF)	**$R_\mu \times \Omega_u = 4 \times 1.5 = 6$**	NBC 105:2025 Table 4-2
IS 1893:2016	Special RC moment-resisting frame (SMRF)	**R = 5**	IS 1893:2016 Table 8

IS 1893:2023 Draft	Special RC moment-resisting frame (SMRF)	**R = 5 (unchanged from 2016)**	IS 1893:2023 Draft
BNBC 2020	Special RC moment frame (SMF)	**R = 8**	BNBC 2020 Table 5.2.19
GB 50011-2010	RC moment frame, Seismic Grade 1 (special detailing); ductility via detailing rules	**NO explicit R-factor; α applied directly**	GB 50011-2010 Sec. 5.2 / Ch. 6

3.2 Seismic Load Combinations and the Factor on E

Although each code reports its design seismic coefficient (Cd, Ah, Cs or α) as a base-shear coefficient at the un-factored level, the actual force used to design the columns and beams is obtained after multiplying the seismic action E by the load-combination factor on E (1.5 in IS 1893, 1.3 in GB 50011-2010, 1.0 in NBC 105:2025 and BNBC 2020). Table 3 collects the controlling seismic load combinations, several of which (notably BNBC 2020) follow an ASCE/SEI 7-16-style load-combination structure [11].

Table 3. Seismic load combinations and factor on the earthquake action E

Code	Critical Seismic Load Combination	Factor on E
NBC 105:2025	1.0D + 0.3L ± 1.0Eu (Eu uses Cd at ULS already)	**1.0**
IS 1893:2016	1.5(D + L); 1.2(D + L ± E); 1.5(D ± E); 0.9D ± 1.5E	**1.5**
IS 1893:2023 Draft	1.5(D + L); 1.2(D + L ± E); 1.5(D ± E); 0.9D ± 1.5E	**1.5**
BNBC 2020	1.2D + 1.0L ± 1.0E; 0.9D ± 1.0E (USD strength)	**1.0**
GB 50011-2010	1.2G + 1.3Ehk + 0.5Q; 1.0G + 1.3Ehk + 0.5Q	**1.3**

The factored design horizontal acceleration coefficient used for comparison in Sections 4 - 6 is therefore: Cd × (LC factor on E), where Cd is the un-factored design coefficient produced by the code with its own SMRF reduction factor (Table 2) applied.

4. Northeast India Region

Five border-area sub-regions (NE-1 to NE-5) are selected along the Eastern Himalayan front. For each sub-region a Google-Earth view is given, the inter-site distances are tabulated, the factored seismic inputs and outputs of each applicable code are tabulated (using each code's own prescribed SMRF reduction factor from Table 2), and the factored design horizontal acceleration coefficient is plotted as a bar chart.

4.1 NE-1: Jhapa (Nepal) – Baghmara (India) – Tentulia (Bangladesh)

Figure 2. NE-1 location: Jhapa – Baghmara – Tentulia (Google Earth view).

Table 4. NE-1 — inter-site distances

From	To	Approx. Distance (km)	Note / Border
Jhapa, Nepal	Baghmara, India	≈ 25 km	Nepal-India (Mechi)
Jhapa, Nepal	Tentulia, Bangladesh	≈ 30 km	via Banglabandha
Baghmara, India	Tentulia, Bangladesh	≈ 15 km	India-Bangladesh

Table 5. NE-1 — factored seismic inputs and outputs

Country	Location	Code	Z (g)	I	R (per code)	T_1 (s)	LC × E	Factored Cd	Factored Vb (kN)
Nepal	**Jhapa**	NBC 105:2025	0.30	1.0	6 ($R\mu \times \Omega u$)	0.51	1.0	0.1250	296.58
India	**Baghmara**	IS 1893:2016	0.24	1.0	5 (SMRF)	0.51	1.5	0.0900	213.54
India	**Baghmara**	IS 1893:2023 Draft	0.50	1.0	5 (SMRF)	0.51	1.5	0.1875	444.88
Bangladesh	**Tentulia**	BNBC 2020 (Z2)	0.20	1.0	8 (SMF)	0.46	1.0	0.0479	113.69

