APPENDIX

C Footing Foundations

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Please note that these conversion tables are approximate. They can be used by characterizing the soil as being either predominately granular or cohesive. If possible, the conversion of the Penetration Index (N value) should be checked by using is-situ or laboratory tests.

Table C-1. Approximate Values for N, ϕ and Unit Weight for GRANULAR SOILS

COMPACTNESS	VERY LOOSE		LOOSE		MEDIUM		DENSE		VERY DENSE
Relative Density, D_d		15%		35%		65%		85%	
Standard Penetration Resistance, N = Blows/ft*		4		10		30		50	
Angle of Internal Friction, ϕ		28		30		36		41	
Unit Weight (PCF)									
Moist	100		95-125		110-130		110-140		130+
Submerged	60		55-65		60-70		65-85		75+

VERY LOOSE: A reinforcing rod can be pushed into soil several feet.
DENSE: Difficult to drive a 2x4 stake with a sledge hammer.

*N = Blows/Ft as measured by the standard penetration test (See Appendix B).

Relative Density, $D_d = \frac{0_{max} - e}{0_{max} - 0_{min}} \times 100$

e = existing void ration of mass being considered.

e_{max} = void ratio of same mass in its loosest state.

e_{min} = void ration of same mass in its most compact state.

Table C-2. Approximate Values for N, q_u and Unit Weight for COHESIVE SOILS

CONSISTENCY	VERY SOFT	SOFT	MEDIUM	STIFF	VERY STIFF	HARD
q_u = unconfined comp. strength (PSF)	500	1000	2000	4000	8000	
Standard Penetration Resistance, N – Blows/Ft *	2	4	8	16	32	
Unit Weight (PCF) Saturated	100-200		110-130		120-140	130+

VERY SOFT: Exudes from between fingers when squeezed in hand.
SOFT: Molded by light finger pressure.
MEDIUM: Molded by strong finger pressure.
STIFF: Indent by thumb.
VERY STIFF: Indent by thumb nail.
HARD: Difficult to indent by thumb nail.
*N = Blows/ft as measured by the standard penetration test (See Appendix B)

To be used only as a rough guide.

STATE OF CALIFORNIA -- BUSINESS, TRANSPORTATION, AND HOUSING AGENCY PETE WILSON, Gov

DEPARTMENT OF TRANSPORTATION
Nevada City Construction Office
P. O. Box 691
Nevada City, CA 95959

September 10, 1991

03-NEV-49-21.9
03-295604 F-P049(95)
S. Yuba River Br.

David A. Mowat Company
Highway 49
Nevada City, CA

Gentlemen:

This letter is to clear up any possible misunderstanding about field revision of the elevation of spread footings. You are reminded that Section 51-1.03 of the Standard Specifications states that "the elevations of the bottoms of footings shown on the plans shall be considered as approximate only..."

The Engineer will establish final footing elevations at the earliest time possible consistent with the progress of the work, and that you will be informed in writing of the Engineer's decision.

You are reminded that should you elect to do any work or order any materials before receiving the Engineer's decision regarding spread footing elevations, you do so at your own risk and assume the responsibility for the cost of alterations to such work or materials in the event that revisions are required.

If you have any questions about this or any other matter, please call me at (916) 265-9413.

Sincerely,

John Rodrigues
Resident Engineer
David R. Keim
by David R. Keim
Structures Representative

cc: OSC
03 Const
DKDefoe
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http://www.dot.ca.gov/hq/esc/ctms/ctmsindex100.html

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY

California Test 112
August 2012

DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Transportation Laboratory
5900 Folsom Boulevard
Sacramento, California 95819-4612

METHOD FOR INSTALLATION AND USE OF EMBANKMENT SETTLEMENT DEVICES

A. SCOPE

The installation, maintenance, and data collection procedures for the various embankment settlement devices used to monitor subsurface settlement are described in this method. Analysis of the settlement data is included as a separate part of this method.

Settlement devices are used to monitor the rate and magnitude of settlement occurring at a point within or beneath an embankment during and subsequent to construction. The data obtained from these devices are used to determine the allowable loading rate during embankment construction and the appropriate time for removal of surcharge and/or commencement of permanent structure construction.

This method is divided into the following parts:

1. Fluid Level Settlement Devices
2. Pipe Riser Settlement Device
3. Settlement Data Analysis

The fluid level vented standpipe unit may be used at most locations. A sealed standpipe unit must be installed at locations where groundwater may interfere with the operation of the unit or where excess pore water is expected from the use of dredged material or wet soil in embankment construction. Where it is possible, the tube length between standpipe and indicator unit should generally be limited to a maximum 300 linear ft. Installations over longer distances can be made but are not advisable under normal circumstances since it may result in inconsistent test data. Factors such as larger size tubes, change of platform location, or changes in elevation of the water line may have to be considered (see NOTE).

NOTE: There may be job conditions with respect to terrain, long tube length between standpipe and indicator unit, or anticipated large settlements that require special installations.

The pipe riser settlement device is used for monitoring fill settlement over soft foundation soils where the fluid level settlement devices are not feasible because of flat terrain, width of embankment construction, or other features which would make installation of a fluid level type of settlement platform undesirable. The pipe riser settlement device is a direct-reading unit which is exposed for the full duration of fill construction and surcharge removal. Because of the vulnerability of this unit to damage by the contractor's operations, the pipe riser settlement device should be used only on those projects where the fluid level type of settlement device would be impractical.

B. REFERENCE

None.

