

Timber Pile Design and Construction Manual



Timber Piling Council
American Wood Preservers Institute

PREFACE

This *Timber Pile Design and Construction Manual* has been developed by the American Wood Preservers Institute (AWPI) as its official recommendation for Timber Piling Design and Construction.

The data in this publication has been prepared in accordance with recognized engineering principles and is based on available technical data. The information in this manual should not be used or relied upon for a specific application without competent professional examination and verification of its accuracy, suitability, and applicability by a licensed professional engineer.

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The manual was developed to assist design engineers with the design of timber piling.

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Future changes to this manual will be posted on the following web site.
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CHAPTER 1.0

INTRODUCTION

1.1 SCOPE OF MANUAL

All objects and structures transfer their load either directly or indirectly to the earth. The capacity of the earth to support such loads depends on the strength and stability of the supporting soil or rock materials. Not all foundation materials possess the required characteristics to carry imposed loads or to resist natural or man made forces without resulting in damage to the structures they support. Consequently, the engineer is faced with the task of designing foundations to distribute high-intensity loads in a manner that can be supported by existing natural subgrade materials, and/or modifying those natural materials.

There are three basic approaches to achieving proper support of structures. These are: a) distribution of structural loads to foundations, such that the intensity of the loads transferred will not cause shear failure or objectionable settlement of the structure; b) modification of the foundation soil (i.e., soil improvement); or c) a combination of "a" and "b" above.

There are two general types of foundations for distributing applied structural loads to the ground: shallow foundations, and deep foundations. Shallow foundations principally distribute structural loads over large areas of near-surface soil to lower the intensity of the applied loads to levels tolerable for the foundation soils. The analysis and design of shallow foundations is not discussed in this manual. Deep foundations distribute loads to deeper, more competent soils or to rock, by means of skin-friction, end bearing, or a combination of both. This manual is devoted to the discussion of the structural and geotechnical aspects of timber pile foundation design.

This design manual follows the design methodology presented in the Federal Highway Administration's *Design and Construction of Driven Pile Foundations* (FHWA-HI-97-013). The information from this FHWA document has been condensed to focus solely on timber piles and has been supplemented to provide additional guidance with respect to the selection of timber pile structural properties required for design.

1.2 BACKGROUND

Timber piles have successfully supported structures for more than 6,000 years. Over the years, the methods that man has employed to extend the life of timber piling have evolved to the point that timber piles will last for over 100 years. Ancient civilizations used various animal, vegetable, and mineral oils to preserve timber. In Roman times, timbers were smeared with cedar oils and pitch, then charred to extend their service life. Roman roads built on treated piles were still in good condition 1,900 years later. A building built in Venice, Italy in 900 A.D. was rebuilt around 1900 on the same 1000 year old piles.

The modern age of wood preserving began in England in 1832. Pressure injection of coal-tar creosote into wood began in 1838. Following the successful use of pressure treated railroad ties, U.S. railroads started treating foundation piles in the early 1880's.

Since then, pressure treatment has been recognized as a process that protects wood by extending its life indefinitely. This is why building codes require wood for certain uses to be “treated” and why codes explicitly define “treated” as pressure treated.

In recent years, extensive load tests have been performed on pressure treated timber foundation piles. Design loads as high as 75 tons have been specified, and ultimate loads as high as 235 tons have been carried by timber piles. There are wooden piles loaded to 60 tons each under bridges spanning the Thames River in London and 100 ton timber piles in bridges spanning the River Seine in Paris.

Today wood piles are a mainstay of foundation designers. Wood piles are being routinely used in all kinds of structures, including manufacturing plants, processing facilities, commercial buildings, and highway bridges. For example, thousands of pressure treated wood piles were used for the foundation of new facilities at JFK Airport in New York, and at Dulles International Airport in Northern Virginia. The city of New Orleans, Louisiana is built on timber piles. Residential buildings, commercial buildings and the Superdome as well as paved highways in New Orleans are supported on timber piles. New Orleans, however, is not alone in its use of timber piles to support highways. The highest ever recorded design load for timber piles in U.S. highway construction is a 1000 foot long viaduct, supported by timber piles, which have a 75 ton design load on Interstate 80 near Winnemucca, Nevada.

1.3 SEISMIC DESIGN CONSIDERATIONS

The scope of this manual does not include seismic design considerations. There is on-going research on Performance-Based Seismic Design funded by the Federal Emergency Management Agency (FEMA). A separate bulletin is planned on Seismic Design Considerations for timber piling in the future.

1.4 ORGANIZATION OF MANUAL

This manual is intended to be a stand-alone document and is geared towards providing the practicing structural and geotechnical engineer with a thorough understanding of the design and construction of timber pile foundations. The organization of the manual is presented below.

Chapter 2 provides an overview of the design and construction process for a timber pile foundation.

Chapter 3 covers the selection of the strength properties of timber piles and considerations with respect to pile durability.

Chapter 4 gives an overview of the static design process for timber piles.

Chapter 5 presents five design methods to determine the static capacity of single piles in both cohesive and cohesionless soils.

Chapter 6 covers the design of timber pile groups.

Chapter 7 discusses design considerations for Marine applications.

Chapter 8 discusses pile installation considerations.

Chapter 9 covers static and pile load testing.

Chapter 10 deals with quality assurance and quality control during timber pile installation.

Chapter 11 provides a model specification for timber pile projects.

Chapter 12 reviews the geotechnical considerations that are important in defining the site conditions (i.e., subsurface exploration program) and provide the design engineer with the necessary information to perform the foundation design with respect to the subsurface soils.

This manual does not cover seismic/dynamic analysis. For information on this subject, the readers are referred to the Federal Highway Administration's *Design and Construction of Driven Pile Foundations* (FHWA-HI-97-013).