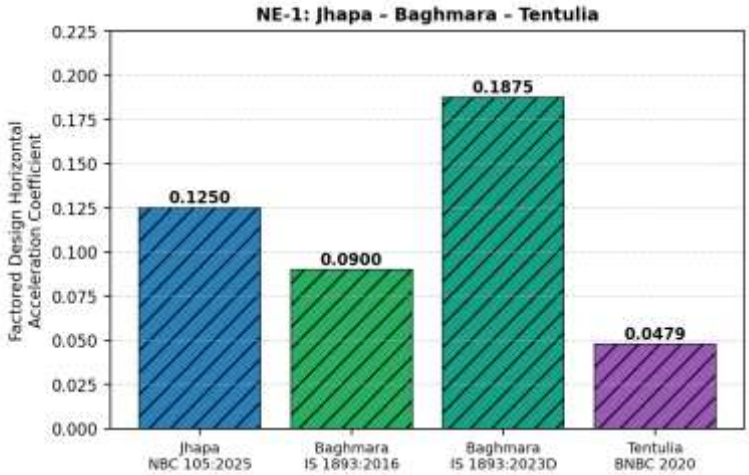

Figure 3. NE-1 — factored design horizontal acceleration coefficient by code.

4.2 NE-2: Biratnagar (Nepal) – Jogbani (India)

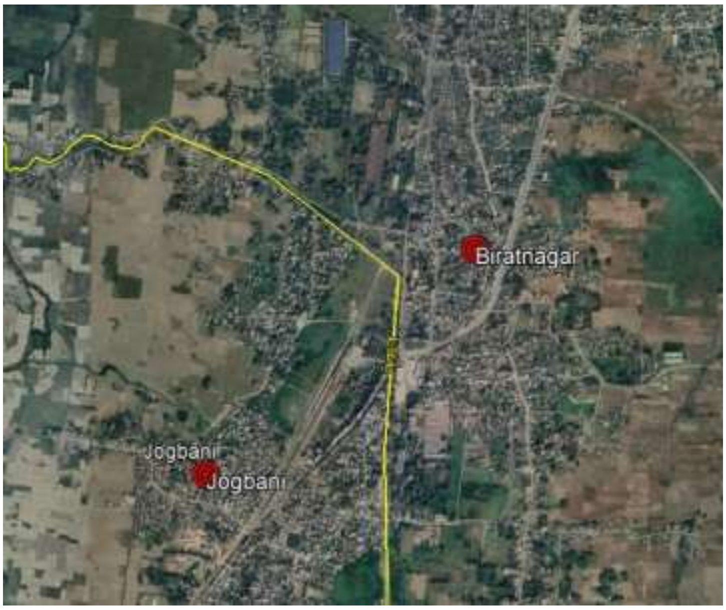

Figure 4. NE-2 location: Biratnagar – Jogbani (Google Earth view).

Table 6. NE-2 — inter-site distances

From	To	Approx. Distance (km)	Note / Border
Biratnagar, Nepal	Jogbani, India	≈ 6 km	Nepal-India (open border)

Table 7. NE-2 — factored seismic inputs and outputs

Country	Location	Code	Z (g)	I	R (per code)	T_1 (s)	LC × E	Factored Cd	Factored Vb (kN)
Nepal	**Biratnagar**	NBC 105:2025	0.30	1.0	6 (Rμ×Ωu)	0.51	1.0	0.1250	296.58

India	**Jogbani**	IS 1893:2016	0.36	1.0	5 (SMRF)	0.51	1.5	0.1350	320.31
India	**Jogbani**	IS 1893:2023 Draft	0.50	1.0	5 (SMRF)	0.51	1.5	0.1875	444.88

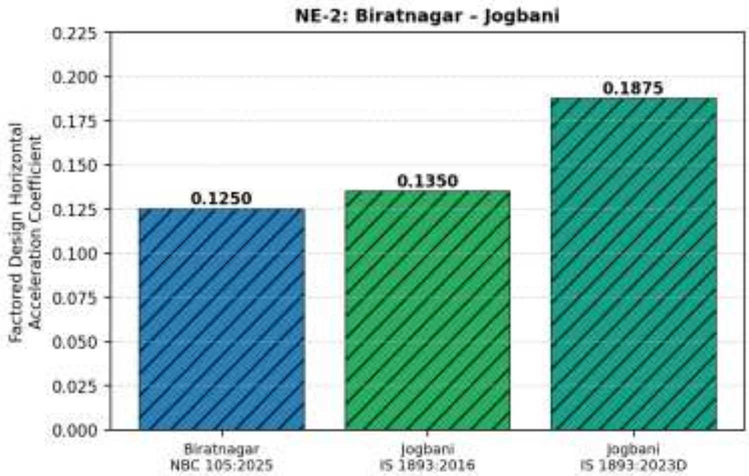

Figure 5. NE-2 — factored design horizontal acceleration coefficient by code.

