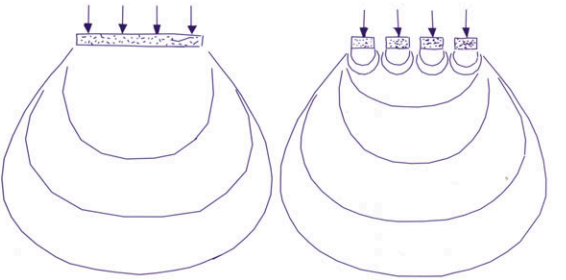
DESIGN OF SHALLOW FOUNDATIONS



SAMUEL E. FRENCH

ASCE PRESS

Design of Shallow Foundations

Samuel E. French, Ph.D., P.E.

ASCE PRESS
1801 Alexander Bell Drive
Reston, Virginia 20191–4400

Abstract: This book delivers a balanced presentation of both soils and structures as they relate to shallow foundations. From soils, it includes a treatment of relevant soil properties and soil mechanics at shallow depths. From structures, it includes a summary of loads on foundations and the deformations produced by such loads. The focus, however, remains at the founding line where the particular structural design is matched to the particular soil conditions. This book is intended for use by students as well as the practicing engineer.

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PREFACE

The study of foundations is invariably treated as two separate and distinct topics: the study of shallow foundations and the study of deep foundations. The concepts, approaches and practices involved in these two topics are quite different; it is a very natural choice to study them separately. This book deals with the first topic, the study of shallow foundations. Traditionally, the design of routine shallow foundations is presented at the undergraduate level, while the study of deep foundations is ordinarily presented in more advanced work, quite often at the graduate level.

The design of shallow foundations necessarily involves two disciplines: soil mechanics and structural mechanics. Specialists in soils are somewhat inclined to view foundation design as a soils problem with implications in structures. Specialists in structures are similarly inclined to view foundation design as a structures problem with implications in soils. In this text, only the most common case is considered, where foundation design is an interwoven indistinct melding of the two disciplines.

It is intended that this book will set forth a balanced presentation of both soils and structures as they relate to foundations. From soils, it includes a treatment of relevant soil properties and soil mechanics at shallow depths. From structures, it includes a summary of loads on foundations and the deformations produced by such loads. The focus, however, remains at the founding line, where the particular structural design is matched to the particular soil conditions.

The approach used in this book has been simplified where such simplification does not diminish accuracy. However, there should be no delusions about high levels of accuracy in foundation design, where at best, concrete properties may be accurate to two places and soil properties may be accurate to one. Elaborate methods of analysis requiring high levels of predictability in the material properties are avoided.

In any field of study as new as soil mechanics, numerous fragments of information will continually be generated as research expands piecemeal in all directions. It should be expected that some of these fragments will be shown in future years to be relevant, some merely peripheral. There has been a concerted effort in the preparation of this textbook to bypass such a mass of fragmented information and to focus on a single line of "established" and proven methods. Some of these established methods will undoubtedly be superceded in future years as newer,

better and more efficient methods emerge. For now, the methods presented here have been chosen simply because they are known to work. They will not cease to work just because more accurate methods or more comprehensive methods or more efficient methods are developed in the future.

This book is intended for use both by students as well as persons already in practice. It is intended to include architecture, construction and engineering technology as well as civil engineering. It is presumed that the user will have taken the usual preparatory courses in statics and strength of materials. It is also presumed that the user will be fully familiar with concepts of stress and strain, to include the Mohr's circle analysis for state of stress at a point.

The Imperial (British) system of weights and measures is used exclusively in this text. However, in deference to the publisher's policy of including a ready and convenient means of conversion to SI units, a table of common conversion factors is included at the beginning of the text.

The exclusive use of Imperial units rather than SI units is a matter of practicality rather than preference. In Memphis, for example, there has been only one application in memory for a building permit in metric units. That application (1996) was from a Canadian engineering firm on behalf of their Canadian client. All materials manufactured to metric standards (doors, windows, plywood, plumbing fixtures, pipe, etc.) were presumably shipped from Canadian suppliers; they are not generally available in the U.S.

Since the conversion to SI units is not proceeding at a rapid pace, the short life of about eight years for a book such as this requires that currently familiar terms, phrases and measurements be used. In consideration of market size and market appeal in the U.S., the author has chosen to stay with the more familiar Imperial units.

In U.S. literature, the practice of providing parenthetic SI units following each use of Imperial units seems to promote clutter with no apparent promotion of conversion. Since there is a conscious effort in all of the author's books to reduce clutter, the practice of using parenthetic SI units is avoided here.

As with his earlier books, the author is again indebted to his wife Sherry, who typed the original manuscript of the text. Her unwavering support of these speculative ventures is gratefully acknowledged.

Samuel E. French, Ph.D., P.E.
Martin, Tennessee, 1998

TABLE OF CONVERSION FACTORS FOR UNITS COMMONLY USED IN FOUNDATION DESIGN

To convert	To	Multiply by
inches	millimeters	25.400
$inches^2$	$millimeters^2$	645.16
$inches^3$	$millimeters^3$	16387
feet	millimeters	304.80
feet	meters	0.3048
$feet^2$	$meters^2$	0.09290
$feet^3$	$meters^3$	0.02832
$feet^3$	liters	28.3169
$feet^3$	gallons	7.48055
pounds (lbs)	Newtons (N)	4.44822
kips (k)	kilonewtons (kN)	4.44822
slugs ($lb \cdot sec^2/ft$)	kilograms (kg)	14.59390
lbs/ft (plf)	Newtons/meter (N/m)	14.59390
kips/ft (klf)	kilonewtons/meter (kN/m)	14.59390
lbs/in^2 (psi)	N/mm^2 (MPa)	0.006895
$kips/in^2$ (ksi)	N/mm^2 (MPa)	6.89475
lbs/ft^2 (psf)	$Newtons/meter^2$ (Pa)	47.8803
$kips/ft^2$ (ksf)	$kilonewtons/meter^2$ (kPa)	47.8803
lbs/ft^3 (pcf)	N/m^3	157.0874
$kips/ft^3$ (kcf)	kN/m^3	157.0874
gallons (gal.)	liters	3.785
gallons of water	pounds	8.342
miles/hour (mph)	kilometers/hour (kph)	1.609
$yards^3$ (cy)	$meters^3$	0.76455