

7. SAN FRANCISCO, CALIFORNIA, WORKSHOP - WRITTEN COMMENTS,  
CORRESPONDENCE AND INFORMATION

STAFF:

JAMES H. KLEINFELDER  
CYRIL M. McRAE  
EARL C. KLEINFELDER  
MICHAEL E. MAHONEY  
RICHARD M. WARY

# J. H. KLEINFELDER & ASSOCIATES

GEOTECHNICAL CONSULTANTS • MATERIALS TESTING

1981 OLYMPIC BOULEVARD, SUITE 300

WALNUT CREEK, CA 94596

(415) 938-5618 TELEX: 171266

ROBERT D. HOWELL  
WILLIAM E. ELLIS  
ROBERT A. WILKINSON  
DAVID C. MATHY

July 10, 1981

Mr. Felix Yokel  
U.S. Dept. of Commerce  
National Bureau of Standards  
Bldg. 226, Rm. B162  
Washington, D.C. 20234

Subject: San Francisco OSHA Subpart P Workshop

Dear Felix:

Listed below are my comments on the workshop and OSHA Draft.

### General

I like your idea of an industry committee representing Contractors, Engineers and Workmen carrying the final draft to the powers that be in OSHA. This would have to be a well balanced committee. I imagine A.G.C. would represent contractors, ASFE the design profession, but I don't know who would represent the workmen.

### Specific Comments

1. I am not sure that those representing labor are informing their people that following the "standard of practice" or an "engineered" system will only reduce risk, not eliminate it.
2. Section 1926.651 (P)
  - . 5 ft. exit requirement sounds reasonable
  - . Wide excavations could be exempt
  - . I am not sure about large pipes
  - . Negotiable slope may be difficult to define
3. Section 1926.652 (a)(2)
  - . I don't believe that the standard of practice should go below 20 ft.
  - . An exploration program should be required in excavations deeper than 20 ft. In some cases it may be wise to have a geologist involved as well as geotechnical engineer. The geol./enr. should determine the design parameters. If a



professional engineer is required to design the shoring, he should be an engineer qualified in the area of shoring design. If you are not going to require a qualified engineer, some checking mechanism should be set up, requiring the signatures and dates of the designer and the checker. (A professional engineer may be required by law in some states).

4. Section 1926.652 (b) (1)
  - . Short term excavation cannot be dropped without revising your design loads. I can see the desirability to drop it in some localities, but not nationwide. Maybe it could be increased to 3 days. Many changes can occur in 7 days.
5. Page 11, Table 1
  - . The "stable slope" concept must be kept since the standard of practice is not conservative enough to be used blindly.
6. Page 12, Figure 2
  - . Four (4) ft. seems to be working in California.
7. Section 1926.652 (b) (4) (ii)
  - . I see no problem with the existing format.
8. Section 1926.652 (b) (5) (ii)
  - . No comment
9. Section 1926.652 (b) (5) (iii)
  - . The sentiment was for 2 ft.
10. This work is normally out of the Architects field.
11. I like the idea of having a competent person in the field. Certainly the designer will not be in the field.
12. Maybe it could be replaced with "soil or rock movement that can cause physical harm to workers."
13. Old Section 1926.651 (c)
  - . No comment

I appreciate the opportunity of attending your workshop.

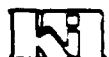
Sincerely,

J. H. KLEINFELDER & ASSOCIATES

*Jim Kleinfelder*  
James H. Kleinfelder  
President

197

JHK:dc  
cc: Bill Zoino



**DRAFT**

DISCUSSION OF:

WORKING DRAFT OF SUGGESTED REVISION IN SUBPART P OF  
THE SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION  
BASED ON BUILDING SCIENCE SERIES REPORT BSS 127

by Felix Y. Yokel

by

BUILDING AND CONSTRUCTION TRADES DEPARTMENT AFL-CIO  
JACK L. MICKLE

SAN FRANCISCO, CALIFORNIA

JULY 8, 1981

# DRAFT

Dr. Yokel is to be commended for his efforts to improve upon the Occupational Safety and Health Administration, (OSHA), 29 CFR Part 1926. Subpart P, Excavation, Trenching and Shoring Regulations document.

