Multimedia Package for LRFD Steel Bridge Design

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15. Supplementary Notes A CD-ROM was developed in this project and can be obtained by contacting the PI, Dr. H. Toutanji.		
16. Abstract This project developed a Load and Resistance Factor Design (LRFD) multimedia package to provide a practical introduction and an in-depth understanding of the new technological advances in the design of steel bridges. This package can be used to train engineers, architects, designers, and personnel who are in charge of the design, construction, maintenance, and rehabilitation of bridges. The complete package includes instructions of how to design a steel bridge with AASHTO load and resistance factor design recommendations and specifications. The package includes five practical examples to provide a generic overview of the design concept and process.		
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Executive Summary

Multimedia technology is an essential instrument in the development of all informed engineers. This multimedia package provides an exclusive background and an in-depth understanding of the new technological advances in the design of steel bridges. It gives guidelines and step-by-step instructions for the design of different steel elements of a bridge using the Load and Resistance Factor Design (LRFD) specifications. One of the advantages of the package is that it can be conveniently updated and modified to add future changes and procedures necessary for tomorrow's structural demand.

The LRFD specifications were created with a conservative point of view, applying almost exclusively the limit states of strength. It is consistent with other major bridge codes adopted or being adopted in other countries such as Canada and the European countries. Because of this many states throughout the United States have changed their specifications and are currently implementing LRFD. It incorporates deep analysis and design methods with different kinds of loads and resistance factors, which are based on the known variability of applied loads and the material properties. This multimedia package provides a basis on which an engineer can design a steel bridge using LRFD specifications. It includes some PDF documents containing explanatory examples and an overview of the strategic development of this structural code.

This project focuses on training inexperienced engineers who are interested in learning about the implementation of LRFD specifications in the design of steel bridges. It is a valuable tool because it contains procedures and specifications for many possible situations, together with detailed examples and illustrations. This package is a time saving, user-friendly, reliable way of learning.

The CD multimedia package will be periodically updated by the principal investigator.

1.0 Introduction

The main goal of this Load and Resistance Factor Design (LRFD) multimedia package is to provide a practical introduction and an in-depth understanding of technological advances in the design of steel bridges. This package can be used to train engineers, architects, designers, and personnel who are in charge of the design, construction, maintenance, and rehabilitation of bridges. The complete package includes instructions of how to design a steel bridge with AASHTO load and resistance factor design recommendations and specifications. The package includes five practical examples to provide the user with a generic overview of the design concept and process.

LRFD is a method of proportioning structures such that no applicable limit state is exceeded when the structure is subjected to all appropriate design load combinations. The LRFD specifications, like all other specifications, treat almost exclusively the limit states of strength because of the overriding considerations of public safety for people and property. LRFD specifications are among the many publications developed and maintained by the American Institute of Steel Construction (AISC). Since the first edition of LRFD was published in 1994, many states have been developing plans and taking steps to fully implement LRFD. The Federal Highway Administration (FHWA) has established a goal that the LRFD standards shall be used in all new bridge designs in the United States after 2007.

The CD package developed in this project offers a tutorial that employs a wide range of multimedia, including hyperlinks and high-resolution graphics. To ensure the wide use of this multimedia package, it will run on different operating systems. The advantage of this package is that it can be accessible for updating and adding information whenever necessary. It is a self-training and time-saving tool.

2.0 Methodology

An exhaustive literature review was done on existing work using LRFD. Since LRFD is an important, emerging topic, step-by-step procedures were included in the package for better understanding.

The package is divided into twelve chapters accompanied with three design examples and various technical definitions. Each chapter contains specific equations, tables, and diagrams of relevance. To utilize the benefits of a multimedia product to the fullest, hyperlinks were created in all chapters and design examples to quickly access the required details. There are also display boxes that provide instantaneous definitions to technical terms, a feature designed for a new engineer. This package was created with the Macromedia Dreamweaver MX software for producing dynamic HTML pages.

To facilitate future updates of the multimedia package, including recommendations by the Alabama Department of Transportation (ALDOT), the contact information of the principal investigator is included in the package.

3.0 The CD-ROM Description

The CD-ROM includes a home page, introduction, theory, chapters, design examples, definitions, and general and contact information pages. A floating menu is present on the top of each page for quick accessibility of the contents of the package. The floating menu always remains at the top of the page.

3.1 Home Page

The home page is a welcoming page explaining the goals and an overview of the package. This multimedia package is a self-training tool providing information on LRFD specifications (see Figure 3-1).

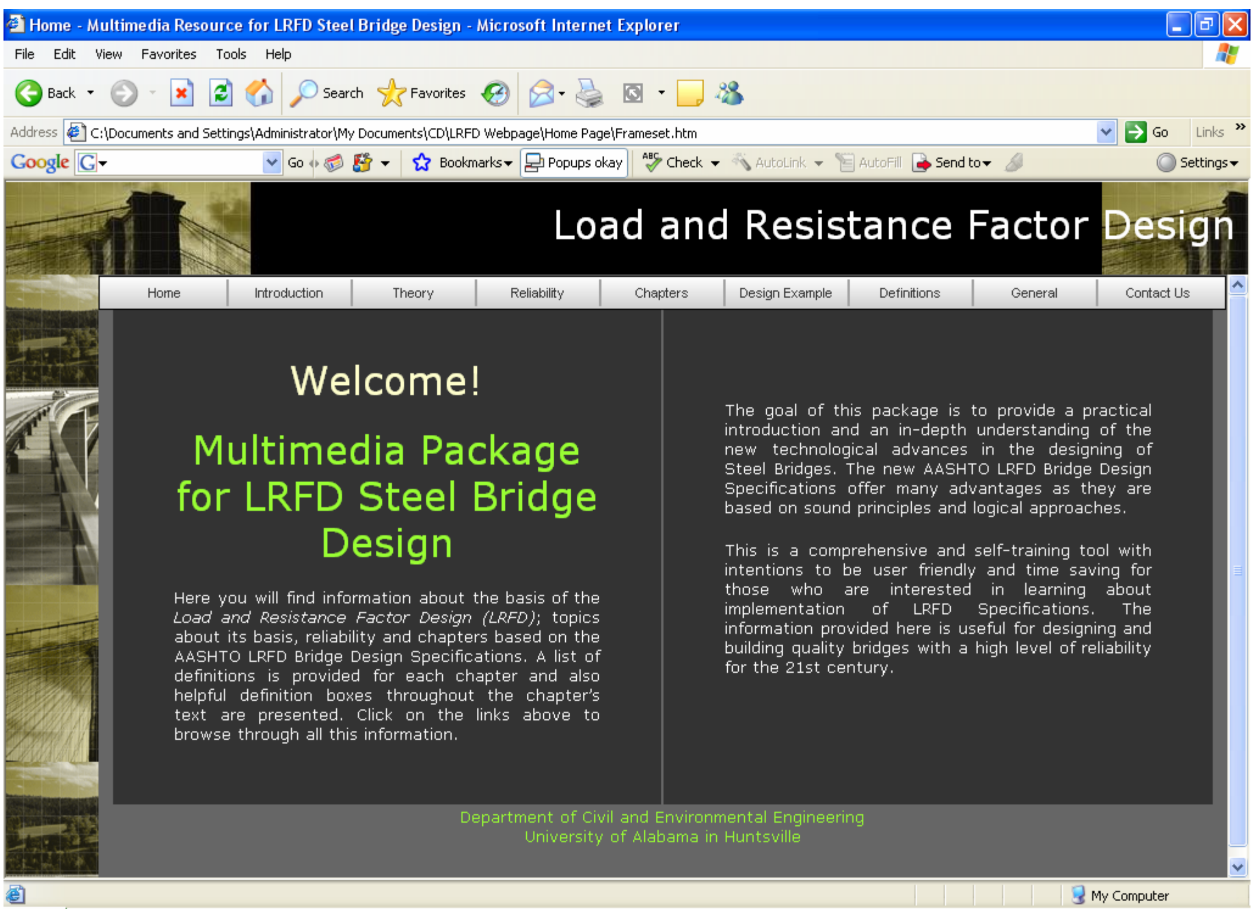


Figure 3-1. Home page of the multimedia package for LRFD steel bridge design

3.2 Introduction

The introduction page provides a brief description of LRFD specifications. This page explains the importance of these specifications for bridge safety and design. It introduces the user to the benefits of LRFD. This page projects the idea of LRFD being implemented for all bridge designs in the United States (see Figure 3-2).

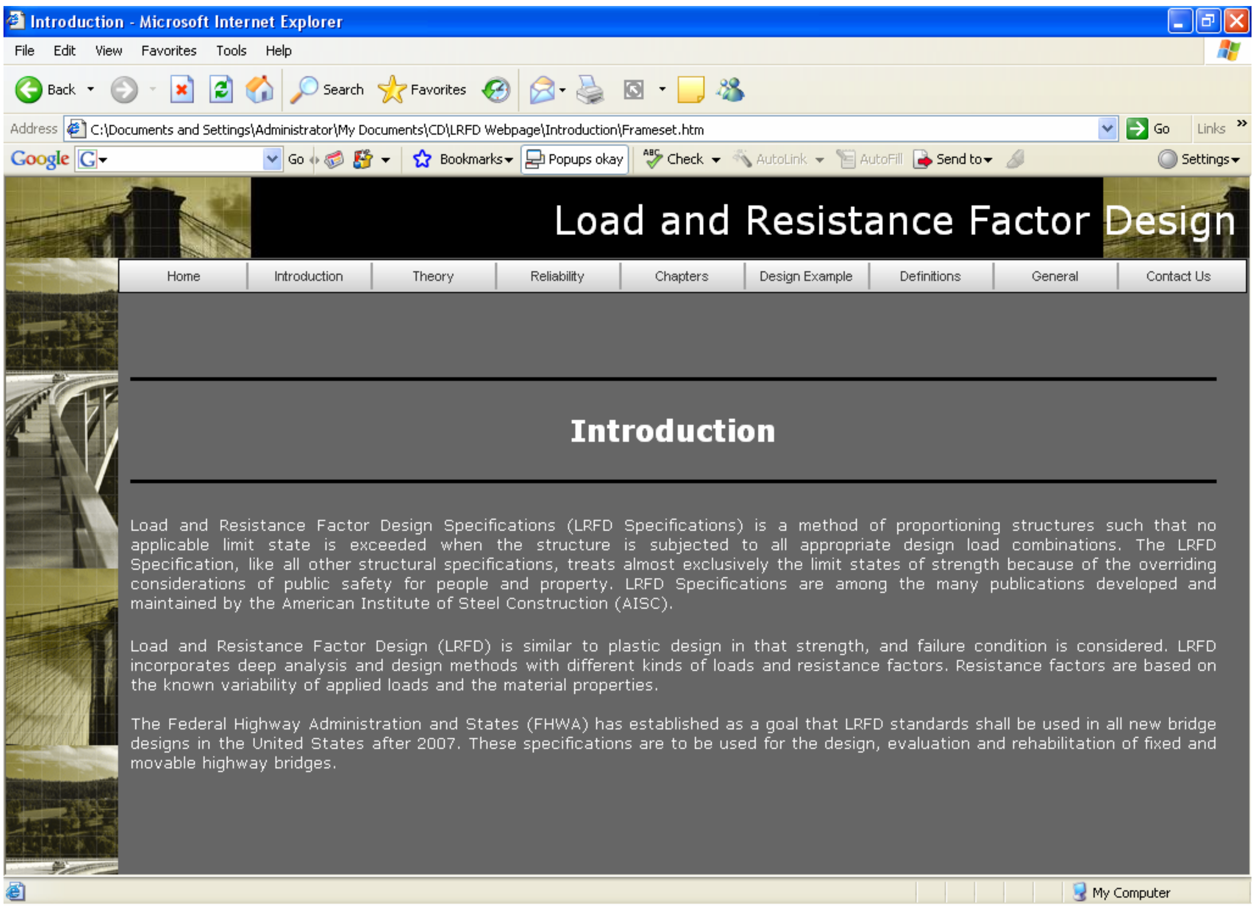


Figure 3-2. Introduction page of multimedia package

3.3 Theory

This page introduces the user to the basic theory of LRFD specifications and provides basic equations of its methodology and concepts (see Figure 3-3).