4.3 NE-3: Ilam (Nepal) – Kalimpong (India)

Figure 6. NE-3 location: Ilam – Kalimpong (Google Earth view).

Table 8. NE-3 — inter-site distances

From	To	Approx. Distance (km)	Note / Border
Ilam, Nepal	Kalimpong, India	≈ 60 km	Nepal-India (mountain)

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Table 9. NE-3 — factored seismic inputs and outputs

Country	Location	Code	Z (g)	I	R (per code)	T_1 (s)	LC × E	Factored Cd	Factored Vb (kN)
Nepal	**Ilam**	NBC 105:2025	0.40	1.0	6 (Rμ×Ωu)	0.51	1.0	0.1667	395.45
India	**Kalimpong**	IS 1893:2016	0.24	1.0	5 (SMRF)	0.51	1.5	0.0900	213.54
India	**Kalimpong**	IS 1893:2023 Draft	0.50	1.0	5 (SMRF)	0.51	1.5	0.1875	444.88

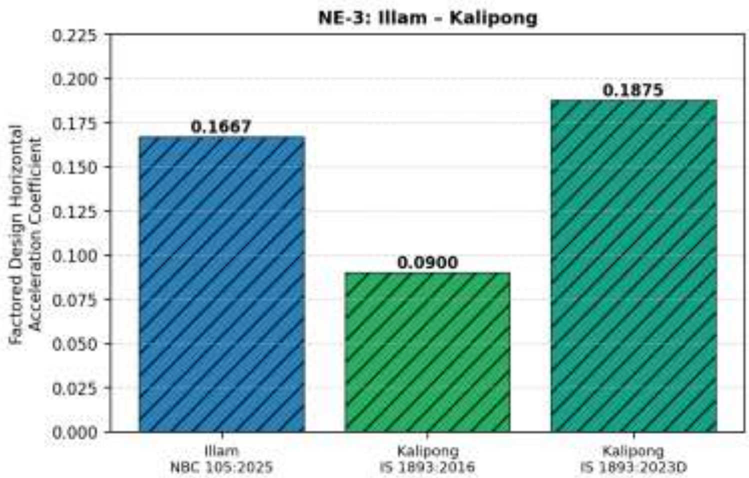

Figure 7. NE-3 — factored design horizontal acceleration coefficient by code.

4.4 NE-4: Murshidabad (India) – Nawabganj (Bangladesh)

Figure 8. NE-4 location: Murshidabad – Nawabganj (Google Earth view).

Table 10. NE-4 — inter-site distances

From	To	Approx. Distance (km)	Note / Border
Murshidabad, India	Nawabganj, Bangladesh	≈ 30 km	India-Bangladesh

Table 11. NE-4 — factored seismic inputs and outputs

Country	Location	Code	Z (g)	I	R (per code)	T_1 (s)	LC × E	Factored Cd	Factored Vb (kN)
India	**Murshidabad**	IS 1893:2016	0.16	1.0	5 (SMRF)	0.51	1.5	0.0600	142.36
India	**Murshidabad**	IS 1893:2023 Draft	0.40	1.0	5 (SMRF)	0.51	1.5	0.1500	355.90
Bangladesh	**Nawabganj**	BNBC 2020 (Z1)	0.12	1.0	8 (SMF)	0.46	1.0	0.0287	68.21

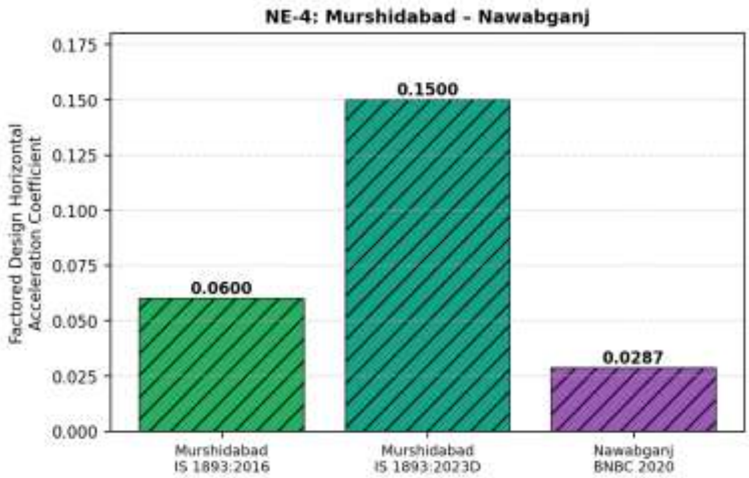

Figure 9. NE-4 — factored design horizontal acceleration coefficient by code.