The Building and Construction Trades Department, AFL-CIO has been supportive of and assisted Dr. Yokel, where possible, since he began work on this project with the National Bureau of Standards in June, 1976.

In January, 1977 the B&CTD began the planning stage of a "Trenching Hazard Identification Task Force", hereinafter called the Task Force, to help the NBS obtain employee input aimed at hazard identification. In March, 1977 the Task Force met for a four day "retreat" type workshop; the six labor and management members brought with them 182 years of experience in trenching and related work. The charge was "to identify procedures and conditions that create safety hazards during excavation and trenching operations". Others present for the deliberations were Jim E. Lapping, Director of Safety and Health, B&CTD as coordinator; Felix Y. Yokel as Technical Observer for the NBS and Jack L. Mickle, Chairperson. The final report (1)\* was filed with the NBS in April, 1977. The final report appears in appendix G of NBSIR 80-1988 (2).

In September, 1978 Dr. Yokel (3) presented the preliminary findings and recommendations of the NBS study. Out of that two-day workshop came the agreement for this series of workshops to bring the results of Dr. Yokel's NBS study to the attention of labor, management and engineers in the field. Actually the essence of the working draft we are using for this workshop was printed in the Concrete Pipe News (4) in April of this year.

Since the 1978 workshop the B&CTD has responded to a number of requests for criticisms of drafts by Dr. Yokel.

---

\* Numbers in parentheses refer to references given at the end of this paper.

**DRAFT**

Two premises underlie all remarks and criticisms given in this critique:

That the worker be assured of safe and healthful working conditions, and

that the journeyman worker and the compliance officer as well as the management representative be able to fully understand the precautions that have been taken and the protective measures that have been provided to assure worker safety and health, or that the safety of the worker on the job be placed in the hands of a licensed professional.

The first premise is spelled out in the preamble of the Occupational Safety and Health Act of 1970.

The second premise assumes that an average journeyman or compliance officer, using the official OSHA regulations governing excavation and trenching safety, can determine whether or not the safety provisions on any jobsite are in compliance with the appropriate regulations. If the provisions are not "standard practice" as outlined in the regulations then there must be a certificate issued by a licensed professional which assures the worker that the jobsite safety and health measures have been designed by and certified by the licensed professional.

There are undoubtedly many "competent persons" and "qualified persons" who are quite capable of designing a safe worksite, but how are they to be identified by the worker or compliance officer? The license is the evidence. All licensing laws have encountered competent or qualified persons and have eventually incorporated them into or excluded them from practice. While there are probably quite capable people who know a great deal about medicine or law, the prudent individual seeks the licensed practitioner when medical or legal opinions or services are sought.

Actually suggesting that registered engineers need to be consulted is not new with this suggestion. Thompson and Tanenbaum (5) recommend substantial involvement of registered engin-

**DRAFT**

ers in construction activities requiring trenching or excavations.

In view of the foregoing, this discussion will be concerned with only the first 20 pages of Dr. Yokel's working draft which outlines "standard practice". Even portions of the first 20 pages probably belong in the "guidelines" which have been included to assist professionals. It is also assumed that only the "standard practice" will eventually be recommended for inclusion in the OSHA regulations Subpart P; Dr. Yokel has indirectly suggested that by what was included in the article which he co-authored in the Concrete Pipe News (4).