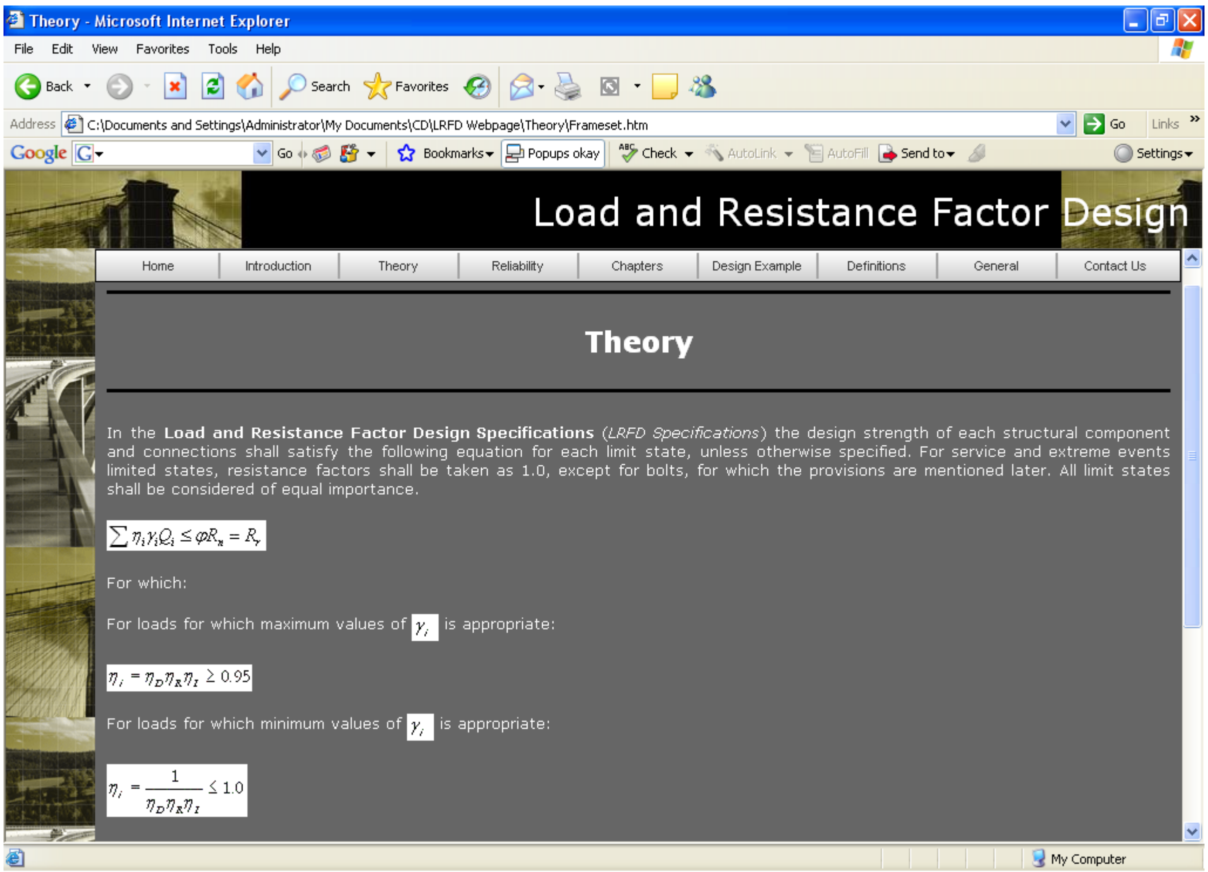


Figure 3-3. Theory page showing the basic equations of LRFD

3.4 Reliability

The main idea of this page is to give the user a background about why AASHTO adopted LRFD Specifications in 1994. There is a comparison of the three design philosophies: elastic design / working stress design (allowable stress design), plastic design, and LRFD.

For a better understanding of the speed with which states have embraced LRFD Specifications, Figures 3-4 and 3-5 show the progress of implementing LRFD over a recent two-year period.

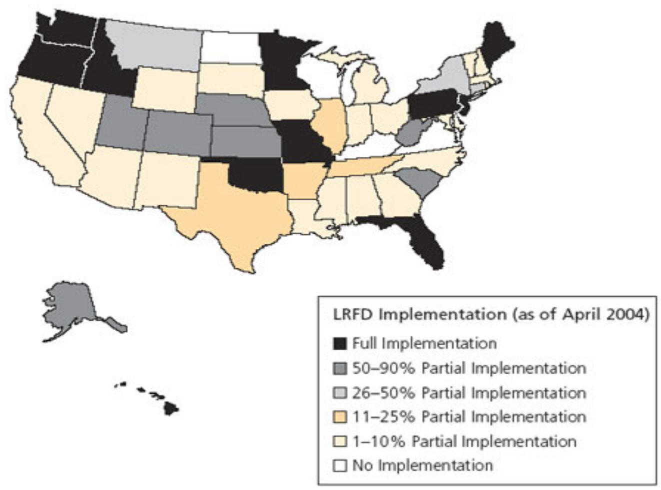


Figure 3-4. LRFD implementation by states and local governments, as of April 2004

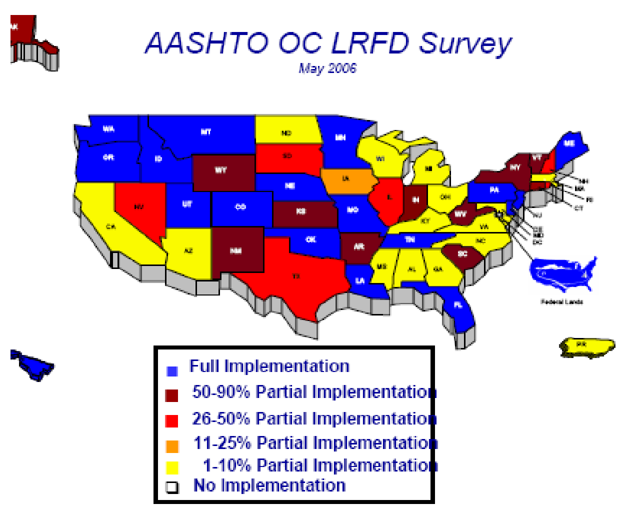


Figure 3-5. LRFD implementation by states and local governments, as of May 2006

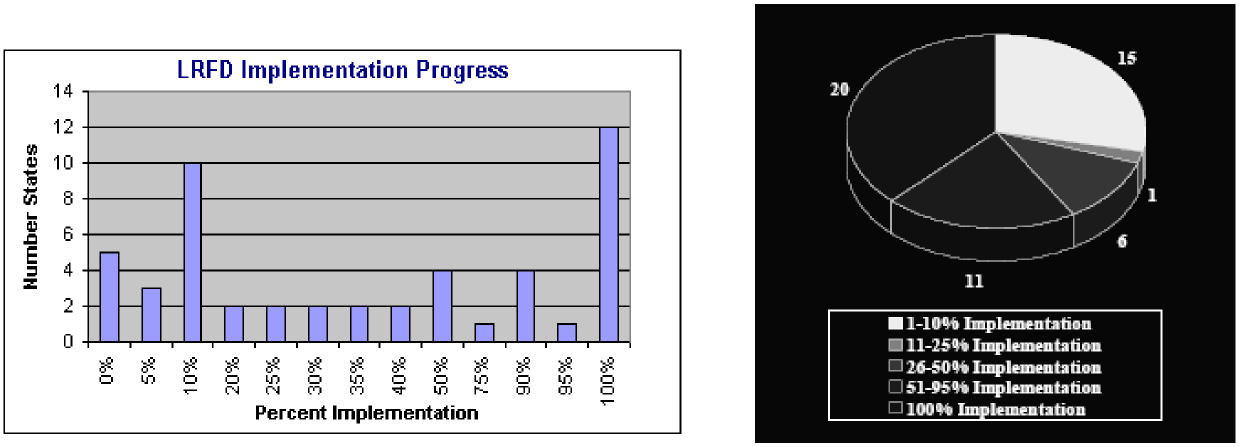


Figure 3-6. LRFD implementation progress

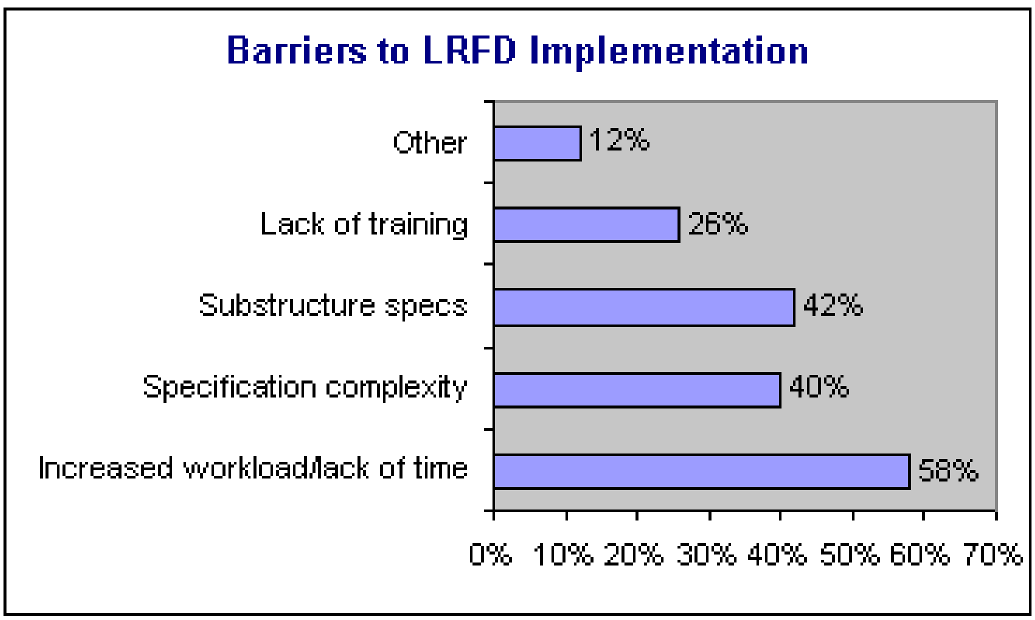


Figure 3-7. Barriers to LRFD implementation

Twelve U.S. states have fully implemented LRFD Specifications as shown in Figure 3-6. Obstacles and barriers of LRFD implementation are shown in Figure 3-7.

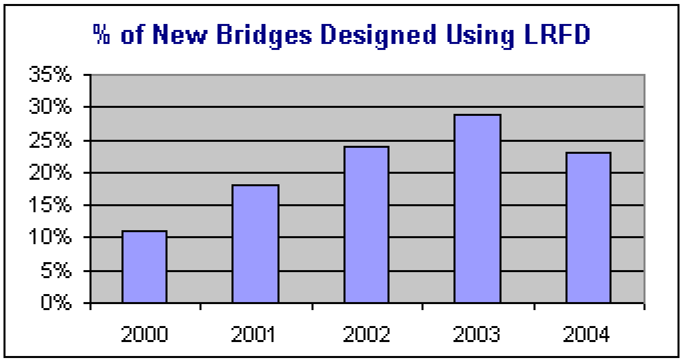


Figure 3-8. Progress in LRFD bridges construction during recent years

The LRFD live load model, designated HL-93, was developed as a representation of shear and moment produced by a group of legal-limit vehicles routinely permitted on the highways in various states. This is shown in a screenshot (Figure 3-9) of the resource tool developed in the research, taken from the section on Evaluation of AASHTO Bridge Design Specifications and Reliability Concepts.

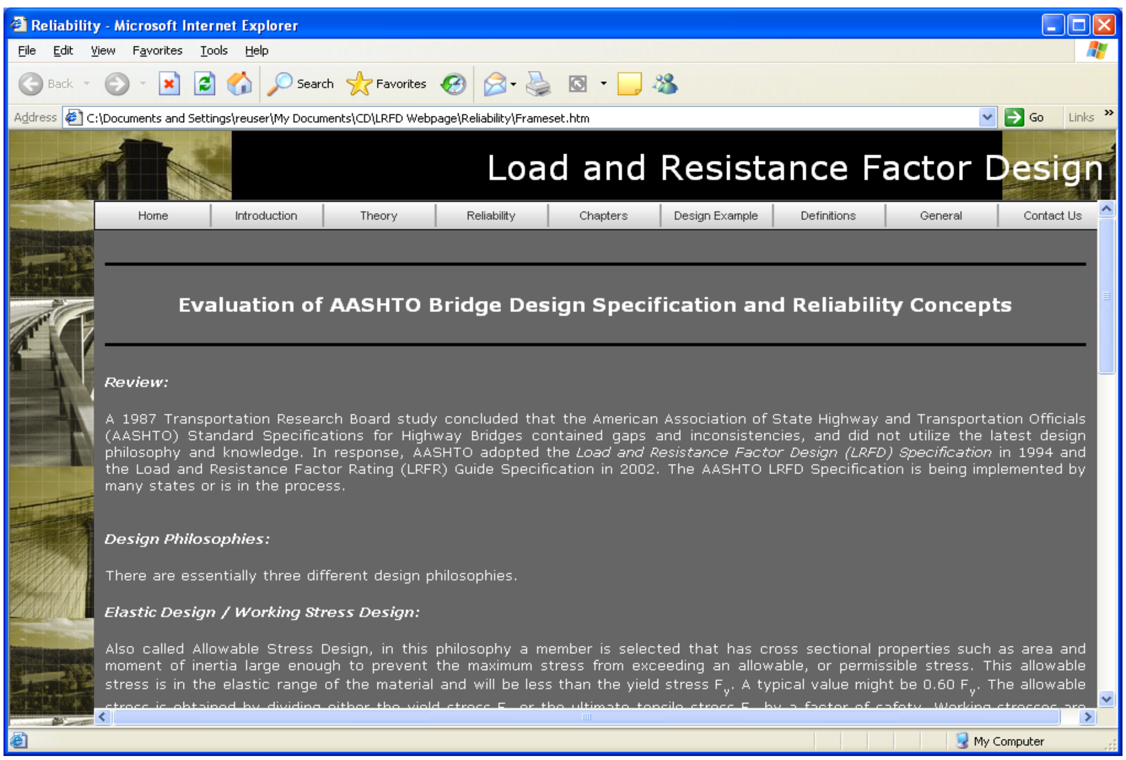


Figure 3-9. Reliability concepts page describes the three principal design philosophies

3.5 Description of Chapters

Full descriptions of each chapter are presented in the coming section. These descriptions were adopted from the AASHTO LRFD Specification Manual-Interim Revision 2005.

3.5.1 Chapter 1: Introduction

Chapter 1 introduces the concept of limit states and load modifiers that are required in the design specifications of LRFD (see Figure 3-10).