4.5 NE-5: Arunachal Pradesh (India) – South Tibet (China) – Sylhet (Bangladesh)

Figure 10. NE-5 location: Arunachal Pradesh – South Tibet – Sylhet (Google Earth view).

Table 12. NE-5 — inter-site distances

From	To	Approx. Distance (km)	Note / Border
Arunachal (border)	South Tibet (Cona)	≈ 30 km	India-China
Arunachal Pradesh	Sylhet, Bangladesh	≈ 20 km	via Meghalaya
South Tibet (Cona)	Sylhet, Bangladesh	≈ 20 km	long-range, illustrative only

Table 13. NE-5 — factored seismic inputs and outputs

Country	Location	Code	Z (g)	I	R (per code)	T_1 (s)	LC × E	Factored Cd	Factored Vb (kN)
India	**Arunachal**	IS 1893:2016	0.36	1.0	5 (SMRF)	0.51	1.5	0.1350	320.31
India	**Arunachal**	IS 1893:2023 Draft	0.50	1.0	5 (SMRF)	0.51	1.5	0.1875	444.88

China	**South Tibet**	GB 50011-2010 (IX)	0.40	1.0	— (no R)	0.54	1.3	0.3175	753.41
Bangladesh	**Sylhet**	BNBC 2020 (Z4)	0.36	1.0	8 (SMF)	0.46	1.0	0.0862	204.64

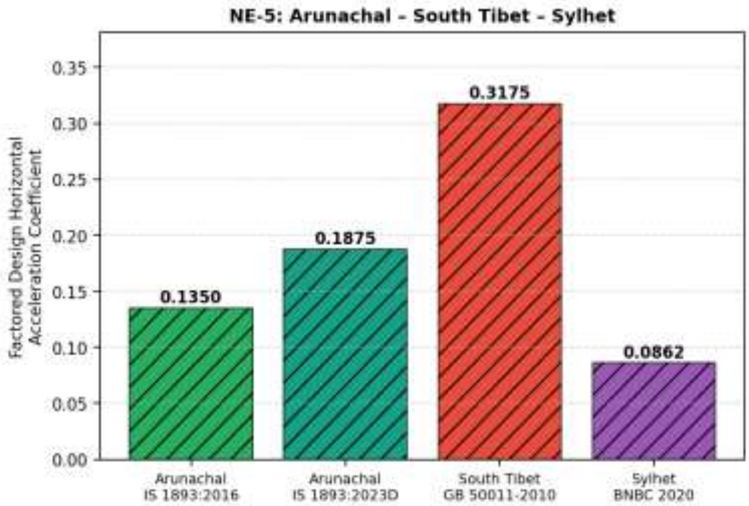

Figure 11. NE-5 — factored design horizontal acceleration coefficient by code.

5. Northwest India Region

Two border-area sub-regions (NW-1 and NW-2) are selected along the Mahakali front (Nepal-India) and the Humla-Tibet front (Nepal-China). At both sites the chosen settlements on either side of the border lie within just a few kilometers of one another.

5.1 NW-1: Darchula (Nepal) – Garbyang (India)

Figure 12. NW-1 location: Darchula – Garbyang (Google Earth view).

Table 14. NW-1 — inter-site distances

From	To	Approx. Distance (km)	Note / Border
Darchula, Nepal	Garbyang, India	≈ 5 km	Nepal-India (Mahakali river)

Table 15. NW-1 — factored seismic inputs and outputs

Country	Location	Code	Z (g)	I	R (per code)	T_1 (s)	LC × E	Factored Cd	Factored Vb (kN)
Nepal	**Darchula**	NBC 105:2025	0.40	1.0	6 (Rμ×Ωu)	0.51	1.0	0.1667	395.45
India	**Garbyang**	IS 1893:2016	0.36	1.0	5 (SMRF)	0.51	1.5	0.1350	320.31
India	**Garbyang**	IS 1893:2023 Draft	0.50	1.0	5 (SMRF)	0.51	1.5	0.1875	444.88