# DRAFT

## COMMENTS ON SELECTED ITEMS ON PAGES 1-20 OF THE WORKING DRAFT

Page	Location	Comment
1	item 3	?boxes. It is addressed to contractors, shoring manufacturers and engineers..." Why address it to the contractor unless the contractor is also an engineer?
2	item 5	"...which would aid field personnel and contractors in the selection of shoring." Once again, these persons are going to be dealing with the standard practice unless they are licensed professionals in their own right.
2	last line	Note that a qualified person is not an engineer (recognizing this as just an example)
3&4	All Issues	The items listed on pages 3 and 4 will be considered individually as they encountered in the text.
5	(g)	..be provided with and shall be instructed (required) to wear .....
5	(i)	...shall be permitted under loads handled by <del>power-shovels,-derricks,-or-hoists</del> (equipment). This item is too specific for not listing all equipment which is used to handle loads; for example, backhoes are not listed.
6	(j) 2nd para. line 8	...or the shoring system, and shall <del>increase-protection-against-slides-and-cave-ins-if-necessary</del> (see that all work in the excavation shall cease until necessary precautions have been taken to safeguard employees.)
6	(c)(1) line 3	?..shall be effectively stored and retained at least 2 (3) feet or more from the edge of the excavation." The Task Force specifically stated that 3 feet was necessary for proper protection.
6	(c)(2) line 3	"...may use effective barriers <del>or-other-effective retaining-devices-in-lieu-thereof</del> in order..." Task Force recommended extending tight sheeting above ground level as an effective barrier. Twelve to 18 inch extensions were discussed.
8	(l) line 2	?.. equipment, they shall be <del>designed-and</del> constructed by qualified persons..." Design implies work done by a licensed professional.
8	(o)	This item is silent with respect to straight sided pier holes; some confusion has arisen because 1926: straight sided holes are covered elsewhere. 800(h)(3)
8	(p)	When employees are required to be in trenches 4 <del>(5?)</del> feet deep...." Leave at 4 feet.



# DRAFT

Page	Location	Comment
8	(s)	"...boxes or shields are used they shall be designed (and certified as to use by a professional engineer and shall be maintained in a manner which will provide protection for the worker.)" Strike the balance of (s).
9	(a)(1)a	Excavations less than 5 ft. deep, except when examination-of-the-ground-by-a-competent-person-indicates-that hazardous ground movement may occur."
9	(a)(2)	"Excavations from 5 ft. to 20 ft. {24-ft-?} deep.." Why consider 24 feet? A better choice might be 15 feet for Standard Practice. Thompson and Tanebaum data (5) indicate that 87 per cent of the fatalities and injuries occur in excavations less than 20 feet deep and that 72 per cent occur in those less than 15 feet deep. Hinze and Carino (2) state in their summary that their "...study showed that most trenchwork is between 5 and 15 feet deep with the trench width usually being about 3 feet." Cass (6), speaking about the stacking of two standard 7 ft. aluminum hydraulic shores, notes that where the trench is over 14 feet deep (page 68) "other shoring systems should be applied" and on (page 72) "Maximum trench depth, this method, is 15' (4.58 m). Over 15' (4.58m), see Fig. 60.2, multi-type shoring." Multi-type shoring shown on Fig 60.2 is a different system using aluminum hydraulic shoring and plywood backing. A maximum depth of 15 feet for Standard Practice seems appropriate.
9	(a)(2)a line 3	"..sloping requirements must be determined by an engineer {a-qualified-person?}."
9	(a)(2)b Figure 1	May lead an individual to believe that FOOTING A is not a cause for concern; this could be dangerous. It is worthy of note that the role of the engineer has not been challenged at this point where property damage as well as personal injury is possible.
10	(a)(3)	See comments under: page 9 (a)(2). Fifteen ft. depth may be a better limit for Standard Practice rather than 20 ft.
10	(b)(1) line 6	The distinction between short-term and long-term is very difficult to reckon with; virtually no firm data exists. Not only stresses in the mass vary with time, but environmental factors may be critical. Twenty-four hours seems more logical than seven days.