According to LRFD philosophy, bridges are designed for specific limit states that fulfill the security, service, aesthetic, economy, and constructability objectives. The following four limit states are considered for the design of a steel bridge all of which are of equal importance:

1. Service Limit State – It is based on restricting stress, deformation and crack width under regular service conditions.

2. Fatigue and Fracture Limit State – It is intended to limit the crack growth under repetitive loads in order to prevent fracture under the design life of the bridge.

3. Strength Limit State – It is used to ensure that the bridge receives the statistically load combinations without affecting its stability and strength in a local and global form. Structural integrity is expected to be always maintained.

4. Extreme Event Limit State – It is used to ensure the structural survivability of the bridge under extreme conditions like earthquakes, floods, vehicle collision, tidal waves, etc.

The following are the three load modifiers considered in LRFD specifications:

1. *Ductility* – At strength and extreme event limit states, the structural system of the bridge will undergo significant and visible inelastic deformations before failure.

2. *Redundancy* – Main elements and components whose failures are expected to cause a collapse of a bridge shall be designated as failure critical and the associated structural system as non-redundant.

3. *Operational Importance* – The owner may declare a bridge or any structural component and connections to be of operational importance.

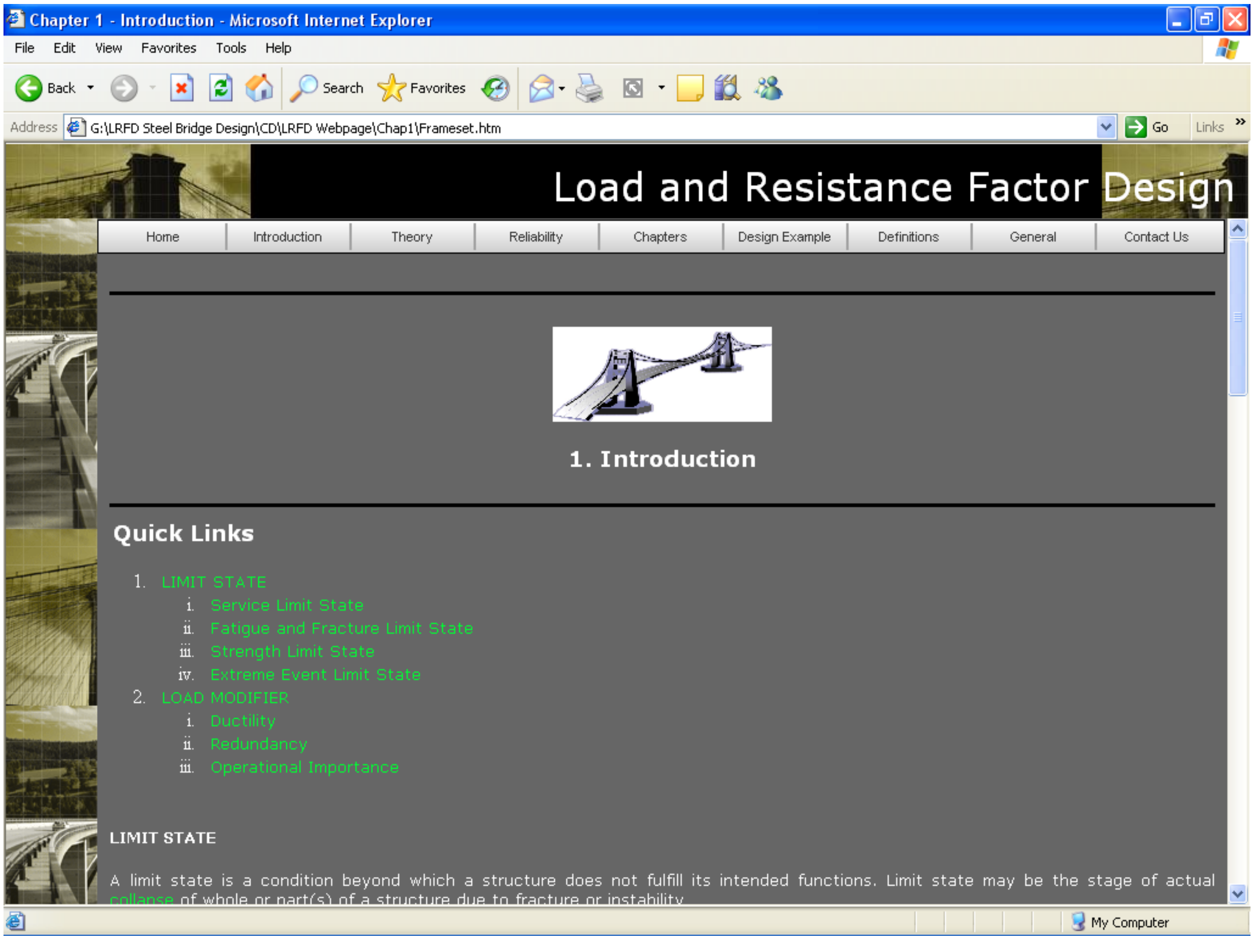


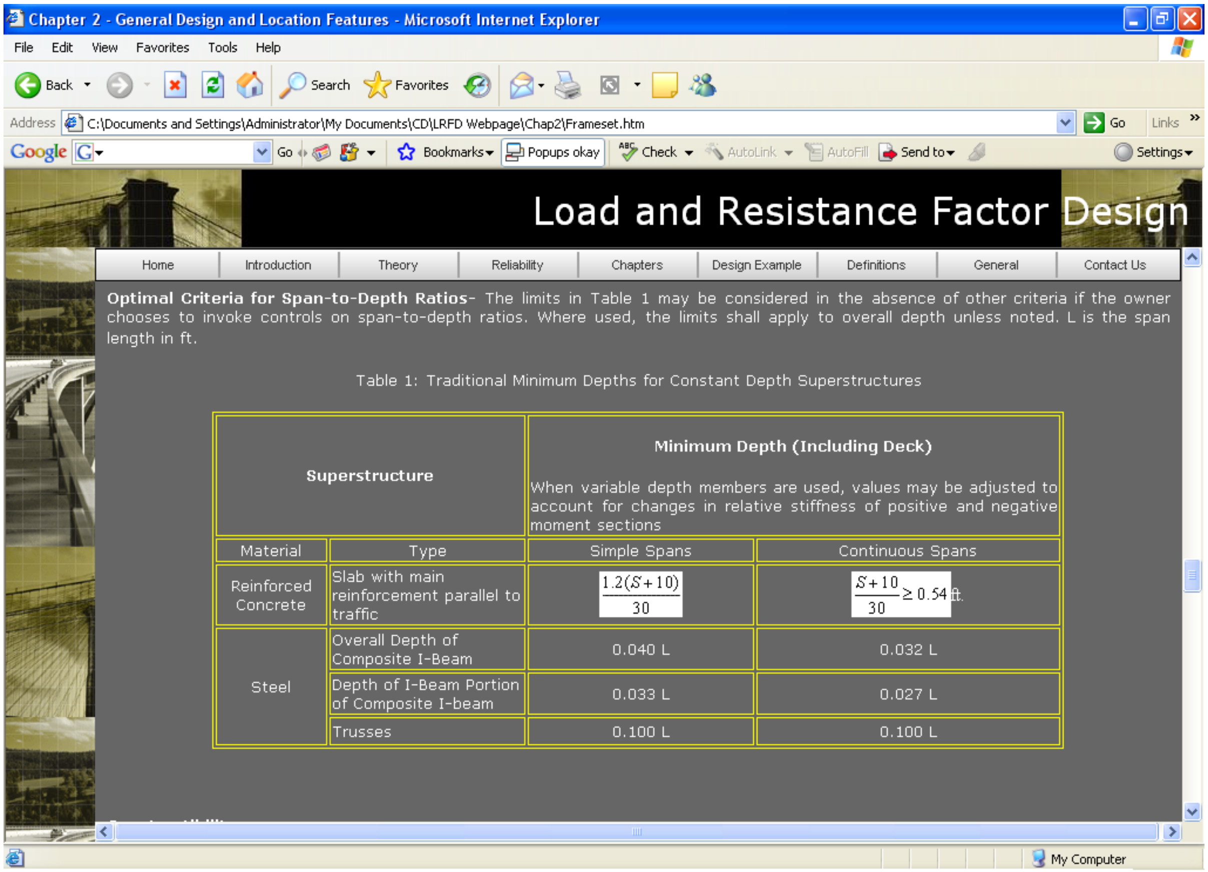
Figure 3-10. Chapter 1: introduction page explains the limit state and the load modifier

3.5.2 Chapter 2: General Design and Location Features

This chapter provides minimum requirements for clearances, environmental protection, aesthetics, geological studies, economy, rideability, durability, constructability, inspectability, and maintainability (see Figure 3-11). Traffic safety is also considered in this section.

Chapter 2 also involves the minimum requirements for drainage facilities and self-protecting measures from ice, water, and water-borne salts. Scour, hydrology, and hydraulics that have caused bridge failure are included.

The configuration and overall dimensions of a bridge should be able to be determined from this chapter.



Optimal Criteria for Span-to-Depth Ratios- The limits in Table 1 may be considered in the absence of other criteria if the owner chooses to invoke controls on span-to-depth ratios. Where used, the limits shall apply to overall depth unless noted. L is the span length in ft.

Table 1: Traditional Minimum Depths for Constant Depth Superstructures

Superstructure		Minimum Depth (Including Deck) When variable depth members are used, values may be adjusted to account for changes in relative stiffness of positive and negative moment sections	
Material	Type	Simple Spans	Continuous Spans
Reinforced Concrete	Slab with main reinforcement parallel to traffic	$\frac{1.2(S+10)}{30}$	$\frac{S+10}{30} \geq 0.54$ ft.
Steel	Overall Depth of Composite I-Beam	0.040 L	0.032 L
	Depth of I-Beam Portion of Composite I-beam	0.033 L	0.027 L
	Trusses	0.100 L	0.100 L

Figure 3-11. Traditional minimum depths for constant depth superstructure table (from Chapter 2)

3.5.3 Chapter 3: Loads and Load Factors

Chapter 3 defines minimum requirements for loads and forces, the application's limits, load factors, and load combinations used for the design of new bridges. The load provisions can also be used for the structural evaluation of existing bridges. This chapter also includes the force effects due to collisions, earthquakes, and settlement and distortion of the structure (see Figure 3-12).

Force effects that develop during construction have a specified minimum load factor. Construction loads are not included in this section.

The following loads are discussed in the section:

Permanent Loads – The weight of all components of the structure, appurtenances and utilities attached thereto, earth cover, wearing surface, future overlays, and planned widening.

Live Loads – Forces that are variable within the bridge's normal operation cycle (Example: load exerted by a vehicle).

Water Loads (WA) – Loads that include static pressure, buoyancy, stream pressure, and wave load.

Wind Loads (WL and WS) – The loads include horizontal wind pressure, vertical wind pressure, and aeroelastic instability.

Earthquake Effects (EQ) – Loads that shall be included are the horizontal force effects determined on the basis of the elastic response coefficient and the equivalent weight of the superstructure. These loads should be adjusted by the response modification factors.

Earth Pressure (EH, ES, LS, DD) – Loads to be considered are those due compaction, presence of water in the earth, and the effect of earthquakes.

Force Effects due to Superimposed Deformations (TU, TG, SH, CR, SE) – Internal forces due to creep, shrinkage, and temperature gradient are considered. Forces resulting from resisting deformation and support movements should also be included.

Friction Forces (FR) – Forces due to friction shall be established on the basis of extreme values of the friction coefficient between the sliding surfaces.

Vessel Collision (CV) – A bridge constructed in a navigation channel is designed for a vessel collision.

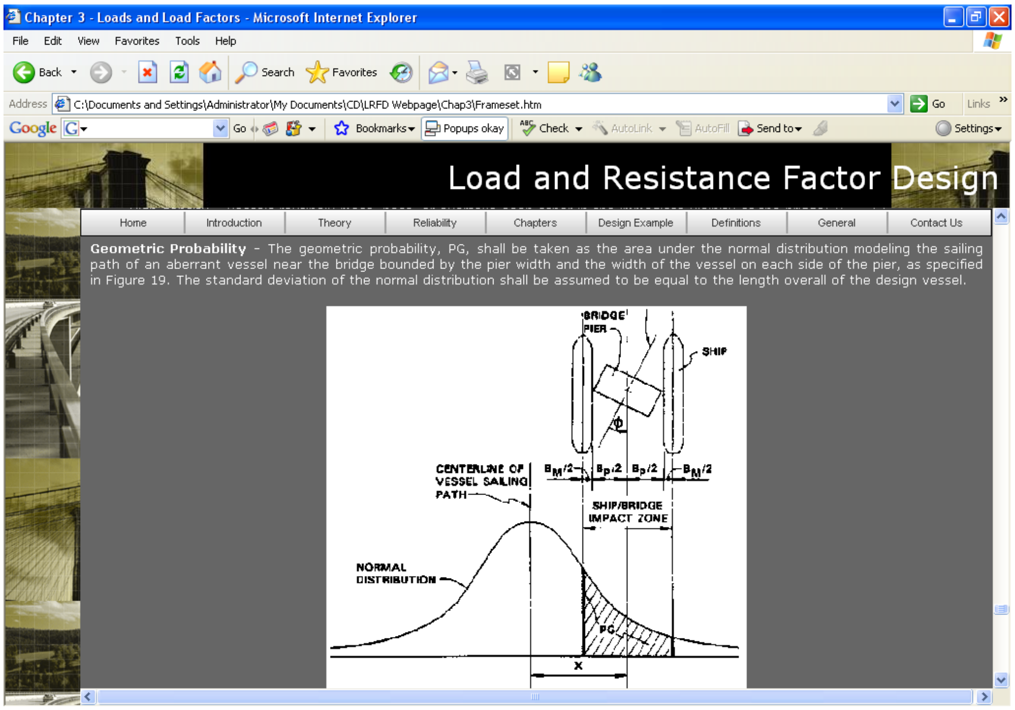


Figure 3-12. Chapter 3: geometric probability of a pier collision

3.5.4 Chapter 4: Structural Analysis and Evaluation

This chapter defines methods of analysis suitable for the design and evaluation of bridges and is limited to the modeling of structures and the determination of force effects.