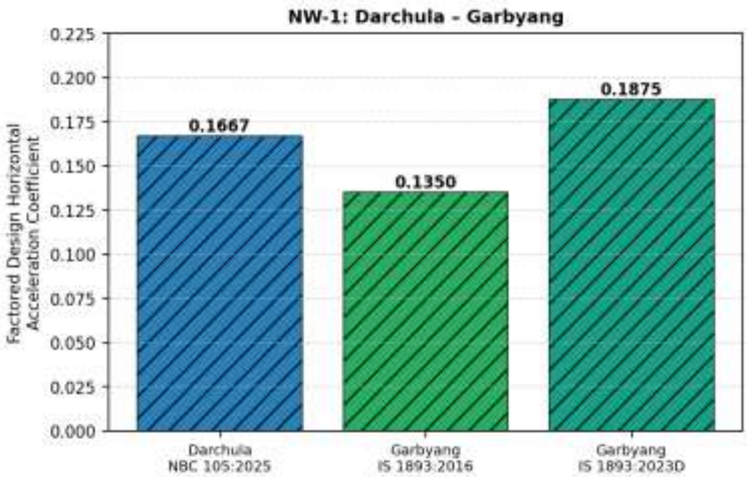

Figure 13. NW-1 — factored design horizontal acceleration coefficient by code.

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5.2 NW-2: Hilsa (Nepal) – Xieerwa (Tibet, China)

Figure 14. NW-2 location: Hilsa – Xieerwa (Google Earth view).

Table 16. NW-2 — inter-site distances

From	To	Approx. Distance (km)	Note / Border
Hilsa, Nepal	Xieerwa (Tibet), China	≈ 1 km	Nepal-China (Karnali River)

Table 17. NW-2 — factored seismic inputs and outputs

Country	Location	Code	Z (g)	I	R (per code)	T_1 (s)	LC × E	Factored Cd	Factored Vb (kN)
Nepal	**Hilsa**	NBC 105:2025	0.30	1.0	6 (Rμ×Ωu)	0.51	1.0	0.1250	296.58
China	**Xieerwa**	GB 50011-2010 (VIII)	0.20	1.0	— (no R)	0.54	1.3	0.1588	376.71

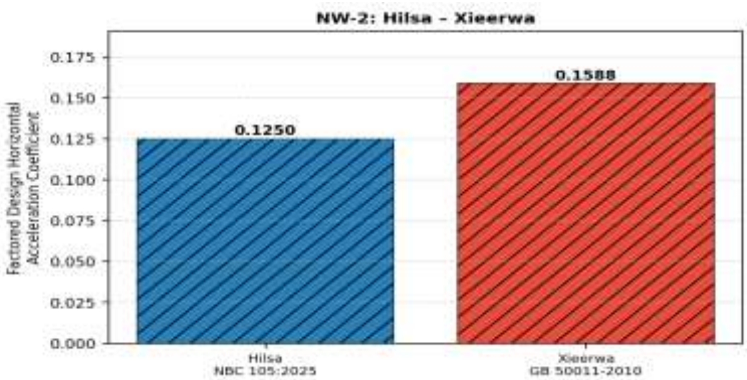

Figure 15. NW-2 — factored design horizontal acceleration coefficient by code.

6. Factored Design Response Spectra at Maximum PGA

To compare the worst-case design demand of the five codes on a single common axis, each spectrum is drawn at the highest PGA (or seismic-fortification intensity) encountered for that code in the present study and is then multiplied by its load-combination factor on E. Each code's own prescribed force-reduction factor for the SMRF system is applied: NBC 105:2025 by Rμ × Ωu = 6 (Ductile MRF), IS 1893:2016 / 2023 Draft by R = 5 (SMRF), BNBC 2020 by R = 8 (Special RC Moment Frame, BNBC 2020 Table 5.2.19), and GB 50011-2010 by NO R (the code does not prescribe an explicit force-reduction factor; α is applied directly with Seismic Grade 1 detailing). The resulting factored design response spectra are plotted in Figure 16.

