

The Most Common Errors in Seismic Design ...And How to Properly Avoid Them

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Abstract

The paper identifies the most common errors that structural engineers make when performing seismic design and calculations. The paper demonstrates the proper application of Codes and Standards so as to avoid errors and misapplications. The paper initially focuses on low seismic risk design categories (and the surprisingly numerous seismic provisions which apply therein) and then advances to the requirements unique to high seismic risk design categories only.

Introduction

This paper is based upon IBC 2012, ASCE 7-10, AISC 360-10, ASCE 318-10, ACI 318-11 (including Chapter 21 and Appendix D) and other Standards. A few of the topics/common errors that are addressed include: Amplified seismic force Omega o, Cd deflection amplification, Modal analysis triggers, Rho redundancy factor, 0.7 E for Allowable Stress Design, Ev Vertical seismic effect, Vertical distribution of base shear, Orthogonal effects on corner columns, Diaphragm forces, Accidental torsion, Foundation ties, Unique calculations and detailing for Special Steel Systems, Concrete detailing and splice lengths when subject to high seismic, Wood frame hold-downs, Masonry wall anchors, and Wind governed buildings.

Seismic Design and Errors

This paper is written in checklist format. It is intended that an engineer could read the list so as to review and verify adequate knowledge of seismic design and common errors, as well as on a per project basis when checking a project by the engineer or by others. The basis of this paper is ASCE 7-10, and IBC 2012. Referenced sections are highlighted in brackets thus: [ASCE 7 Section Number].

1. Seismic Design Category A

[11.4.1] [11.7] [1.4]

[1.4 General Structural Integrity]

When in Seismic Design Category A, you should not use any of the provisions of Chapter 12. Instead, use the General Structural Integrity provisions of Section 1.4. Note that the General Structural Integrity provisions have some loads which may often be erroneously unaccounted for. The forces required include 1% dead load, 5% of dead plus live load for beam connections, and 20% of wall weight for wall connections. Non-Structural Components in Seismic Design Category A are exempt from Seismic Design requirements, as stated in Section 11.7.

2. Importance Factor

[11.5.1] [Table 1.5-2] [Table 1.5-1] [IBC Table 1604.5]

The Importance factor is based upon Risk Category and the associated Life Safety, Hazard and Essential nature of the structure. Both the ASCE 7 and IBC tables should be reviewed. A typical building can sometimes evolve into an I_p equal to 1.25 or 1.5 when occupancy or use expands. Examples include relatively small churches (occupancy greater than 300), or a building where hazardous materials are stored. It should be noted that for building design I_p = 1.0, 1.25, or 1.5 but for non-structural components I_p = 1.0, or 1.5 only [13.1.3] such that I_p may not equal I_e, and in some instances I_p may be less than I_e.

3. Continuous Load Path

[12.1.3] ASCE 7 has very specific provisions for many elements such collectors, connections, diaphragms, walls, etc. However, in addition to the specifics, the engineer is required by Section 12.1.3 to provide a continuous load path for all inertial forces from their origin to the foundation. Such load path shall conform to the relative stiffness and strength of the elements which exist in the structure.