Bridge structures are to be analyzed elastically; however, this section permits the inelastic analysis or redistribution of forces in some continuous beam superstructures. It specifies inelastic analysis for compressive members behaving inelastically and as an alternative for extreme event limit states.

The loads, load factors, and resistance factors specified throughout the specifications were developed using probabilistic principles combined with analyses based on linear material models.

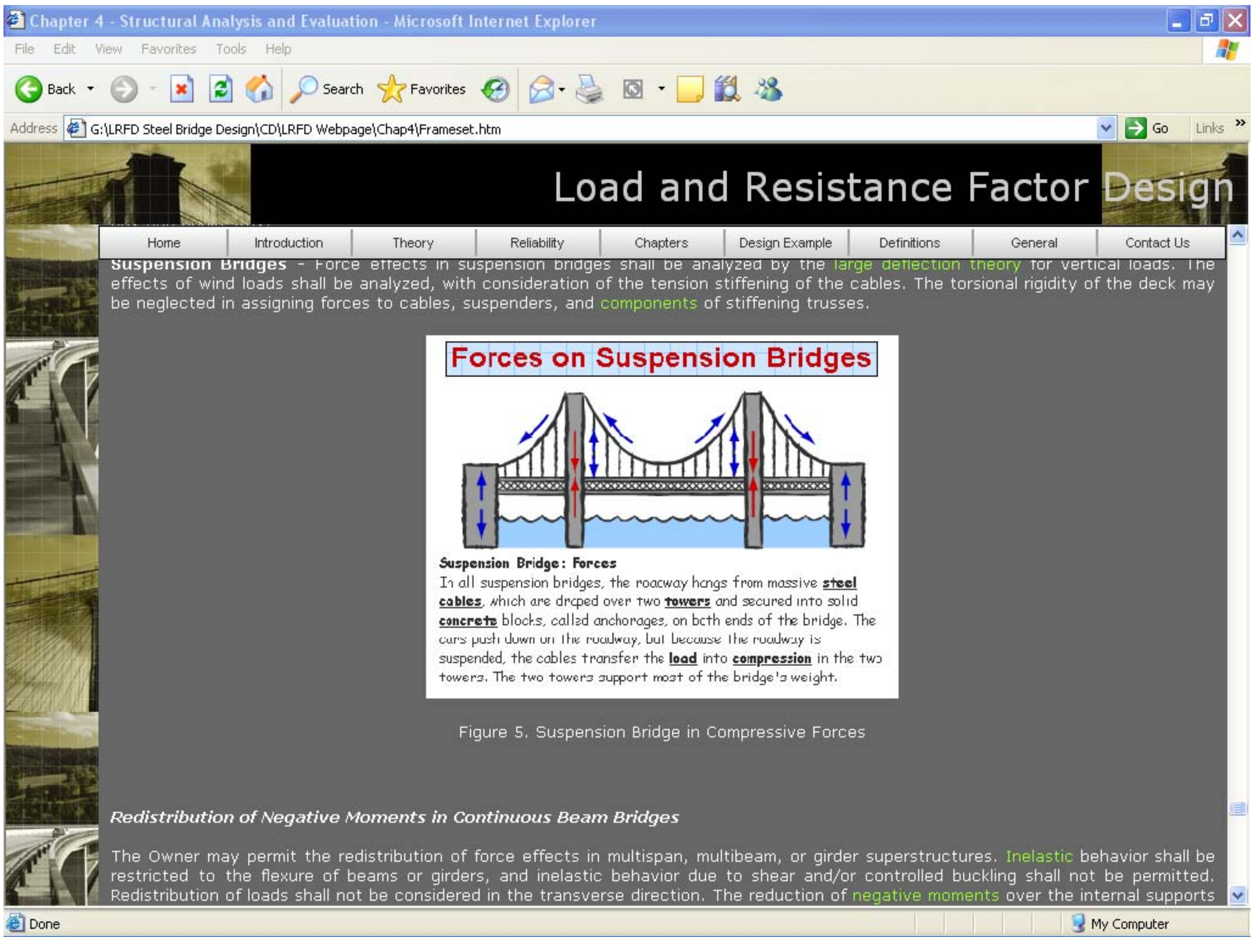


Figure 3-13. Chapter 4: compressive forces on suspension bridges

3.5.5 Chapter 5: Steel Structures

This section describes the design of steel components, splices, and connections for straight or horizontally curved beams and girder structures, frames, trusses, arches, cable-stayed and suspension systems, and metal deck systems (see Figure 3-14). The chapter includes the following topics:

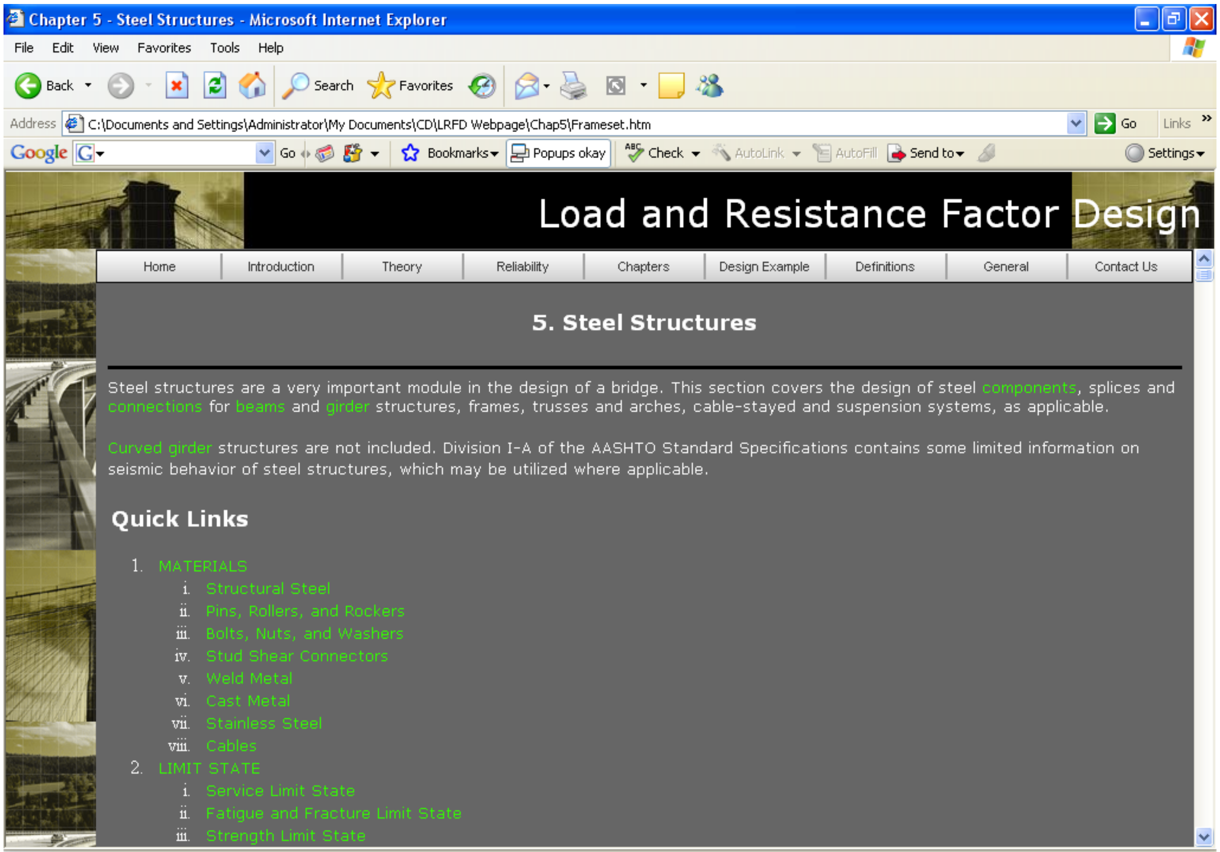


Figure 3-14. Chapter 5: steel structures home page

- *Materials* – This section includes the specifications and minimum requirements for different components used in steel bridge construction. These materials are composed from different types of structural steel. The parts discussed here are pins, rollers, rockers, bolts, nuts, washer, weld metals, cast metals, stainless steel, and cables.

- *Limit States* – Resistance factors for different strength load combinations are given. The structural components must satisfy all the requirements such as strength, extreme event, service, and fatigue limit states. These structural components must be considered for each critical stage during construction, handling, transportation, erection, and service life of the bridge.

- *Fatigue and Fracture Considerations* – This section has two components, fatigue and fracture, for which it gives general conditions and criteria. For the fatigue component, there are two categories: load-induced fatigue and distortion-induced fatigue. Load-induced fatigue considers the live load stress range, while distortion-induced fatigue deals with the load paths that transmit all intended and unintended forces by either welding or bolting.

- *General Dimensions and Details Requirements* – It provides description about the material used in points of support in the design like rolled beams, girders, spans, trusses, and arches. It provides some specifications concerning sizes and material's condition that should be used in order to fulfill the desired requirements.

- *Tension Members* – These members shall satisfy slenderness requirements, fatigue requirements, and block shear strength at end connection. Members subjected to axial tension shall be investigated for yield on the gross section and fracture on the net section.

- *Compression members* – The section shall apply to prismatic noncomposite and composite steel members with at least one plane of symmetry and subjected to either axial compression or combined axial compression and flexure about the axis of symmetry.

- *I-Section Flexural Members* – These provisions apply to flexure of rolled or fabricated straight, kinked continuous or horizontally curved steel I-section members symmetrical about the vertical axis. All types of I-Section flexural members shall be designed as a minimum to satisfy:
    - The cross-section proportion limits
    - Constructability requirements
    - Service limit state requirements
    - Fatigue and fracture limit state requirements
    - Strength limit state requirements

- *Box-Section Flexural Members* – These provisions apply to flexure of straight or horizontally curved steel single or multiple closed-box or tub sections symmetrical about the vertical axis in the plane of the web in simple or continuous bridges of moderate length. This section covers the design of composite, hybrid and non-hybrid, and constant and variable web depth members. They shall not be applied to multiple cell single box sections, or to composite box flanges used as bottom flanges.

- *Miscellaneous Flexural Members* – The provisions apply to:
    - Non-composite box shaped member
    - Non-composite H-shaped members bent about either axis in the cross-section.
    - Non-composite circular tubes
    - Concrete encased rolled shapes
    - Composite tubes
    - Channels, angles, tees, and bars

- *Connections and Splices* – This section describes the specifications of connections and splices for primary members and the different connections used in the design of bridges that are made to support trusses, beams and other connections used to create balance and resistance in the design.

- *Provisions for Structure Types* – Where beams or girders comprise the main members of through-spans, such members shall be stiffened against lateral deformation by means of gusset plates or knee braces with solid webs connected to the stiffeners on the main members and the floor beams.

3.5.6 Chapter 6: Decks and Deck Systems

This section contains provisions for the analysis and design of bridge decks and deck systems of concrete, metal, or their combination subjected to gravity loads. It focuses on the design philosophy of reducing inspection efforts and maintenance costs and increases the structural effectiveness and redundancy of the system. The chapter is divided into five parts covering the following areas: the general design requirements, the limit states, the proper structural analysis, and its application to concrete deck slabs and metal slabs. An example involving orthotropic decks is shown in Figure 3-15.

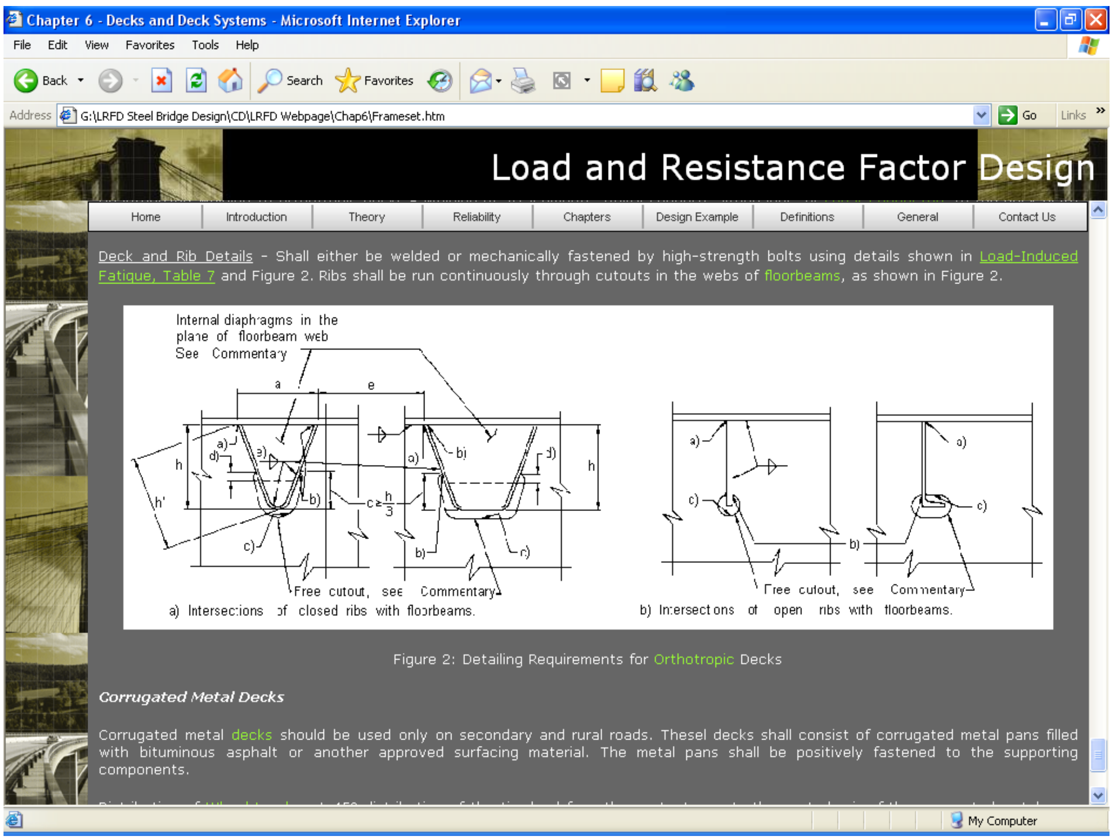


Figure 3-15. Chapter 6: detailing requirements for orthotropic decks in diagrams

3.5.7 Chapter 7: Foundations

This chapter provides the LRFD specifications for the design of spread footings, driven piles, and drilled shaft foundations (see Figure 3-16). In case of spread footings the general considerations shall apply to the design of isolated footings and, in some cases, to combined footings. Footings should be designed so that pressure under the footing is as nearly uniform as practical.