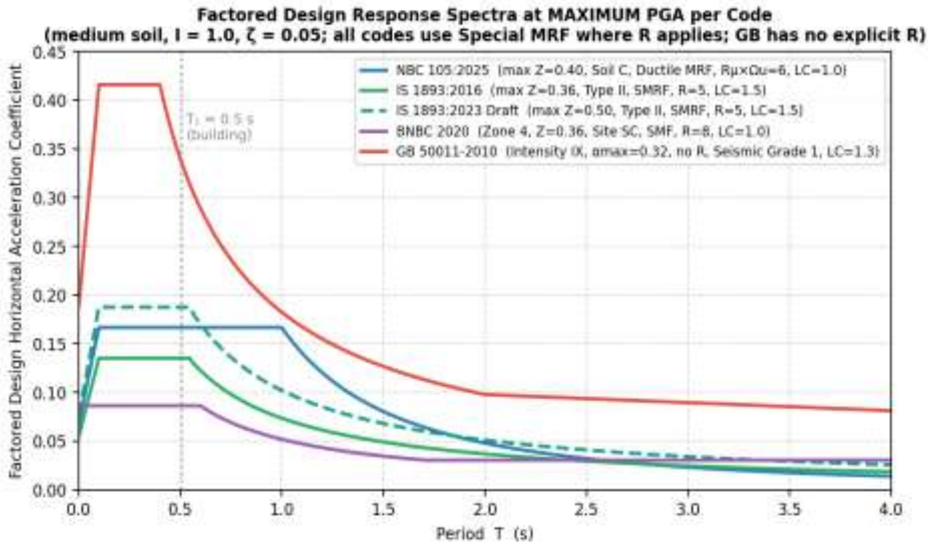

Figure 16. Factored design response spectra of the five codes at the maximum PGA per code (medium soil, I = 1.0, ζ = 0.05; all codes use the SMRF / Ductile MRF where R applies; GB has NO explicit R).

At the building period $T_1 \approx 0.5$ s the GB 50011-2010 spectrum is the highest (0.32 × 1.3 = 0.416 at the plateau), reflecting that the Chinese code does not divide the elastic spectrum by R. The IS 1893:2023 Draft is next (0.188), then NBC 105:2025 (0.167), IS 1893:2016 (0.135) and BNBC 2020 (0.086 — the lowest of the four, owing to BNBC's higher SMF reduction factor of R = 8 versus R = 5 in IS 1893). The very high apparent GB demand reflects the difference in design philosophy: GB 50011-2010 uses αmax frequent-EQ (representing a 50-year / 63 % probability event) and applies it elastically without an R-reduction, whereas the other four codes use a DBE-level (475-year) elastic spectrum and divide by R to obtain the inelastic design force. The two design routes produce different numerical force levels but are not necessarily inconsistent — the implicit reduction in the Chinese code is built into the αmax frequent / αmax rare ratio (≈ 0.32 / 1.40 ≈ 1/4.4 for Intensity IX), close to the explicit R = 5 used by the IS / NBC codes.

7. Discussion

The principal observation is that the factored design horizontal acceleration coefficient varies widely across the codes for what is effectively the same Himalayan-front seismic environment, and that the choice of force-reduction factor R is one of the major drivers of this variation alongside the prescribed PGA and the load-combination factor on E.

With the SMRF assumption applied consistently across all codes, IS 1893 retains the lowest of the four DBE-based codes' R values (R = 5), NBC 105:2025 retains its effective R = 6 from Rμ × Ωu, and BNBC 2020's R = 8 (Special RC Moment Frame) yields the smallest factored demand among the DBE-based codes (because the higher R divides the elastic spectrum more aggressively). GB 50011-2010 has no explicit R and applies αmax frequent directly, so its factored demand sits highest among all five codes at the highest-intensity sites.

Within the close-proximity sub-region NW-1 (Darchula-Garbyang, 5 km apart), the factored values are 0.167 (Nepal NBC 105:2025) vs 0.135 (India IS 1893:2016) — a 24 % gap — and 0.167 (Nepal) vs 0.188 (India IS 1893:2023 Draft) — an 11 % gap. In NW-2 (Hilsa-Xieerwa, 1 km apart) the factored values are 0.125 (Nepal NBC 105:2025) vs 0.159 (China GB 50011-2010, no R-division). The Chinese factored value at the same border environment is therefore 27 % higher than the Nepali factored value.

Within the proximate Northeast sub-regions NE-1 to NE-3 the factored values range from 0.048 (BNBC 2020 SMF / Tentulia) to 0.188 (IS 1893:2023 Draft). NE-2 (Biratnagar-Jogbani, 6 km apart) gives the cleanest direct comparison: NBC 105:2025 = 0.125, IS 1893:2016 = 0.135, IS 1893:2023 Draft = 0.188.

