

PREFACE

The California Department of Transportation Trenching & Shoring Manual was originally developed by the Offices of Structure Construction in 1977. Its purpose then, which continues now, is to provide technical guidance for Structure's field engineers analyzing designs of trenching & shoring systems used in the California Highway Construction program. Beginning with the initial edition of 1977, this Manual was well received by both the Department and the construction industry, and was distributed nationwide as well as to many foreign countries.

This 2011 Manual edition remains to be devoted to the analysis of trench and excavation earth support (shoring) systems needed for the construction of the Department's infrastructure. Its main objectives are to inform the Engineer of California's legal requirements, and to provide updated technical guidance for analysis and review. The Engineer should bear in mind that this Manual is a book of reference and instruction to be used with respect to the administration and engineering of excavation shoring. In cases of conflict, the contract documents shall prevail.

This edition includes significant procedural analysis improvements that have been developed since the previous major update of 1990. These enhancements were possible through significant contribution from Anoosh Shamsabadi PhD, PE. His work and those of Kenneth J Burkle, PE represent thousands of hours of effort for this Manual and for the current Caltrans Trenching and Shoring Check Program.

Current concepts in soil mechanics or geotechnical engineering are summarized in order to better acquaint the reader with the practical considerations and accepted application of theoretical principles. Some situations or conditions that may cause difficulty are noted. This 2011 Edition has reorganized and consolidated some Chapters of the previous Manual. A significant change is the chapter on Earth Pressure Theory, which was developed around AASHTO and Transportation Research Board (TRB Report 611) equations. The new AASHTO simplified procedures now provides the ability to address conditions with multiple soil layers, both granular and cohesive.

The first two chapters are devoted to the legal requirements and the responsibilities of the various parties involved. Not only must construction personnel be aware of the various legal requirements, they must thoroughly understand the implications excavations pose to work site safety.

The engineering objective of a shoring system is to be both safe and practical. There are two major parts of the engineering effort. First is the classification of the soil to be supported, determination

of strength, calculation of lateral loads, and distribution of lateral pressures. This is the soil mechanics or geotechnical engineering effort. The second is the structural design or analysis of members comprising the shoring system. The first part, the practical application of soil mechanics, is the more difficult. The behavior and interaction of soils with earth support systems is a complex and often controversial subject. Books, papers, and "Experts" do not always concur even on basic theory or assumptions. Consequently, there are no absolute answers or exact numerical solutions. A flexible, yet conservative approach is justified. This Manual presents a procedure that will be adequate for most situations. The Engineer must recognize situations that affect the use of the procedures discussed in the Manual and utilize sound engineering judgment as to which methods are appropriate.

There are many texts and publications of value other than those listed in the list of references. Use them; however, be cautious with older material. There are other satisfactory methods of approaching the engineering problem. This subject is recognized as an engineering art. The need for good judgment cannot be over emphasized. Do not lose sight of the primary objective: a safe and practical means of doing the work.

There are two major reasons why the Department considers shoring and earth retaining systems a subject apart from other temporary works such as falsework. First, an accident in a trench or excavation is more likely to have a greater potential for the maximum penalty, that is, the death of a workman. Cave-ins or shoring failures can happen suddenly, with little or no warning and with little opportunity for workers to take evasive action. Second, earth support systems design involves the complex interaction of soil types plus engineering factors that are often controversial and highly empirical.

Trenching or shoring is generally considered temporary work. Temporary work can mean 90 days for complicated structures, but it can also be understood to mean only several days for the majority of the trenching work done. The term "temporary" can be adversely affected by weather, material delays, change order work, strikes and labor disputes, and even subcontractor insolvency.

In preparing this Manual, it has been the Department's goal to cover as completely as practical some temporary earth retaining structures or systems. This Manual is the result of blending the Offices of Structure Construction (OSC) experience with continued research and study by

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engineering staff from the Division of Engineering Services (DES). This Manual represents hundreds of years of experience compiled through a statewide team as noted below.

It would be impossible to acknowledge each and every individual who contributed to the development of the Manual. However, recognition is due to the major contributors as follows:

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Construction Safety Order from California Code of Regulations (CCR), Title 8, Sections 1504, 1539, 1540, 1541, 1541.1 (including appendices A - F), and Sections 1542 and 1543
Manual for Railway Engineering, 2002 American Railway Engineering and Maintenance-of-Way Association (AREMA)