In some cases, positive anchorage should be provided between the rock and footing such as that provided by rock anchors, bolts, or dowels. In case of inclined load, failure by sliding shall be investigated for any footing that supports this condition.

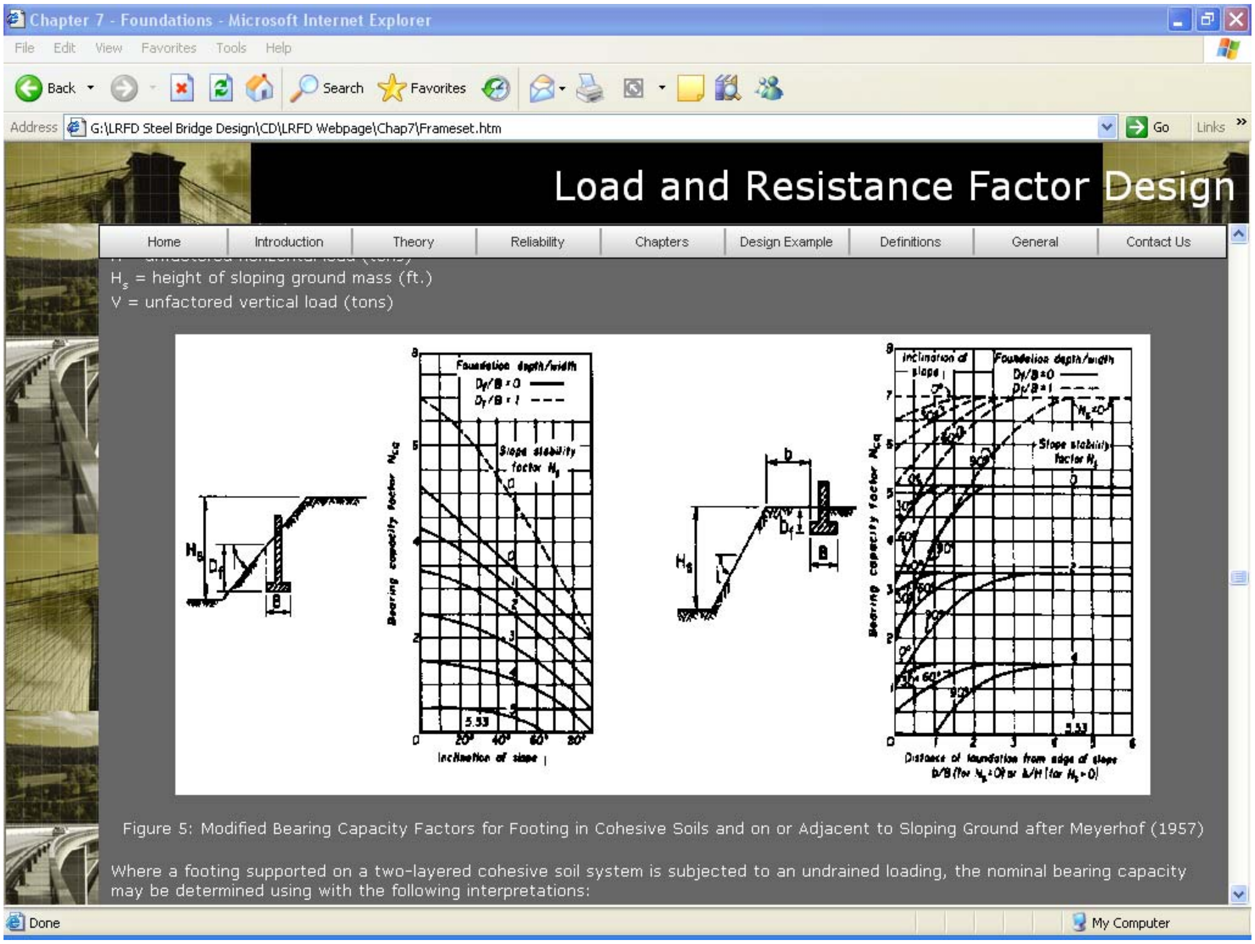


Figure 3-16. Chapter 7: modified bearing capacity factors for footing in cohesive soils

3.5.8 Chapter 8: Abutments, Piers, and Walls

This chapter provides requirements on the design of abutments, piers, and walls. These shall be designed to resist water pressure, the self weight of the wall, any live and dead load along with temperature and shrinkage effects.

In accordance with LRFD steel bridge design specifications, the design should be able to resist any vertical and lateral deformation or displacement. In addition this section provides the general considerations for the abutments and conventional retaining walls: loadings, wing walls, and reinforcement (see Figure 3-17).

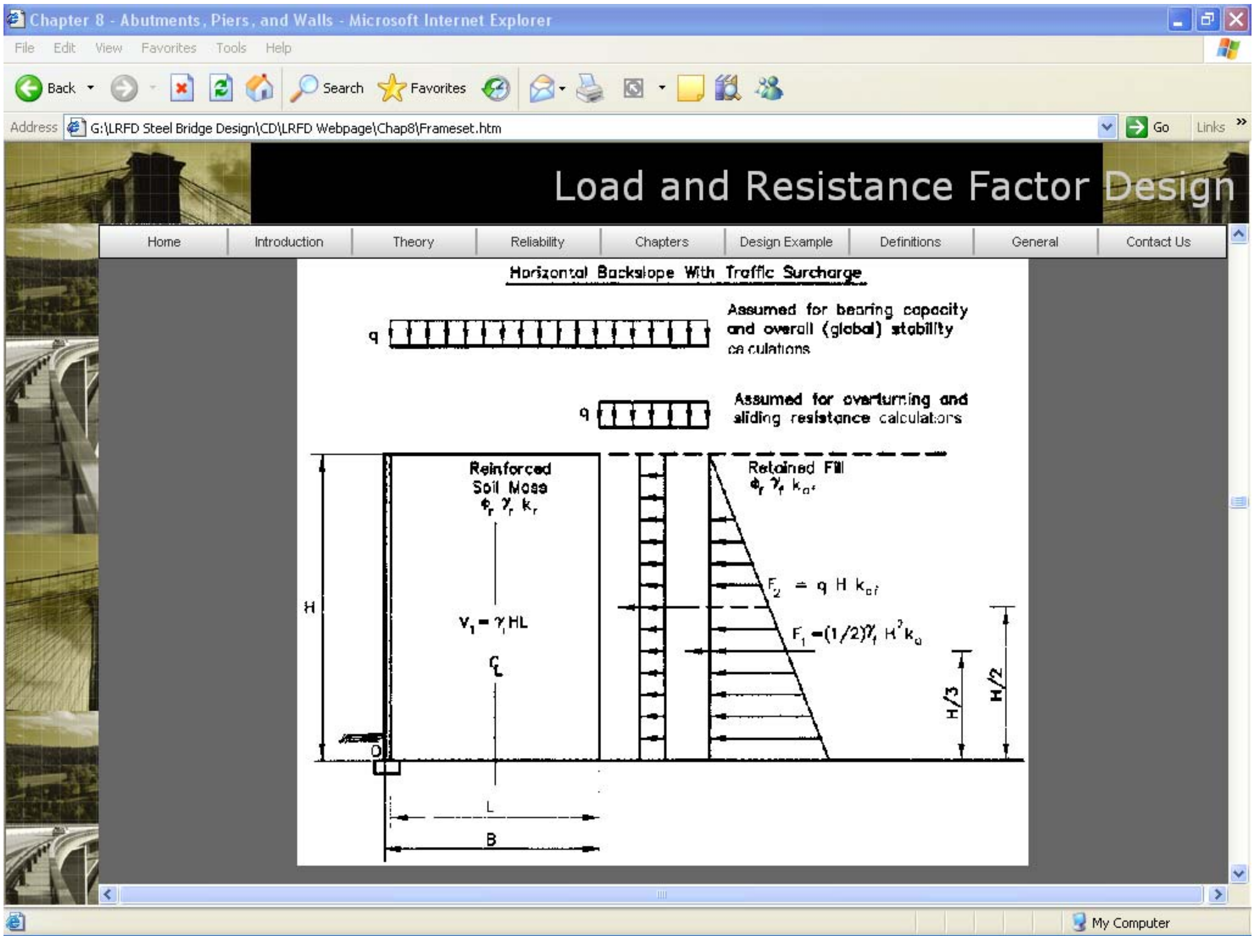
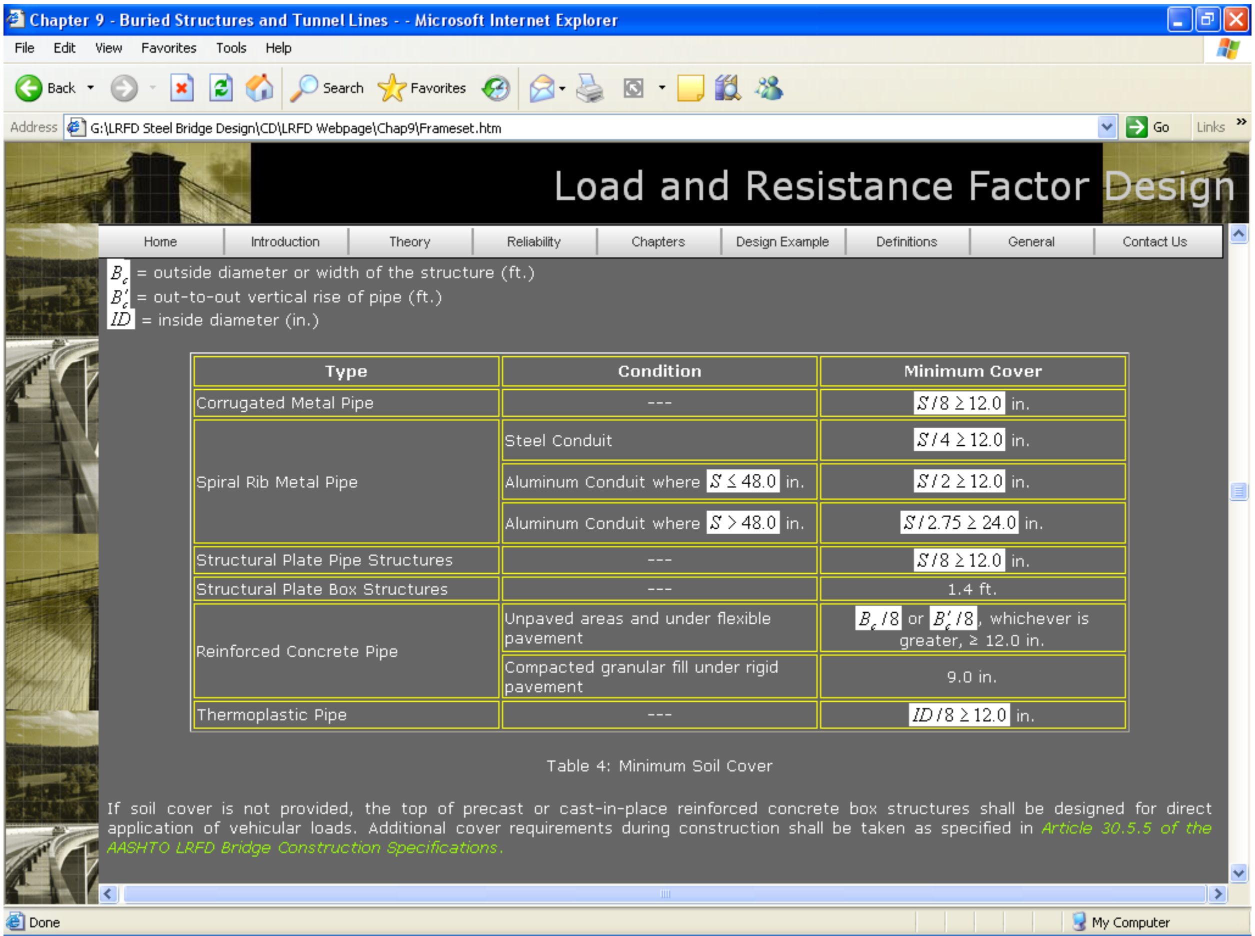


Figure 3-17. Chapter 8: external stability for a wall with horizontal back-slope and traffic surcharge

3.5.9 Chapter 9: Buried Structures and Tunnel Lines

This chapter gives the requirements for the selection of structural properties and dimensions of buried structures such as culverts and steel plates used to support tunnel excavations in soil (see Figure 3-18). It discusses the terms and characteristics of buried structure systems used in the designs such as metal pipes, structure plate pipes, box and elliptic structures, long-span structural plates, structural plate boxes, and thermoplastics pipes.