# DRAFT

Page	Location	Comment
11	bottom of page last two lines	There may be some merit to allowing steeper slopes in some cases. The Task Force indicated that slopes flatter than 1:1 were probably not necessary for worker safety. Slopes of 1:1 were recommended for most conditions.
12	Fig. 2 Case IV	This particular configuration should be made a part of the "guidelines" proposed by NBS. While the configuration looks good on paper, it may be difficult to understand and/or enforce in the field. If included in Standard Practice the 3 ft max bank should be retained.
13	(b)(4)(i)b.	See the first four lines at the top of page 13. Table 2 is necessary in Standard Practice only if Fig. 3(b) is retained. Moving the option shown as Fig. 3(b) to the Guidelines removes the need for Table 2 which is confusing and also removes the need for special tables and figures outlining the placement of shoring in the lower part of the ditch.
13	(b)(4)(i)c.	For Standard Practice it may be worthwhile to include all surcharges, including allowances for heavy equipment, in the adjusted depth. The Task Force recommended a minimum of 300 pounds per square foot for surcharge. Dr. Yokel has greatly simplified Table 3 but it still can be confusing. Moving Table 3 to the Guidelines and greatly increasing the surcharges to allow for heavy equipment may lead to "overdesigned" shoring and shields, but Standard Practice would thereby be greatly simplified.
13	(ii)b.	The Task Force recommended a 500 lb gravity load.
13	(ii)c.	This statement is not clear. Does this mean a 240 ft-lb impact load per square foot? The entire (ii)c. should become a part of the Guidelines and removed from Standard Practice.
13	(ii)	This entire section devoted to the required strength of shoring systems, trench shields and trench boxes needs to be moved to the Guidelines.
16	b.	If some of the previous suggestions are followed, hydraulic shores and other assemblies can be brought into Standard Practice. At a meeting in October, 1980 with NBS and members of the hydraulic shoring industry it was agreed that reasonably simple charts for the selection of shores can be developed. This seems to be in keeping with Cass' (6) recommendations for depth to 14 or 15 ft. There is no question that the resulting system would be greatly over-designed

Page	Location	Comment
		at times, but the freedom to use Standard Practice for most work (2) and thereby not requiring the services of an engineer seems to outweigh the disadvantages of overdesign.
16	c.	Timber shoring is properly located in the Guidelines; selection must be by an engineer. The Guidelines are for the use of licensed professionals.
16	(5)(ii) last two lines	The statement in parentheses is a vague performance specification which detracts from a well stated, precise paragraph.
16	(5)(iii)	Excavation below the bottom of the protective element has merit; exactly how much to allow is difficult to determine. Certainly engineers can design specific protection for unique circumstances, the Guidelines will help, but permitting excavation below the protection device in Standard Practice will require very careful consideration.
18	(a)	"...with standards required by a <del>registered architect</del> , a registered professional engineer, or other duly licensed <del>or-recognized</del> authority. .."
19	(m)	Twenty-four hours for short term seems most reasonable.
19	(o)	Negotiable slope needs to be specified; 1½:1 seems reasonable.
19	(p)	How is a qualified person to be identified? Unless there is a specific procedure anyone can claim to be a qualified person. No objection if the qualified person is permitted to use Standard Practice only.
19	(t)	same argument; use 24 hours for short term.
19	(aa)	<u>Stable Slope</u> . A meaningless term unless it is arrived at by a licensed engineer. This term has no place in Standard Practice!
20	(gg)	Working loads are best relegated to the Guidelines where they can be dealt with by an engineer.

# DRAFT

## Summary

There must be clear separation between Standard Practice and cases where an engineer has certified the procedure to be followed.

It is recommended that Standard Practice be permitted to a depth of cut of 15 feet; this includes most excavation and trenching work. At depths greater than 15 feet, or for special work, the engineer must assume full responsibility for the design of the protective system. The 15 ft. depth needs verified.

Standard Practice must be written such that the protective measures resulting from the application of Standard Practice are observable, measurable, understandable by all parties (with application of the regulations) and provide for the safety and health of the worker. It is recognized that Standard Practice may at times result in substantial overdesign, but this would not be new to the construction field.

It is anticipated that competent or qualified persons working for the contractor would select methods within Standard Practice to protect workers, but that any deviation from Standard Practice would need to be designed by an engineer. The engineer is recognizable by a professional license.

Several items which need consideration: construction right of way requirements, toxic materials, safety program as an item in the bid document, soil conditions and utilities in the bid document and better safety education for all. The Task Force final report lists other concerns.

