

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

*Thomas F. Heausler, PE, SE  
Structural Engineer  
Kansas City, MO*

### 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 310-10, 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<sub>p</sub> 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<sub>p</sub> = 1.0, 1.25, or 1.5 but for non-structural components I<sub>p</sub> = 1.0, or 1.5 only [13.1.3] such that I<sub>p</sub> may not equal I<sub>e</sub>, and in some instances I<sub>p</sub> may be less than I<sub>e</sub>.

#### 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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**PT Brinkman**



## **Common Errors In Seismic Design How To Avoid Them T:**

**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 **Applied Mechanics Reviews** ,1976 **Rock Dynamics and Applications 3** Charlie Li,Xing Li,Zong-Xian 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 The residential construction market may have its ups and downs but the need to keep your construction knowledge current never lets up Now with the latest edition of *Architectural Graphic Standards for Residential Construction* you can keep your practice at the ready This edition was expertly redesigned to include all new material on current technology specific to residential projects for anyone designing constructing or modifying a residence With additional new content covering sustainable and green designs sample residential drawings residential construction code requirements and contemporary issues in residential construction it s a must have resource And now it s easier to get the information you need when you need it with references to the relevant building codes built right into the details and illustrations These new smart details go beyond dimensions with references to the International Residential Building Code presenting all the information you need right at your fingertips New features and highlights include Loads of previously unpublished content over 80% is either new or entirely revised Sustainable green design information in every chapter a must today s practicing building and construction professionals Coverage of contemporary issues in residential construction aging in place new urbanism vacation and small homes historic residences it s all here Coverage of single and multi family dwellings complete coverage of houses row homes and quadraplexes as dictated by the International Residential Building Codes *Foundation Design* Donald P. 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

**Advances in Frontier Research on Engineering Structures Volume 2** Yang Yang,Sudharshan N. Raman,Bingxiang Yuan,Zhijun Xu,2023-02-08 *Advances in Frontier Research on Engineering Structures* focuses on the research of advanced structures and anti seismic design in civil engineering The proceedings present the most cutting edge research directions and achievements related to civil and structural engineering Topics covered in the proceedings include Engineering Structure and Seismic Resistance Structural Mechanics Analysis Components and Materials Structural Seismic Design 3D Printing Concrete Other Related Topics The works of this proceedings will promote development of civil and structural engineering resource sharing flexibility and high efficiency Thereby promote scientific information interchange between scholars from the top universities research centers and high tech enterprises working all around the world **JPT.**

**Journal of Petroleum Technology** ,2000-07 Architectural Graphic Standards The American Institute of Architects,2007-03-30 Since 1932 the ten editions of *Architectural Graphic Standards* have been referred to as the architect s bible From site excavation to structures to roofs this book is the first place to look when an architect is confronted with a question about building design With more than 8 000 architectural illustrations including both reference drawings and constructible architectural details this book provides an easily accessible graphic reference for highly visual professionals To celebrate seventy five years as the cornerstone of an industry this commemorative Eleventh Edition is the most thorough and significant revision of *Architectural Graphic Standards* in a generation Substantially revised to be even more relevant to today s design professionals it features An entirely new innovative look and design created by Bruce Mau Design that includes a modern page layout bold second color and new typeface Better organized a completely new organization structure applies the UniFormat r classification system which organizes content by function rather than product or material Expanded and updated coverage of inclusive universal and accessible design strategies Environmentally sensitive and sustainable design is presented and woven throughout including green materials LEEDS standards and recyclability A bold contemporary new package as impressive closed as it is open the Eleventh Edition features a beveled metal plate set in a sleek black cloth cover Ribbon Markers included as a convenient and helpful way to mark favorite and well used spots in the book All New material Thoroughly reviewed and edited by hundreds of building science experts and experienced architects all new details

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**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 Modern Steel Construction ,2008 Atomic Energy Law Reporter ... Commerce Clearing House,1955 **Proceedings of Seminar on Seismic Design, Performance, and Retrofit of Nonstructural Components in Critical Facilities** ,2003

## **Common Errors In Seismic Design How To Avoid Them T** Book Review: Unveiling the Power of Words

In some sort of driven by information and connectivity, the energy of words has be evident than ever. They have the capability to inspire, provoke, and ignite change. Such may be the essence of the book **Common Errors In Seismic Design How To Avoid Them T**, a literary masterpiece that delves deep into the significance of words and their effect on our lives. Compiled by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we will explore the book is key themes, examine its writing style, and analyze its overall impact on readers.

<https://matrix.jamesarcher.co/public/uploaded-files/fetch.php/Framework%20Digital%20Literacy%20Manual.pdf>

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