B_c = outside diameter or width of the structure (ft.)
B'_c = out-to-out vertical rise of pipe (ft.)
ID = inside diameter (in.)

Type	Condition	Minimum Cover
Corrugated Metal Pipe	---	$S/8 \geq 12.0$ in.
Spiral Rib Metal Pipe	Steel Conduit	$S/4 \geq 12.0$ in.
	Aluminum Conduit where $S \leq 48.0$ in.	$S/2 \geq 12.0$ in.
	Aluminum Conduit where $S > 48.0$ in.	$S/2.75 \geq 24.0$ in.
Structural Plate Pipe Structures	---	$S/8 \geq 12.0$ in.
Structural Plate Box Structures	---	1.4 ft.
Reinforced Concrete Pipe	Unpaved areas and under flexible pavement	$B_c/8$ or $B'_c/8$, whichever is greater, ≥ 12.0 in.
	Compacted granular fill under rigid pavement	9.0 in.
Thermoplastic Pipe	---	$ID/8 \geq 12.0$ in.

Table 4: Minimum Soil Cover

If soil cover is not provided, the top of precast or cast-in-place reinforced concrete box structures shall be designed for direct application of vehicular loads. Additional cover requirements during construction shall be taken as specified in *Article 30.5.5 of the AASHTO LRFD Bridge Construction Specifications*.

Figure 3-18. Chapter 9: minimum soil cover table depending on the different types of pipes or pipe structures

3.5.10 Chapter 10: Railings

This section provides six bridge railing test levels and their associated crash test requirements. This chapter applies to railings for new bridges and for rehabilitated bridges to the extent that railing replacement is determined to be appropriate. The process for the design of crash test specimens to determine their crash worthiness is described. There are three types of railings discussed in this section: traffic railings, pedestrian railings, and bicycle railings (see Figure 3-19).

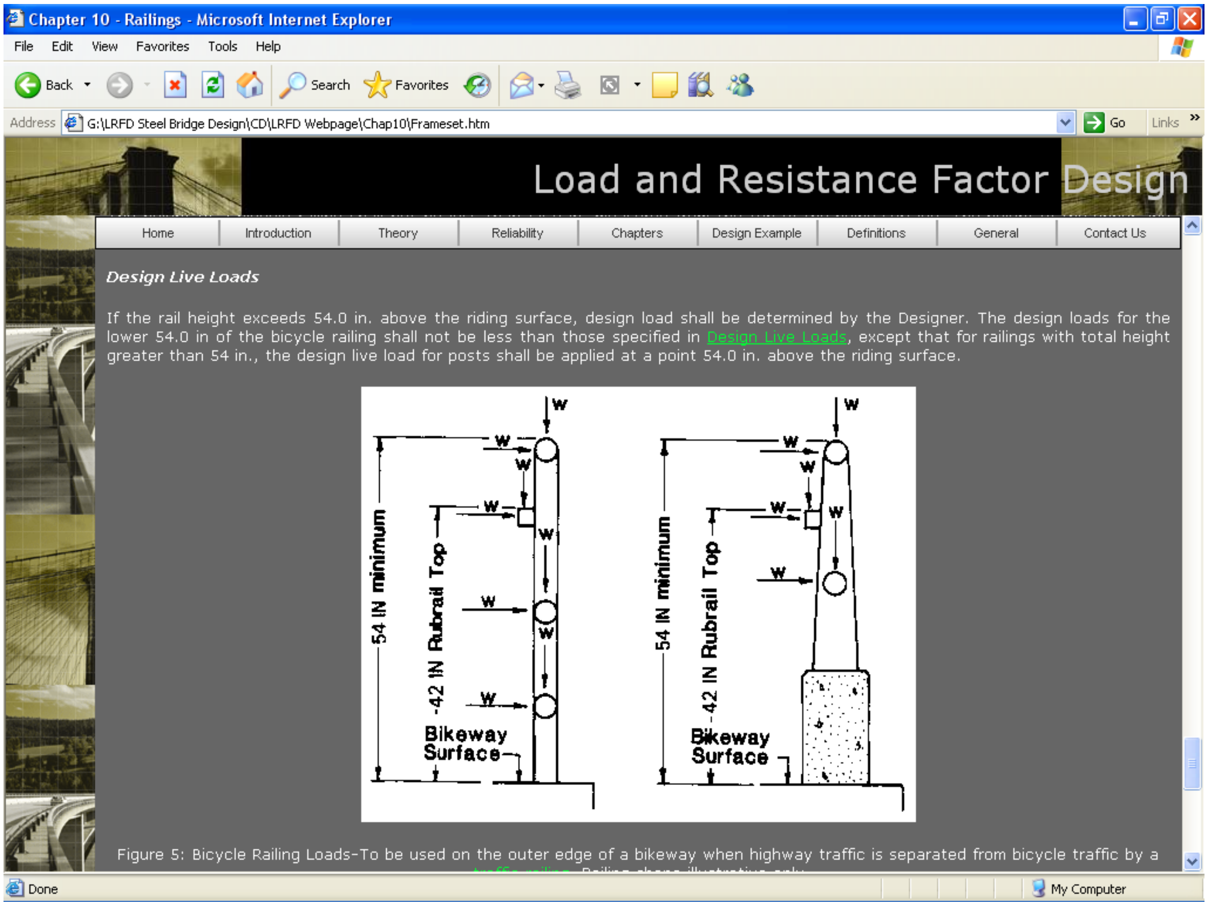


Figure 3-19. Chapter 10: bicycle railing loads

3.5.11 Chapter 11: Joints and Bearings

In this section, requirements for the design and selection of structural bearings and deck joints are outlined. The design specifications for joints and bearings are stated separately. Figure 3-20 illustrates the types of information in this chapter.

Selection and layout of joints and bearings shall allow for deformations due to temperature and other time-dependent causes and shall be consistent with the proper functioning of the bridge. Bridge deck joints and bearings shall be designed to resist loads and accommodate movements at the service and strength limit states and to satisfy the requirements of the fatigue and fracture limit state. Design loads for joints, bearings and structural members shall be based on the stiffness of the individual elements and the tolerances achieved during fabrication and erection. At service limit state no damage due to joints or bearing movement shall be permitted. At strength limit or extreme event states no irreparable damage shall occur.

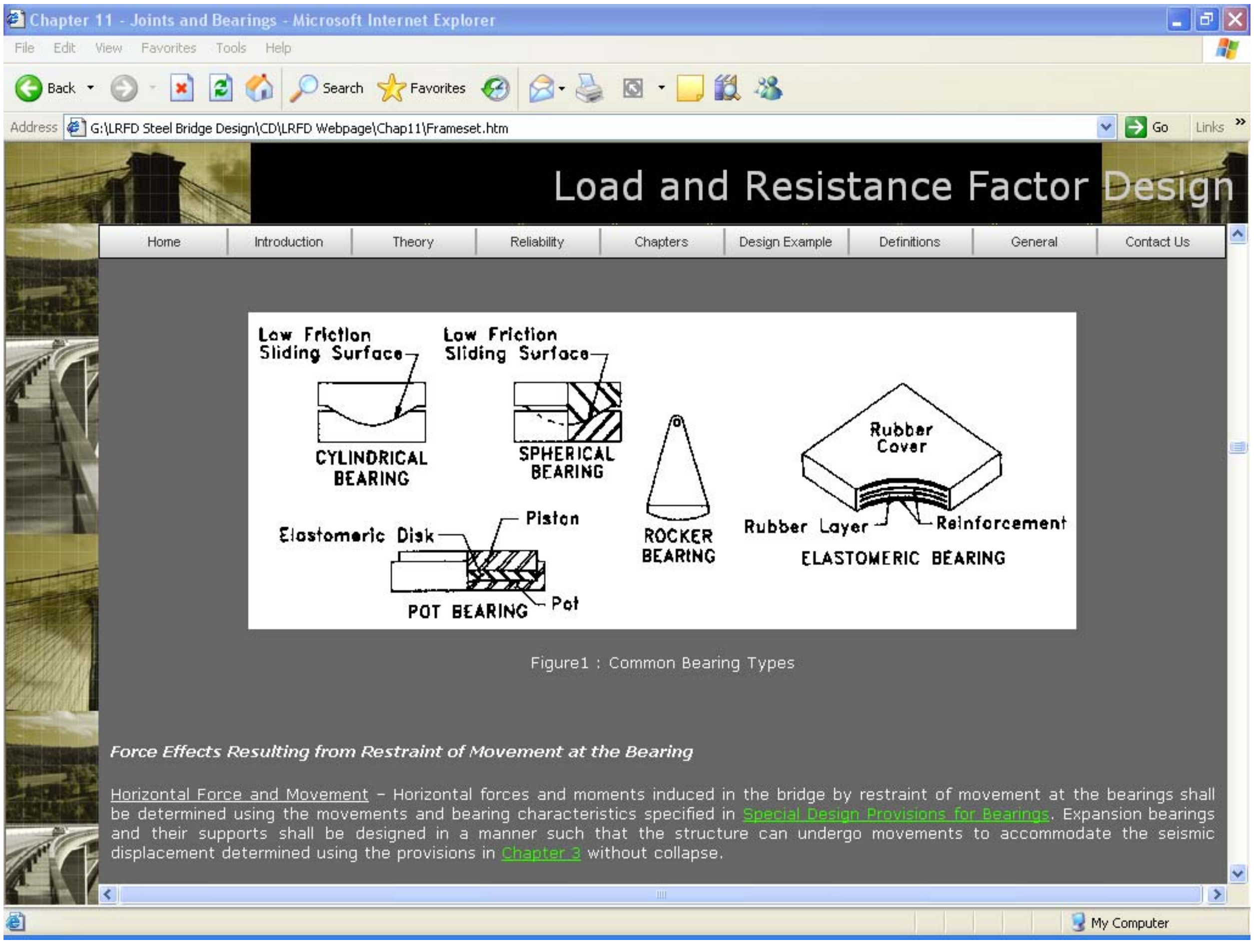
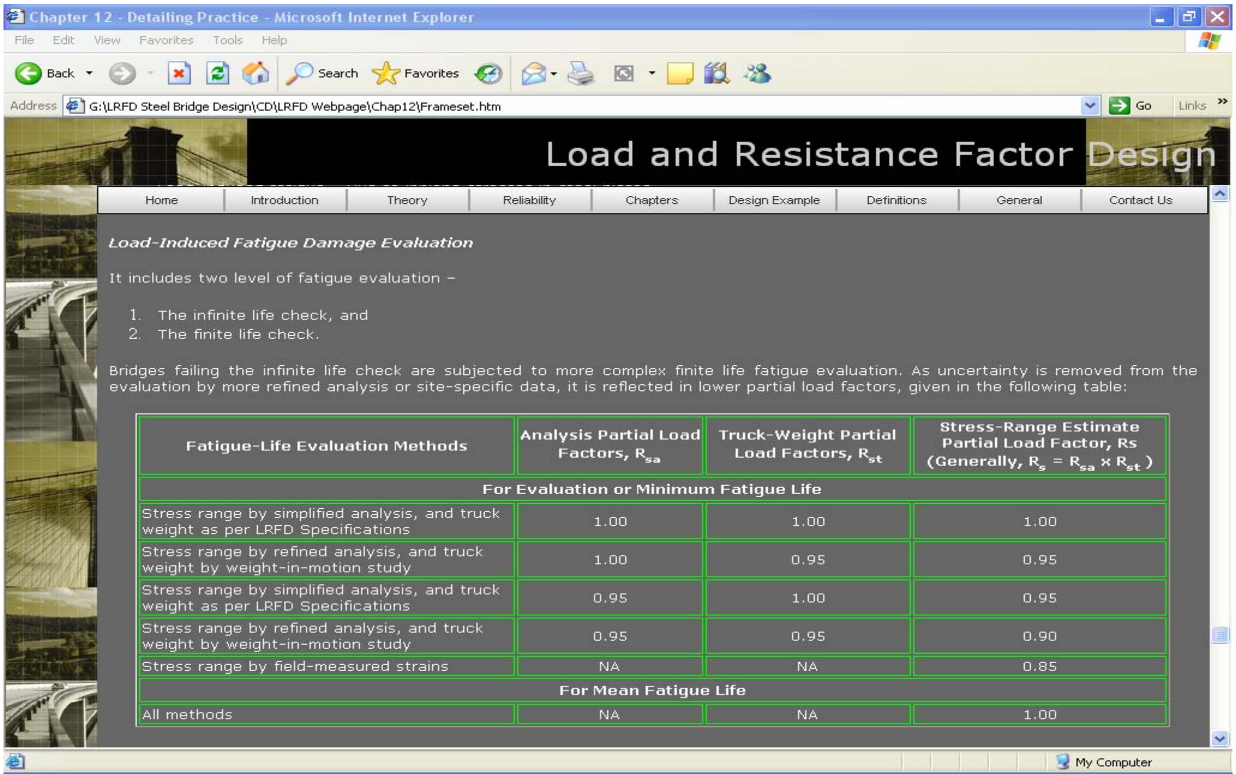