**DRAFT**

**RECOMMENDATIONS**

1. Use Standard Practice to a depth of 15 feet.
2. Over 15 feet or where Standard Practice is changed an engineer must assume full responsibility.
3. Standard Practice must be observable, measurable and understandable by all parties and above all must be effective.
4. Competent and qualified persons working for the contractor would select methods within Standard Practice but an engineer would be required where deviations occur.
5. Construction right-of-way needs to be considered.
6. Toxic materials need to be considered.
7. A safety program needs to be outlined in the bid documents.
8. Soil conditions and utilities need to be considered in the bid documents.
9. Safety education is a must for all.

(9b)

**DRAFT**

**References**

1. Building and Construction Trades Department AFL - CIO. Trenching Hazard Identification Task Force; Final Report. Prepared for the National Bureau of Standards; Building Safety Section; James O. Bryson, Chief. April, 1977.
2. Hinze, Jimmie and Nicholas J. Carino. A Study of Work Practices Employed to Protect Workers in Trenches; NBSIR 80-1988. National Bureau of Standards. March 1980.
3. Salomone, Lawrence A. and Felix Y. Yokel. Proceedings, Federal Workshop on Excavation Safety, September 19 and 20, 1978. National Bureau of Standards. July, 1979.
4. Yokel, Felix Y., Riley M. Chung and Ronald L. Stanevich. New Concepts for Construction Practice Standards for Excavations. Concrete Pipe News; pages 28-33, vol 33 no 2, April, 1981.
5. Thompson, Louis J. and Ronald J. Tanenbaum. Excavations, Trenching & Shoring: the responsibility for design and safety. Sponsored by the Associated General Contractors of America. A report of the Texas A & M Research Foundation. College Station Texas. September, 1975.
6. Cass, W. Martin "Red". Common Sense in the Common Trench. Equipment Guide-Book Company; 2800 West Bayshore Road, Palo Alto, California 94303. 1979.

**CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD**

Amend the definition of Excavation, Trenches, Earthwork in Section 1584 to read:

**Excavation, Trenches, Earthwork.**

(A) **Bell Hole.** An additional excavation made into the sides or bottom of a trench to provide additional work space.

(B) **Belled Excavation.** A part of a shaft or footing excavation, usually near the bottom and bell-shaped, that makes the cross-sectional area at that point larger than that above.

(C) **Braces for Excavations.** The horizontal members of the shoring system whose ends bear against the uprights or stringers.

(D) **Earthwork.** The process of excavating, moving, storing, placing, and working any type of earth materials.

(E) **Excavation.** A man-made cavity or depression in the earth's surface, including its sides, walls, or faces formed by earth removal and producing unsupported earth conditions by reason of the excavation. If installed forms or similar structures reduce the depth to width relationship, an excavation may become a trench.

(F) **Hard Compact.** All earth material not classified as running or-unstable.

(G) **Qualified Person.** A person designated by the employer who by reason of experience or instruction is familiar with the operation to be performed and the hazards involved.

(H) **Running.** Earth material whose angle of repose is approximately zero, as in the case of soil in a nearly liquid state, or dry, unpacked sand which flows freely under slight pressure. Running material also includes loose or disturbed earth that can only be contained with solid sheeting.

(I) **Shaft.** An excavation under earth's surface whose depth, either horizontal or vertical, is much greater than its cross-sectional dimensions such as those formed to serve as wells, cesspools, certain foundation footings, and under streets, railroads, buildings, etc.

## CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

(J) Sheet Pile. A pile, or sheeting, that may form one of a continuous interlocking line, or a row of timber, concrete, or steel piles, driven in close contact to provide a tight wall to resist the lateral pressure of water, adjacent earth, or other materials.

(K) Shore (Strut). A supporting member that resists a compressive force imposed by a load.

( ) Shoring System. A temporary structure for the support of earth surfaces formed as a result of excavation work.

(M) Sides, Walls, and Faces. The vertical or inclined earth surfaces formed as a result of excavation work.

(N) Sloping of Earth. The angle with the horizontal which a particular earth material will stand indefinitely without movement. A method of excavation whereby the faces of an excavation or trench are laid back to provide protection from moving ground.