4. R-Factor

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Seismic Design and Retrofit of Bridges M. J. N. Priestley, F. Seible, Gian Michele Calvi, 1996-04-12 Because of their structural simplicity bridges tend to be particularly vulnerable to damage and even collapse when subjected to earthquakes or other forms of seismic activity Recent earthquakes such as the ones in Kobe Japan and Oakland California have led to a heightened awareness of seismic risk and have revolutionized bridge design and retrofit philosophies In Seismic Design and Retrofit of Bridges three of the world's top authorities on the subject have collaborated to produce the most exhaustive reference on seismic bridge design currently available Following a detailed examination of the seismic effects of actual earthquakes on local area bridges the authors demonstrate design strategies that will make these and similar structures optimally resistant to the damaging effects of future seismic disturbances Relying heavily on worldwide research associated with recent quakes Seismic Design and Retrofit of Bridges begins with an in depth treatment of seismic design philosophy as it applies to bridges The authors then describe the various geotechnical considerations specific to bridge design such as soil structure interaction and traveling wave effects Subsequent chapters cover conceptual and actual design of various bridge superstructures and modeling and analysis of these structures As the basis for their design strategies the authors focus is on the widely accepted capacity design approach in which particularly vulnerable locations of potentially inelastic flexural deformation are identified and strengthened to accommodate a greater degree of stress The text illustrates how accurate application of the capacity design philosophy to the design of new bridges results in structures that can be expected to survive most earthquakes with only minor repairable damage Because the majority of today's bridges were built before the capacity design approach was understood the authors also devote several chapters to the seismic assessment of existing bridges with the aim of designing and implementing retrofit measures to protect them against the damaging effects of future earthquakes These retrofitting techniques though not considered appropriate in the design of new bridges are given considerable emphasis since they currently offer the best solution for the preservation of these vital and often historically valued thoroughfares Practical and applications oriented Seismic Design and Retrofit of Bridges is enhanced with over 300 photos and line drawings to illustrate key concepts and detailed design procedures As the only text currently available on the vital topic of seismic bridge design it provides an indispensable reference for civil structural and geotechnical engineers as well as students in related engineering courses A state of the art text on earthquake proof design and retrofit of bridges Seismic Design and Retrofit of Bridges fills the urgent need for a comprehensive and up to date text on seismic ally resistant bridge design The authors all recognized leaders in the field systematically cover all aspects of bridge design related to seismic resistance for both new and existing bridges A complete overview of current design philosophy for bridges with related seismic and geotechnical considerations Coverage of conceptual design constraints and their relationship to current design alternatives Modeling and analysis of bridge structures An exhaustive look at common building materials and

their response to seismic activity A hands on approach to the capacity design process Use of isolation and dissipation devices in bridge design Important coverage of seismic assessment and retrofit design of existing bridges **PE Structural Depth Exam Study Guide for Civil Engineers (2025-2026)** Jennifer Schultz, You have already done the hard part You earned your engineering degree You gained field experience Now the PE Structural Depth exam stands between you and professional licensure This is not just another test It is the credential that validates your expertise strengthens your authority and expands your career opportunities PE Structural Depth Exam Study Guide for Civil Engineers 2025 2026 was built for engineers who want focused efficient and exam relevant preparation No unnecessary theory No wasted pages Only what you need to master structural depth concepts and perform confidently under exam conditions Inside this guide you will find Clear breakdowns of structural analysis methods Reinforced concrete and steel design principles Load combinations and code application strategies Foundation design and soil structure interaction concepts Seismic and wind design essentials Step by step problem solving techniques Realistic practice problems modeled after the PE Structural Depth format Detailed answer explanations that sharpen engineering judgment Each section is structured to strengthen both calculation accuracy and conceptual clarity You will not just memorize formulas you will understand when and why to apply them The practice problems simulate real exam pressure helping you manage time improve precision and reduce costly mistakes Many candidates fail not because they lack knowledge but because they lack strategic preparation This guide closes that gap Whether you are retaking the exam or preparing for your first attempt this study guide provides the disciplined structure and targeted repetition required for success Professional licensure changes how clients employers and colleagues see you It increases responsibility credibility and earning potential Prepare with purpose Solve with confidence Earn your PE license

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Zhang, 2018-06-18 Rock Dynamics Experiments Theories and Applications is a collection of scientific and technical papers presented at the Third International Conference on Rock Dynamics and Applications RocDyn 3 Trondheim Norway 26 27 June 2018 The papers in the book reflect the recent developments in experiment and theory as well as engineering applications of rock dynamics Rock dynamics studies the response of rock and rock masses under dynamic loading and during the state transition from static loading to kinetic movement It also includes the study of engineering countermeasures to dynamic instability of rock and rock masses The topics in the book include Dynamic theories Numerical simulation Propagation of stress waves Dynamic tests of rock Stability of underground openings under dynamic loading Rockburst Seismic monitoring Dynamic rock support Blasting Earthquake related rock structure damage etc Applications such as rockburst dynamic rock support seismic monitoring blasting and earthquake related rock structure damage are paid special attention in Rock Dynamics Experiments Theories and Applications The papers from specialists both from mining and tunnelling branches discuss commonly interested dynamic issues Their experience and knowledge in the application of rock dynamics are

extremely valuable for all academics engineers and professionals who work with rock dynamics *Engineering News-record*,1930 **Architectural Graphic Standards for Residential Construction** American Institute of Architects,2010-04-26