Throughout the 1990's Caltrans underwent a massive seismic retrofit program. Retrofits of footings designed and built prior to 1973 were required to address deficiencies. These retrofits required the installation of a top mat of reinforcing steel (Figure C-1) to address tensile loads at the top of the footing due to seismic forces. In some cases footing dimensions were increased and/or perimeter piles added (Figure C-2). These additional piles provide additional resistance to bending moment in the structure and provide additional restraint against rotation. Typical spread footings seismic retrofits are shown in the Figures below.

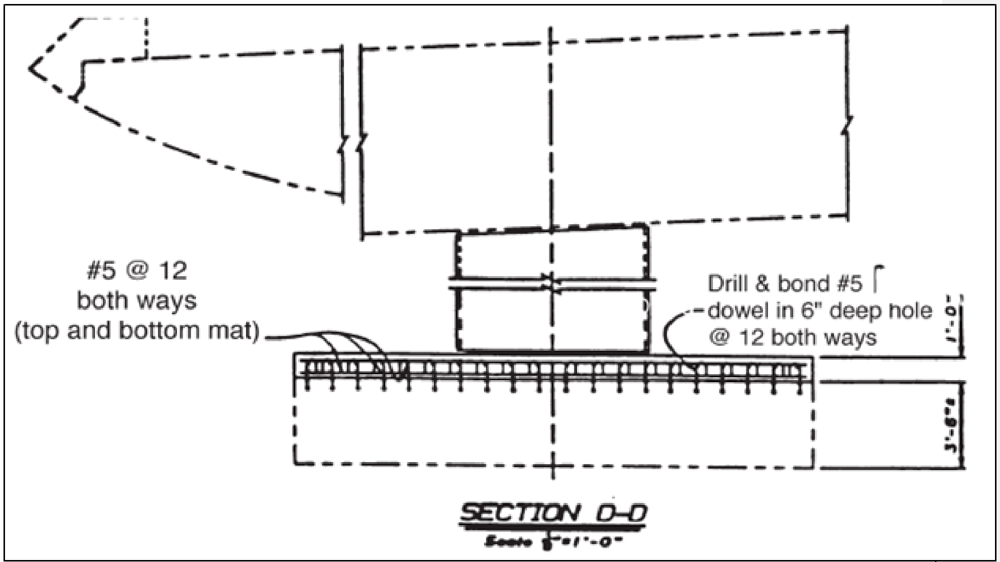

Figure C-1. Seismic Retrofit Strategy – Add Top Mat.

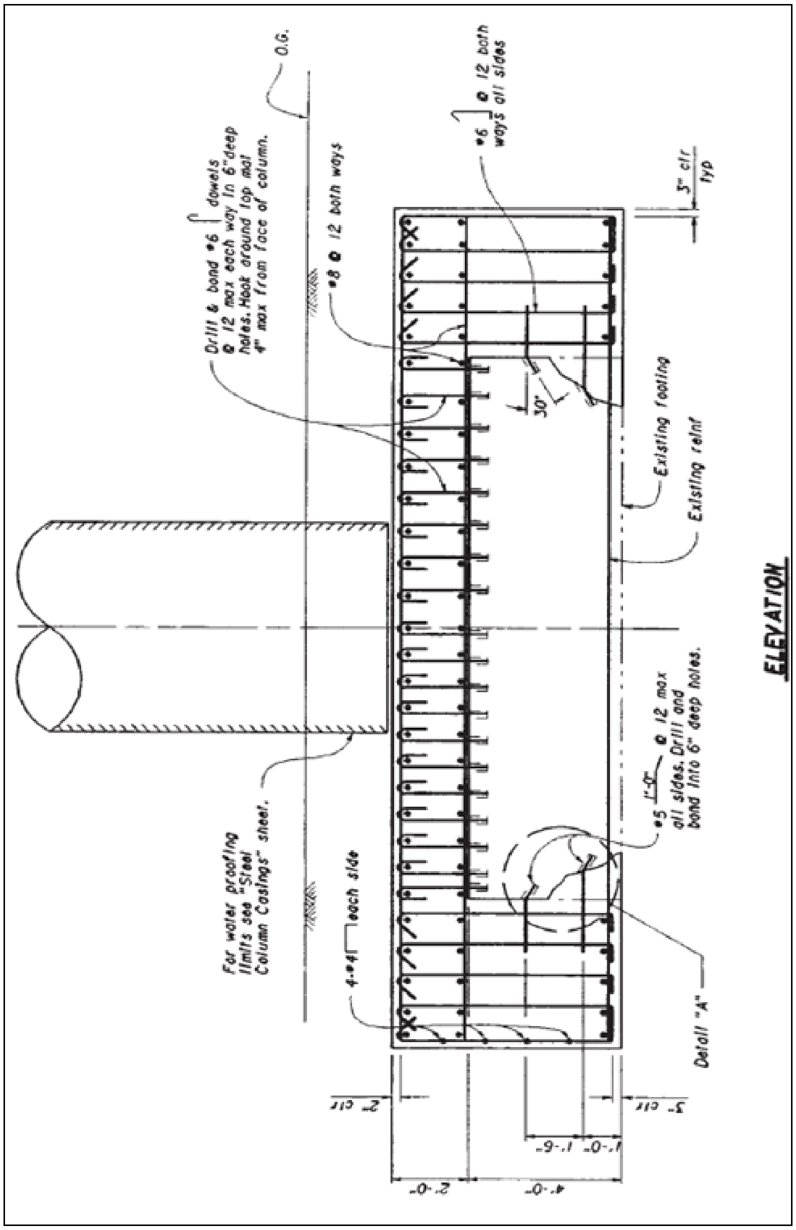

Figure C-2. Seismic Retrofit Strategy – Enlarged Footing.