In NE-5 (Arunachal-South Tibet-Sylhet) the GB factored value (0.318) is the highest in the dataset, but this is a direct consequence of two compounding factors — (i) the highest seismic-fortification intensity (IX, 0.40 g) and (ii) no R-reduction — and not a fundamental 'over-design' inconsistency, since the GB design philosophy compensates through frequent-EQ-level elastic design and detailing-based ductility (Seismic Grade 1).

8. Conclusions

From the seven sub-regions surveyed, after the application of the load-combination factor on E and using each code's own prescribed force-reduction factor with the SMRF / Ductile MRF system uniformly assumed across all codes, the following conclusions are drawn on the actual factored design horizontal acceleration coefficient demanded by each code on the same residential RCC building in the same Himalayan-front seismic environment:

- The factored design horizontal acceleration coefficient is the appropriate basis for cross-code comparison, because it represents the actual force level imposed on the structural members after the load-combination factor on E (1.0 for NBC 105:2025 and BNBC 2020, 1.3 for GB 50011-2010, 1.5 for IS 1893) is applied. Comparing the un-factored 'code value' alone is not meaningful for design force levels.
- To keep the structural-system assumption identical across all five codes, the building is modeled as a Special / Ductile Moment-Resisting Frame (SMRF). The corresponding code-prescribed reduction factors are: Rμ × Ωu = 4 × 1.5 = 6 for NBC 105:2025 (Ductile RC MRF), R = 5 for IS 1893:2016 / 2023 Draft (SMRF), R = 8 for BNBC 2020 (Special RC Moment Frame, BNBC 2020 Table 5.2.19), and no explicit R for GB 50011-2010 (Seismic Grade 1 detailing).
- In NW-1 (Darchula-Garbyang, 5 km apart) the factored value is 0.167 (Nepal NBC 105:2025) vs 0.135 (India IS 1893:2016) — a 24 % gap. The IS 1893:2023 Draft raises the Indian value to 0.188 and reduces the Nepal-India gap to ≈ 11 %, indicating that adoption of the Draft would substantially harmonize Nepal-India design demand.
- In NW-2 (Hilsa-Xieerwa, 1 km apart) the factored values are 0.125 (Nepal NBC 105:2025) vs 0.159 (China GB 50011-2010 at Intensity VIII). The Chinese factored demand is ≈ 27 % higher than the

Nepali factored demand at the same-environment border — a direct consequence of GB 50011-2010 not prescribing an R-division.

- In NE-2 (Biratnagar-Jogbani, 6 km apart) the factored values are 0.125 (Nepal NBC 105:2025) and 0.135 (India IS 1893:2016) — an almost-perfect cross-border match. The IS 1893:2023 Draft (0.188) is then 50 % higher than the Nepali value, so in this particular sub-region the Draft would over-correct.
- The R = 8 (SMF) of BNBC 2020 reduces the factored value to 0.086 across the surveyed Bangladeshi sites, the lowest of any code in the dataset. Combined with the relatively conservative northern Bangladeshi zonation (Tentulia in Zone 2, Nawabganj in Zone 1) this places residential SMRF buildings on the Bangladeshi side at the lowest design demand in the cross-border comparison.
- Adoption of the IS 1893:2023 Draft would substantially close the present cross-border discrepancy between IS 1893:2016 and NBC 105:2025 along the Himalayan front, by raising the Indian factored level from 0.060 - 0.135 to a uniform 0.188 — broadly consistent with NBC 105:2025.

Practical implication for engineering practice: a normal residential SMRF building of the configuration considered in this study would be designed, with each code applied as written, for a factored design horizontal acceleration coefficient of approximately 0.13 in Nepal under NBC 105:2025, 0.06 - 0.14 in India under IS 1893:2016, 0.15 - 0.19 in India under the IS 1893:2023 Draft, 0.03 - 0.09 in Bangladesh under BNBC 2020, and 0.16 - 0.32 in China under GB 50011-2010 along the same Himalayan front. Cross-border projects (border-area schools, hospitals, embassies or industrial structures) should therefore explicitly select the most demanding of the relevant codes — typically GB 50011-2010 at Chinese-side sites or NBC 105:2025 / the IS 1893:2023 Draft at Nepal-India sites — given that adjacent codes can disagree by a factor of two within a few kilometers.

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