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A Comparative Study of IS 1893:2002 And IS 1893:2016 for RCC Multi-Storey Buildings

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Abstract

This Paper Presents A Focused Comparative Study Of The Provisions In The Older Indian Seismic Design Code **IS 1893 (Part 1):2002** And The Revised **IS 1893 (Part 1):2016**, And Discusses The Practical Implications For The Seismic Design Of Reinforced-Concrete (RCC) Multi-Storey Buildings. Key Differences In Response Spectra, Seismic Coefficients, Importance Factors, Site/Soil Characterization, Modelling Of Infill Walls, Minimum Lateral Force Provision, And Irregularity Definitions Are Identified And Discussed. The Study Summarizes How These Changes Affect Base Shear Estimates, Member Design, And Overall Structural Behaviour; It Also Suggests Practical Recommendations For Practitioners Transitioning To IS 1893:2016. Selected Numerical And Literature Results Are Used To Illustrate That IS 1893:2016 Generally Yields Higher Lateral Demands And Tighter Modelling/Detailing Requirements Compared To IS 1893:2002.

Keywords: IS 1893, Seismic Code, India, Response Spectrum, Base Shear, RCC Multi-Storey, Code Comparison

1. Introduction

Design Against Earthquake Forces Is A Critical Component Of Structural Design In Seismically Active Regions. In India, **IS 1893 (Part 1)** Is The Primary Codal Document For Design Of Buildings And Structures For Earthquake Resistance. The 2016 Revision (Hereafter “2016 Code”) Introduced Several Important Changes Relative To The 2002 Edition (Hereafter “2002 Code”)—Changes Motivated By International Practice, Updated Seismicity Data, And Observed Behaviour Of Structures. Practicing Engineers Must Understand These Changes Because They Influence Base Shear, Member Sizing, Detailing, And Overall Construction Cost And Safety. This Paper Compares Salient Provisions Of The Two Editions And Highlights Their Implications For RCC Multi-Storey Buildings.

2. Objectives Of The Study

1. Identify And Summarize Principal Differences Between IS 1893:2002 And IS 1893:2016 Relevant To RCC Multi-Storey Buildings.
2. Discuss How The Revisions Affect Seismic Demand (Base Shear, Storey Forces, Displacements) And Structural Design.
3. Provide Practical Recommendations For Engineers Adopting IS 1893:2016.

3. Methodology And Scope

This Is A Codal Comparison And Literature-Supported Analysis. Key Clauses From The Two Versions

Were Reviewed And Contrasted, And Representative Findings From Published Comparative Studies And Code Commentaries Were Used To Corroborate Observations. Where Appropriate, Typical Consequences Reported In Comparative Analyses (E.G., Change In Base Shear, Effect Of Importance Factor, Response Spectrum Differences) Are Summarized. The Scope Is Limited To Provisions Most Relevant For Design Of RCC Multi-Storey Frames (Equivalent Static Method And Response Spectrum Method, Seismic Coefficients, Site Effects, Importance Factors, Infill Modelling And Irregularity Definitions).

4. Summary Of Major Changes (2002 → 2016)

A Concise List Of The Principal Changes That Affect Design:

- **Design Response Spectra Extended To T = 6 S** (Previously Up To 4 S) And Separate Spectra For Equivalent Static And Response Spectrum Methods. This Affects Long-Period Structures. Cracindia.In
- **Unified 5% Damping Spectra For All Materials**: The 2016 Code Specifies The Same Design Response Spectrum For Different Materials (Clarified Spectral Definitions). Bentleysystems.Service-Now.Com
- **Importance Category Refinements**: An Intermediate Importance Category Introduced; Importance Factors (I) Adjusted For Certain Occupancies—This Increases Seismic Forces For Some Buildings. Scribd
- **Minimum Lateral Force Clarified/Strengthened** To Ensure A Lower Bound Of Design Lateral Demand Even For Short Period Structures. Scribd
- **Separate Sa/G Expressions** (Spectral Acceleration) And Curves For Equivalent Static Vs Response Spectrum Methods; The 2016 Code Provides Clearer, Separate Curves And Empirical Expressions. IJRASET
- **Explicit Guidance On Modelling Masonry Infill**: 2016 Gives Clearer Statements On Whether And How To Include Infill Stiffness In Analysis. This Impacts Effective Stiffness And Distribution Of Forces. Scribd
- **Clarification On Irregularity Types And Treatment** (Plan, Vertical, Mass Irregularities) And Minimum Requirements For Checking Irregular Buildings.

5. Comparative Table — Selected Clauses

Topic	IS 1893:2002 (Old)	IS 1893:2016 (New)	Practical Effect
Design Spectra (T Range)	Spectra Provided Up To 4.0 S	Spectra Defined Up To 6.0 S; Separate Curves For Methods	Affects Long-Period Response Of Tall/Flexible Buildings; More Accurate For Tall Structures. Cracindia.In
Spectra For Methods	Single Set Used For Both Methods	Separate Spectra For Equivalent Static & Response Spectrum Methods	Slightly Different Sa/G → Changes Base Shear And Modal Results. IJRASET
Importance Factor (I)	Fewer Categories; Some Occupancies I	Intermediate Category Introduced; Higher I For	Often Increases Design Lateral Forces For Buildings Previously Assigned

Topic	IS 1893:2002 (Old)	IS 1893:2016 (New)	Practical Effect
	= 1.0	Some Buildings (E.G., Critical, Multistorey)	I=1.0. Scribd
Minimum Lateral Force	Less Explicit (Lower Bound Present)	Strengthened And Clarified Minimum Lateral Force Provisions	Prevents Under-Design For Short-Period Structures. Scribd
Masonry Infill	Use Of Infill Often Ignored Or Treated Simplistically	Clearer Guidance On Modelling Infill Stiffness And Its Effect	Can Reduce Member Sizes If Infill Stiffness Included, But Modelling Cautions Added. Scribd
Irregularities	General Guidance	Expanded Definitions And Clear Procedures For Various Irregularities	Requires Explicit Checks And Potentially More Conservative Design. Bentleysystems.Service-Now.Com
Damping Assumption	Specified But Varied By Material	Same Design Spectra For 5% Damping For All Materials	Simplifies Application; Ensures Consistency.