Figure 3-20. Chapter 11: common bearing types

3.5.12 Chapter 12: Detailing Practice

This chapter describes the procedure of any LRFD design for a bridge structure, in a step-by-step manner, like the example shown in Figure 3-21. It covers the following areas:

1. Bridge Records
2. Bridge Management Systems
3. Inspection
4. Material Testing
5. Load and Resistance Factor Ratings
6. Fatigue Evaluation of Steel Bridges
7. Nondestructive Load Testing
8. Special Topics
   - Evaluation of Unreinforced Masonry Arches
   - Direct Safety Assessment of Bridges
   - Historic Bridges



Fatigue-Life Evaluation Methods	Analysis Partial Load Factors, R_{sa}	Truck-Weight Partial Load Factors, R_{st}	Stress-Range Estimate Partial Load Factor, Rs (Generally, $R_s = R_{sa} \times R_{st}$)
For Evaluation or Minimum Fatigue Life			
Stress range by simplified analysis, and truck weight as per LRFD Specifications	1.00	1.00	1.00
Stress range by refined analysis, and truck weight by weight-in-motion study	1.00	0.95	0.95
Stress range by simplified analysis, and truck weight as per LRFD Specifications	0.95	1.00	0.95
Stress range by refined analysis, and truck weight by weight-in-motion study	0.95	0.95	0.90
Stress range by field-measured strains	NA	NA	0.85
For Mean Fatigue Life			
All methods	NA	NA	1.00

Figure 3-21. Chapter 12: partial load factors, R_{sa}, R_{st} and R_s

3.6 Design Examples

This section contains three typical steel beam and girder superstructure designs and links to more examples (see Figure 3-22). The first two design examples are simple span rolled steel beam bridges: one noncomposite and the other composite. The third example is a three-span continuous composite plate girder bridge. For simplification of the design procedure, a general outline is also presented. These examples provide a generic overview of the design process. It should not be regarded as fully complete nor should it be used as a substitute for a working knowledge of the provisions.

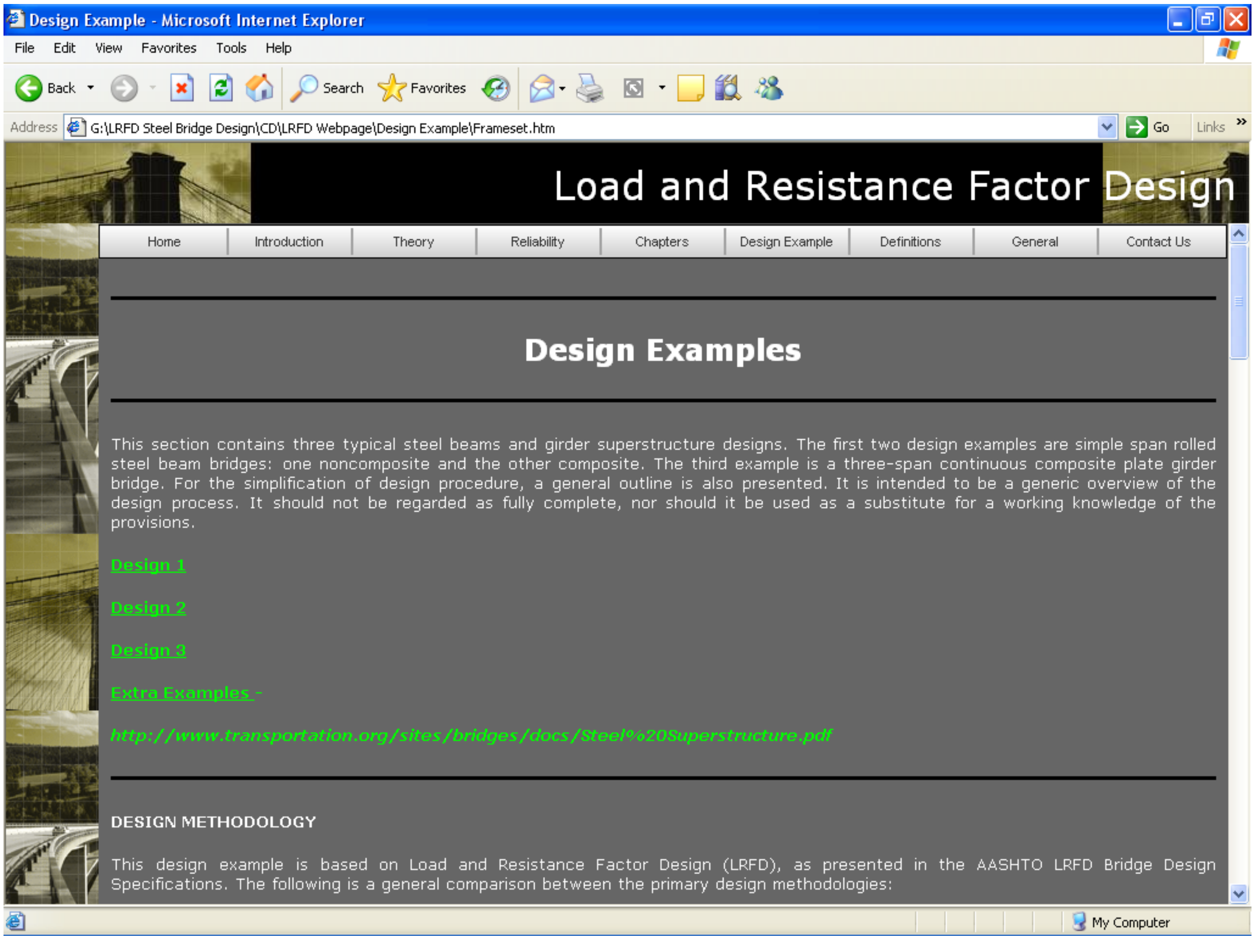


Figure 3-22. Design examples page showing the three different examples

3.6.1 Design Example #1

This example is the design of a simple-span noncomposite rolled steel beam bridge (see Figure 3-23) with a 35-ft. span for an HL–93 live load. The roadway width is 44 ft. curb to curb. H allows for a future-wearing surface of 3 in. thick bituminous overlay, and uses f_c' = 4 ksi and M270 Grade 50 steel. The fatigue detail at midspan is category A. The barrier is 15 in. wide and weighs 0.5 kip/ft.

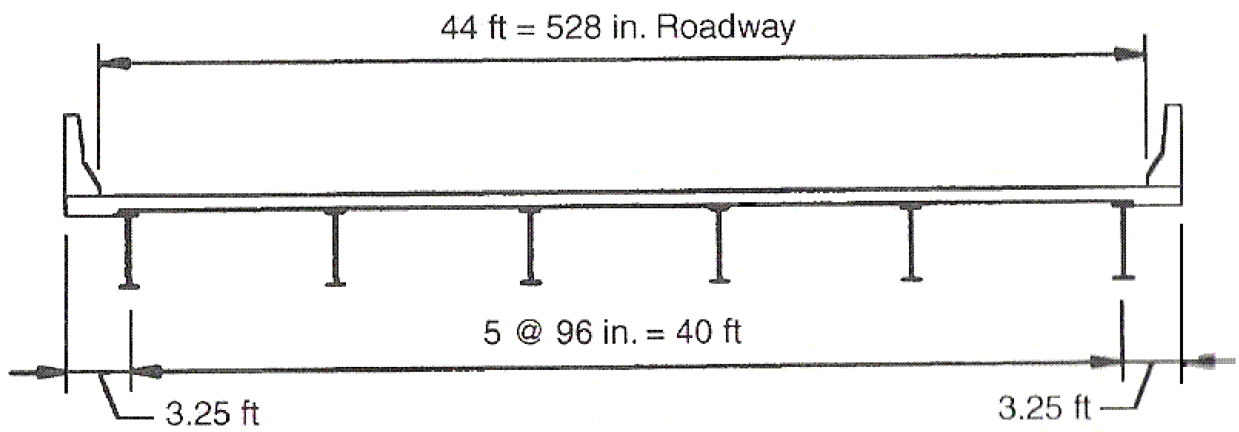


Figure 3-23. Cross section for example #1

3.6.2 Design Example #2

The second example is the design of a simple-span composite rolled steel beam bridge (see Figure 3-24) with 35 ft. span for a HL–93 live load. The roadway width is 44 ft. curb to curb. The design allows for a future wearing surface of 3 in. thick bituminous overlay and uses f_c' = 4 ksi and M270 Grade 50 steel.

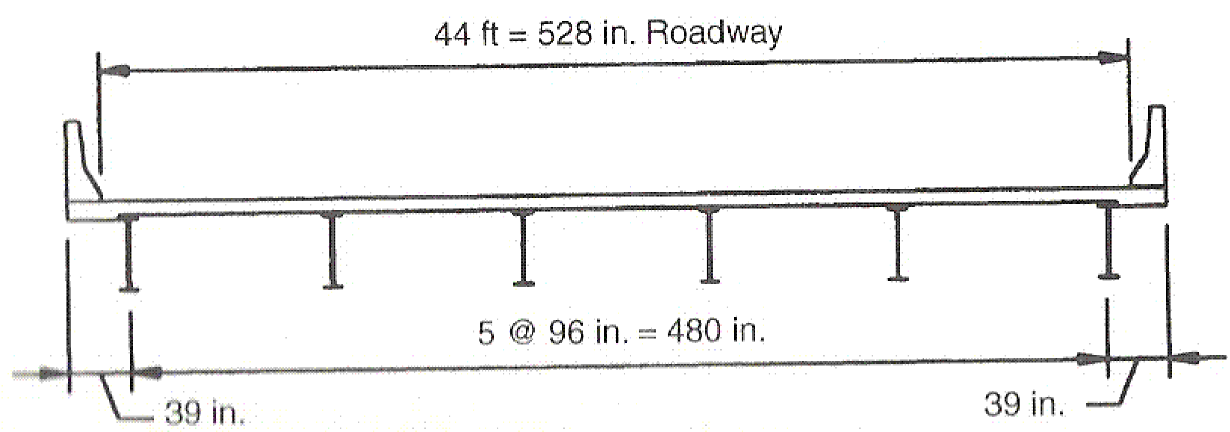


Figure 3-24. Bridge cross section for design example #2

3.6.3 Design Example #3

The third example is the design of a continuous steel plate girder bridge of Figures 3-25 and 3-26 with 30 m, 36 m, and 30 m (100-ft., 120-ft., and 100-ft.) spans for a HL–93 live load. The roadway width is 13,420 mm curb to curb (44 ft.) and carries an interstate highway. The design allows for a future wearing surface of 75 mm (3 in.) thick bituminous overlay. It uses f_c' = 30 MPa (4 ksi) and M270 Grade 345 steel (50 ksi).

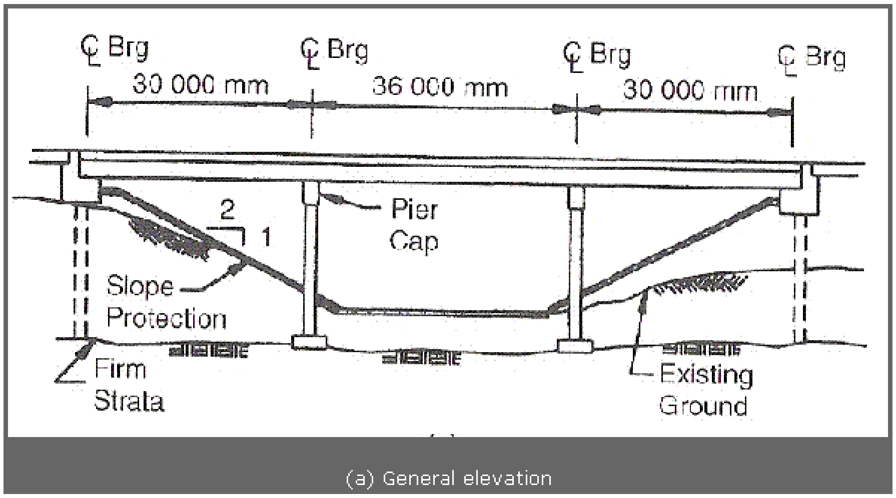


Figure 3-25. General elevation of a bridge in front view

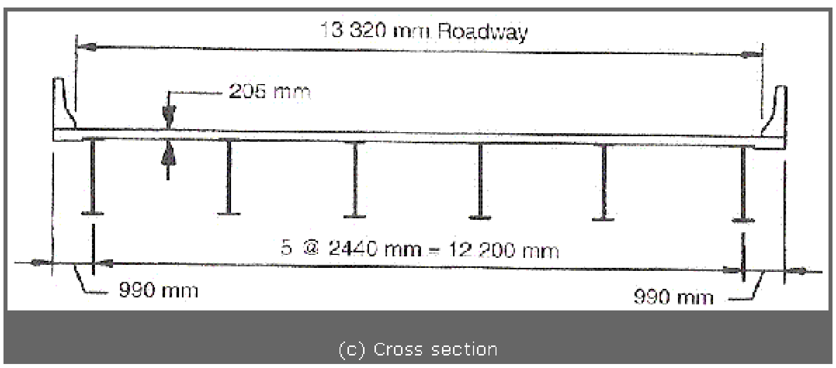


Figure 3-26. Cross section of the bridge

3.6.4 Extra Examples

This links to a document containing a LRFD design example for a steel girder superstructure bridge.