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Coduto,1994 *Foundation Design Principles and Practices* is primarily intended to be a textbook for undergraduate and graduate level foundation engineering courses It also can serve as a reference book for practicing engineers As the title implies it is heavily design oriented and discusses methods of applying engineering theories principles and research to practical design problems *Historical Building Construction: Design, Materials, and Technology (Second Edition)* Donald Friedman,2010 Winner of the Association for Preservation Technology APT 2012 Lee Nelson Book Award this book is an updated edition of the classic text detailing the ins and outs of old building construction A comprehensive guide to the physical construction of buildings from the 1840s to the present this study covers the history of concrete steel and skeleton frame buildings provides case histories that apply the information to a wide range of actual projects and supplies technical data essential to professionals who work with historic structures **JPT. Journal of Petroleum Technology**,2000-07

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Federal Register ,1984-12-18 Concrete International ,2004 Petroleum World ,1927 Proceedings, Fourth U.S. National Conference on Earthquake Engineering ,1990 Proceedings of ATC-29 Seminar and Workshop on Seismic Design and Performance of Equipment and Nonstructural Elements in Buildings and Industrial Structures ,1992 **SPE Global Link** ,2001 Reliability and Optimization of Structural Systems D.M. Frangopol,R.B. Corotis,R. Rackwitz,1997-02-27 This book contains 38 papers presented at the seventh Working Conference on Reliability and Optimization of Structural Systems held at Boulder Colorado USA on April 2 4 1996 The Working Conference was organized by the IFIP International Federation for Information Processing Working Group 7 5 of Technical Committee 7 and was the seventh in a series of similar conferences The objectives of the Working Group and hence this publication are to promote modern structural systems optimization and reliability theory to advance international co operation in the field of structural system optimization and reliability theory to stimulate research development and application of structural system optimization and reliability theory to further dissemination and exchange of information on reliability and optimization of structural systems and to encourage education in structural system organization and reliability theory

Atomic Energy Law Reporter ... Commerce Clearing House,1955 Proceedings of Seminar on Seismic Design, Performance, and Retrofit of Nonstructural Components in Critical Facilities ,2003 **Signal** ,1993

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Table of Contents Common Errors In Seismic Design How To Avoid Them T

1. Understanding the eBook Common Errors In Seismic Design How To Avoid Them T
 - The Rise of Digital Reading Common Errors In Seismic Design How To Avoid Them T
 - Advantages of eBooks Over Traditional Books
2. Identifying Common Errors In Seismic Design How To Avoid Them T
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Common Errors In Seismic Design How To Avoid Them T
 - User-Friendly Interface
4. Exploring eBook Recommendations from Common Errors In Seismic Design How To Avoid Them T

- Personalized Recommendations
 - Common Errors In Seismic Design How To Avoid Them T User Reviews and Ratings
 - Common Errors In Seismic Design How To Avoid Them T and Bestseller Lists
5. Accessing Common Errors In Seismic Design How To Avoid Them T Free and Paid eBooks
 - Common Errors In Seismic Design How To Avoid Them T Public Domain eBooks
 - Common Errors In Seismic Design How To Avoid Them T eBook Subscription Services
 - Common Errors In Seismic Design How To Avoid Them T Budget-Friendly Options
 6. Navigating Common Errors In Seismic Design How To Avoid Them T eBook Formats
 - ePub, PDF, MOBI, and More
 - Common Errors In Seismic Design How To Avoid Them T Compatibility with Devices
 - Common Errors In Seismic Design How To Avoid Them T Enhanced eBook Features
 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Common Errors In Seismic Design How To Avoid Them T
 - Highlighting and Note-Taking Common Errors In Seismic Design How To Avoid Them T
 - Interactive Elements Common Errors In Seismic Design How To Avoid Them T
 8. Staying Engaged with Common Errors In Seismic Design How To Avoid Them T
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Common Errors In Seismic Design How To Avoid Them T
 9. Balancing eBooks and Physical Books Common Errors In Seismic Design How To Avoid Them T
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Common Errors In Seismic Design How To Avoid Them T
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Common Errors In Seismic Design How To Avoid Them T
 - Setting Reading Goals Common Errors In Seismic Design How To Avoid Them T
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Common Errors In Seismic Design How To Avoid Them T

- Fact-Checking eBook Content of Common Errors In Seismic Design How To Avoid Them T
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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