6. Effects On Design Of RCC Multi-Storey Buildings

6.1 Base Shear And Lateral Demand

Multiple Comparative Studies Have Reported **Higher Base Shear Values** When Computations Are Performed Per IS 1893:2016 Compared To IS 1893:2002 For Typical Multi-Storey RC Frames. The Increase Is Attributed Primarily To (A) Higher Or Reclassified Importance Factors, (B) Separate Spectral Definitions For Static Vs Dynamic Methods, And (C) More Conservative Minimum Lateral Force And Irregularity Provisions. Reported Increases In Base Shear Of The Order Of **10–25%** Are Observed In Literature For Many Building Models; The Exact Change Depends On Site Zone, Importance Factor, Soil Class And Natural Period. IJARIIT+1

6.2 Displacements And Drift

Response Spectrum Analyses Under The New Spectra (Extended To 6 S) Can Produce **Different Modal Participation** And Altered Displacement Profiles—Especially For Tall, Flexible Buildings. Some Studies Show Larger Storey-Displacements Under IS 1893:2016 For The Same Model Compared To 2002, Indicating The Need For Attention To Serviceability (Drift) Limits. IJTRD

6.3 Modelling Of Infill Walls

IS 1893:2016 Provides Clearer Guidance On Modelling Masonry Infill. If Infill Stiffness Is Included (As Per Code Caution), The **Effective Stiffness Of Frames Increases**, Which May Reduce Lateral Drift But Change Load Distribution Between Frames And Shear Walls. Designers Must Be Cautious: Including Infill May Inadvertently Change Mode Shapes And Member Forces—So Modelling Must Be Consistent And Conservative. Scribd

6.4 Irregular Buildings And Detailing Needs

With Better Definitions And Stricter Requirements For Irregular Structures In 2016, Some Buildings That Previously Passed Simple Checks Under 2002 May Require **Additional Analysis**, Detailing, Or Seismic-Resistant Features (E.G., Coupling Beams, Redistribution) Under 2016.

7. Numerical (Literature) Illustrations

Several Comparative Papers Used Case Studies (G+4 To G+12 RCC Buildings) And Reported Consistent Observations:

- **Base Shear**: Increased Under IS 1893:2016 (Typical Range 10–25% Higher). IJARIIT+1
- **Member Forces**: Columns And Shear Walls Often Show Higher Design Forces; Beam Forces May Redistribute. IRJET
- **Story Drift**: In Some Studies, Drift Under 2016 Is Larger (Depends On Spectral Shape And Period). IJTRD

Note: Exact Numerical Outcomes Are Case Dependent (Site Zone, Soil Class, Mass Distribution, Stiffness, Importance Factor). Practitioners Should Run Project-Specific Analyses Using The Respective Code Provisions.

8. Practical Recommendations For Design Practice

1. **Review Importance Category**: Identify And Assign The Correct Importance Factor Per IS 1893:2016; Do Not Assume Previous I = 1.0 For Multistorey Or Critical Buildings. Scribd
2. **Use Appropriate Spectra**: Apply The Separate Spectral Curves For Equivalent Static And Response Spectrum Methods As Specified In 2016; Ensure Sa/G Selection Matches Method And Soil Class. IJRASET
3. **Model Infill Carefully**: If Infill Walls Are To Be Modelled, Document Assumptions And Consider Sensitivity Studies (Infill Included Vs Excluded). Infill Can Beneficially Stiffen Frames But Can Also Create Undesirable Load Paths. Scribd
4. **Check Minimum Lateral Force**: Ensure That The Minimum Lateral Force Provision Of IS 1893:2016 Has Been Applied; This Prevents Under-Designed Short Period Structures. Scribd
5. **Evaluate Irregularities**: Apply The Clarified Irregularity Checks In 2016; If Irregularities Exist, Consider More Detailed Dynamic Analysis And Possible Design Modifications. Bentleysystems.Service-Now.Com
6. **Perform Comparative Analysis**: For Major Projects, Run Analyses Under Both Code Provisions During The Transition Stage To Understand The Change In Demands And Cost Implications. Studies Suggest Making This A Standard QA Step. IJARIIT

9. Conclusion

IS 1893:2016 Represents A Substantial Refinement Of The Indian Seismic Design Code Compared To IS 1893:2002. The 2016 Revision Provides Clearer Spectral Definitions (Extended Period), Re-Categorized Importance Factors, Strengthened Minimum Lateral Force Requirements, Explicit Guidance On Infill Modelling, And Better Treatment Of Irregularities—Changes That Often Translate Into **Higher Seismic Demands** For Many RCC Multi-Storey Buildings. Adoption Of IS 1893:2016 Will Likely Improve Seismic Resilience But May Require **Larger Member Sizes, Enhanced Detailing, And Potentially Higher Construction Cost**. Engineers Should Familiarize Themselves With The New Provisions, Apply Careful Modelling (Especially Concerning Infill And Irregularity), And Perform Project-Level Comparative Checks. Cracindia.In+1

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