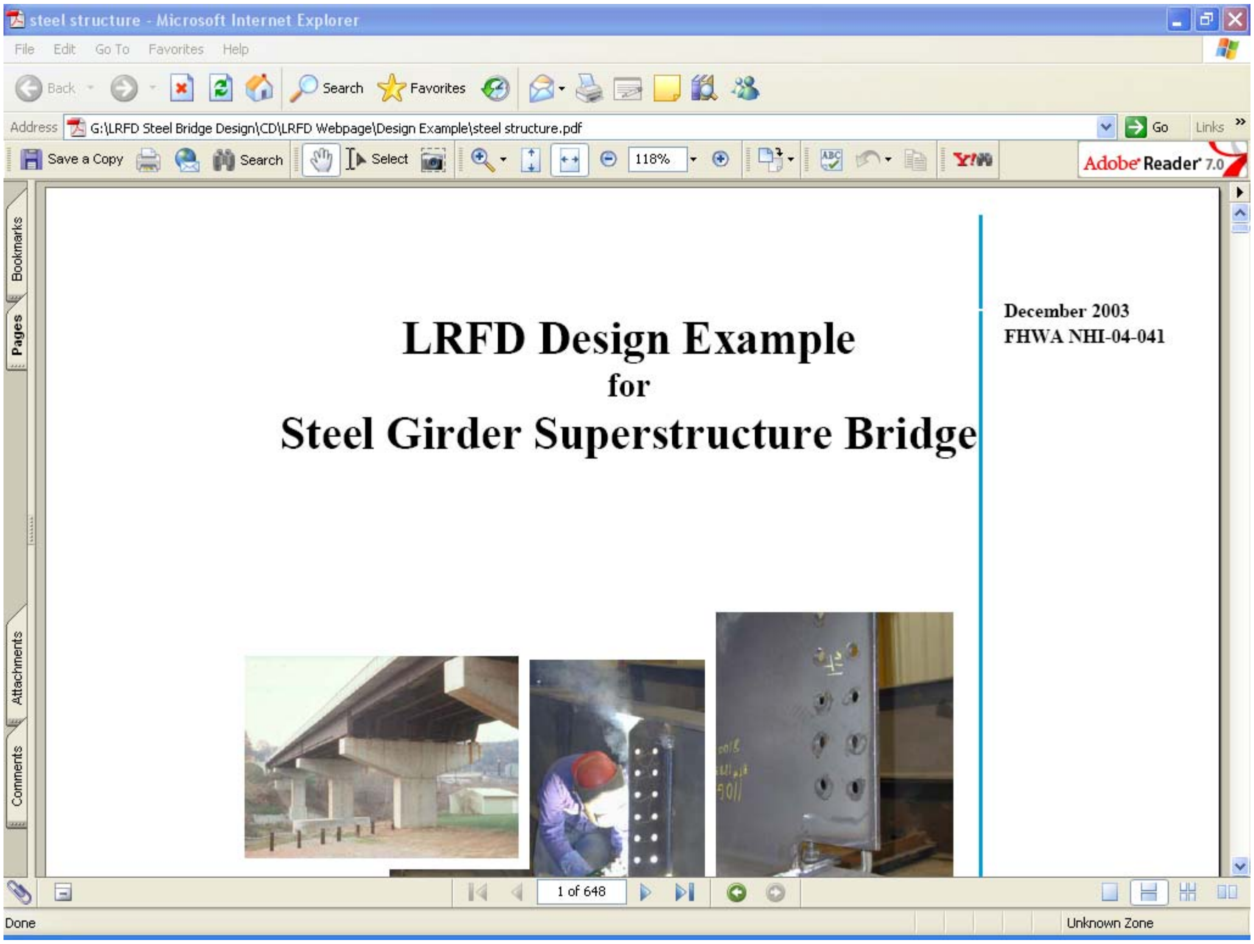


Figure 3-27. Document for an LRFD design example for steel girder superstructure bridge

3.7 Definitions

The section contains an alphabetized list of definitions, grouped according to chapters.

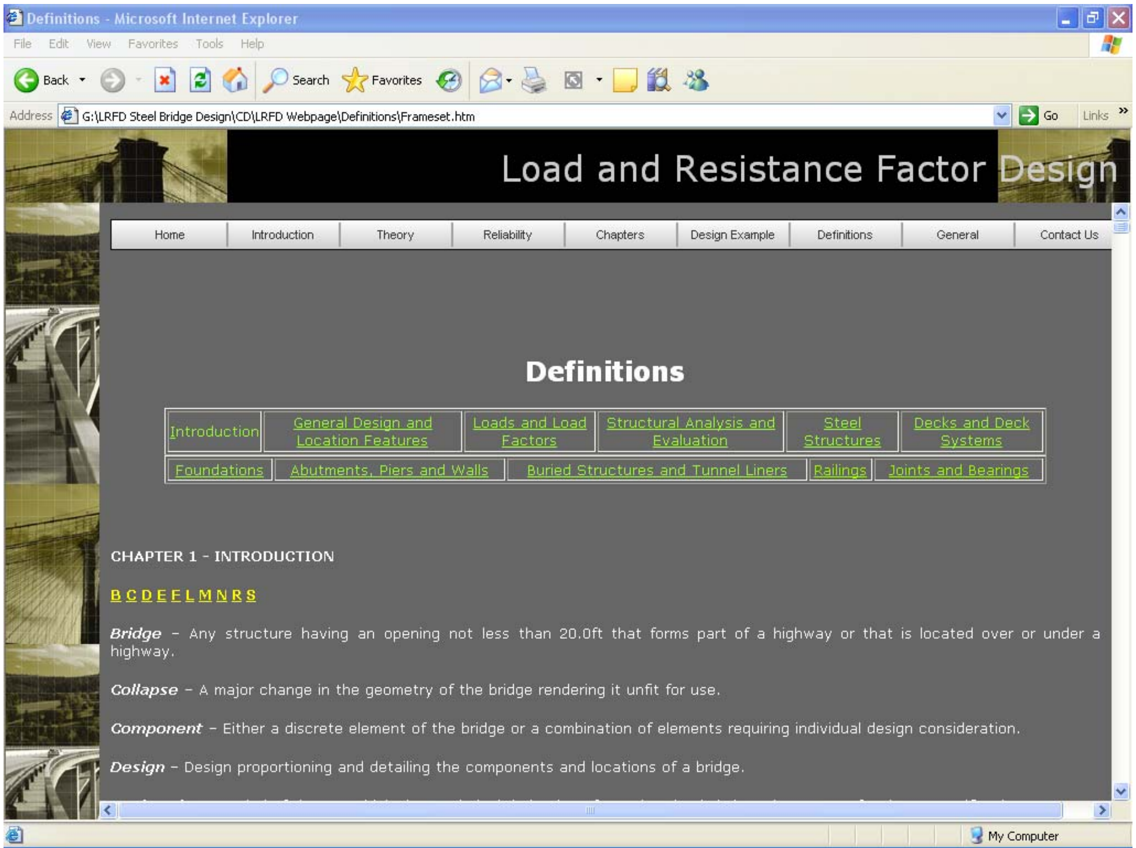


Figure 3-28. The definition page defines words important for LRFD concepts

3.8 General

The general page provides information about the origin and the background of LRFD Specifications. This section also shows the progress of states adopting and implementing the specifications through diagrams (see Figure 3-29).

3.9 Contact Us

This page provides the contact information of the principal investigator of the multimedia package (see Figure 3-30).

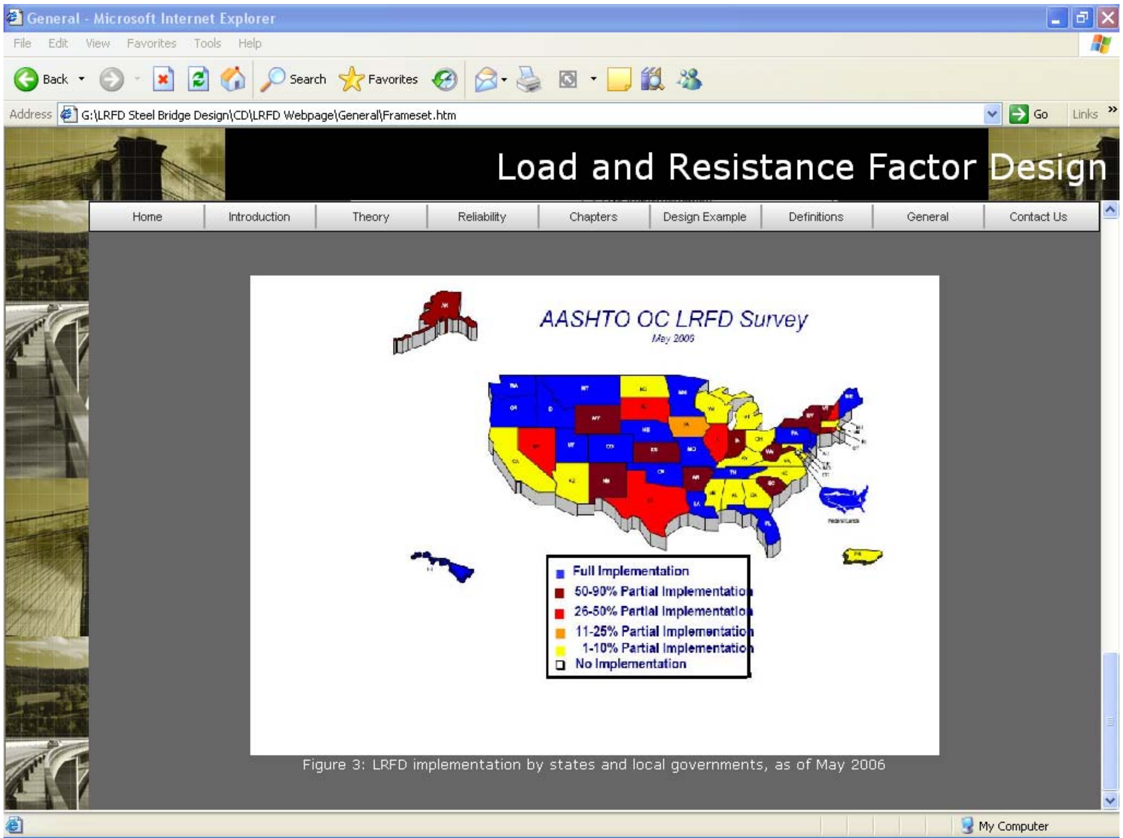


Figure 3-29. General page containing basic information about LRFD specifications

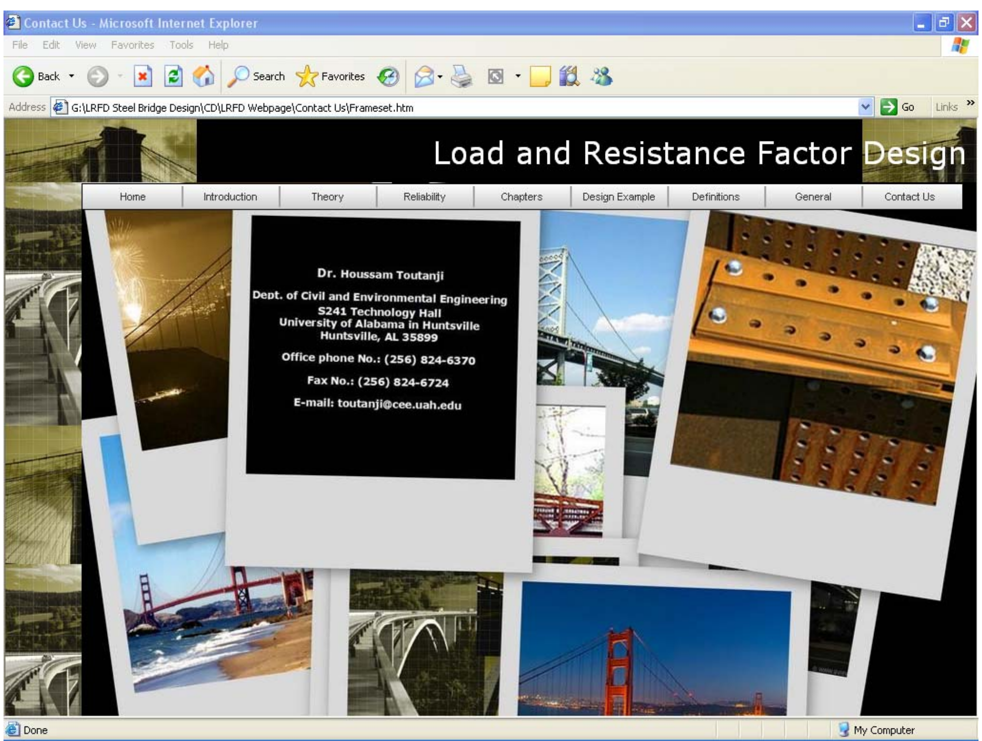


Figure 3-30. Contact page containing Dr. Toutanji's information

4.0 Conclusion

The purpose of this project was to create a user-friendly CD-ROM with an abundance of information on LRFD specifications. This tool can be used as an excellent training mechanism for today's engineers and designers. It can be easily updated to addresses the periodic changes required by AASHTO. The multimedia technology is an advantage in many ways: step-by-step details are presented using diagrams, equations, examples, tables, definition, and theory. This multimedia package can be used like a reference tool for people trying to learn the complicated language of LRFD specifications. This complete package will be available in the Civil and Environmental Engineering Department at the University of Alabama in Huntsville. Its main purpose is to facilitate LRFD information to many inexperienced designers and engineers in the innovative field of LRFD specifications for bridge designs.

5.0 References

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