(O) Spoil. The earth material that is removed in the formation of an excavation.

(P) Stringers. The horizontal members of the shoring system whose sides bear against the uprights or earth.

(Q) Trench. Shall mean an excavation in which the depth exceeds the average width of its cross section. Excavations that are more than 15 feet wide at the bottom, shafts, tunnels, and mine excavations are not trenches. A narrow excavation made below the surface of the ground. In general, the depth is greater than the width at the bottom, but the width of a trench at the bottom is not greater than 15 feet.

(R) Trench Jack. Screw or hydraulic type jacks used as cross bracing in a trench shoring system.

? (S) Trench Shield. A shoring system generally composed of steel plates and bracing, welded or bolted together, which support the walls of a trench from the ground level to the trench bottom of which can be moved along as work progresses. ND

(P) Unstable, as used in Article 5,--Earth material other than running that, because of its nature or the influence of related conditions, cannot be depended upon to remain in place without extra support, such as would be furnished by a system of shoring.

(T) Uprights. The vertical members of the shoring system.

(U) Waler. A structural member in a horizontal or nearly horizontal position used for stiffening or securing other components of concrete forms, excavation sheeting, or similar temporary structures.



CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Adopt new Section 1540 to read:

1540. Excavations.

(a) Scope. Sections 1540(b) through (n) and 1541 apply to all excavations, trenches, shafts or earthwork and establish essential requirements and minimum standards of safety in earth excavation work.

NOTE: (1) Whenever the term "excavation(s)" is used it also applies to trenches, shafts and other earthwork.

(2) For additional shaft and incline excavation details, see Sections 1542 and 1543.

(3) For additional earthwork excavation details, see Sections 1544 through 1547 which apply to such work locations as borrow pits, road or dam construction sites and similar work areas.

(4) The Orders in this Article do not apply to work covered by the Mine Safety Orders or the Tunnel Safety Orders.

(b) Preparations.

(1) Prior to opening an excavation, the employer shall determine whether underground installations such as, sewer, water, fuel, electric lines, telecommunication lines, etc., will be encountered, and if so, where such underground installations are located.

(2) When the excavation work approaches the approximate crossing or parallel location of such an underground installation and danger of accidental contact or disturbance is possible, the exact location shall be determined by appropriate means before proceeding. When it is uncovered, adequate protection shall be provided for the existing installation.

(3) All known owners of underground facilities in the area involved shall be advised of proposed work at least 48 working hours prior to the start of excavation work.

Exception: Emergency repair work to underground facilities.

(4) Trees, boulders, poles and other surface encumbrances located so as to create a hazard to employees involved in excavation work, or in the vicinity thereof at any time during operations, shall be removed or made safe before excavating is begun.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD(c) Exposure.

(1) No employer shall cause or permit his employees to work in or adjacent to any excavation until a reasonable examination of same has been made by a qualified person to determine that no recognizable conditions exist exposing them to injury from possible moving ground.

(2) Excavations shall be inspected by a qualified person after every rainstorm or other hazard-increasing occurrence and the protection against slides and cave-ins shall be increased, if necessary, before employees are permitted to enter the excavation.

(d) Protection. Employees who must enter excavations 5 feet or more in depth shall be protected by a system of shoring, sloping of the ground, benching, or other effective means as provided by these Orders. Protection for employees who must work in excavations less than 5 feet in depth shall also be provided when examination by a qualified person indicates that hazardous ground movement may be expected.

(e) Spoil.

(1) Excavated material shall be prevented from falling back into the area where employees are working. This shall be done by locating the spoil at a distance from the edge of the excavation consistent with the character of the material and the nature of the operations, but unless otherwise contained, in no case shall be excavated material be placed closer than 2 feet from the edge of excavations.

(2) No method that disturbs the soil that is in place (such as driving stakes) shall be used to contain the spoil material.

(f) Supervision. Excavation work and work in an excavation shall at all times be under the immediate supervision of someone with authority and qualifications to modify the shoring, sloping or other system or work methods as necessary to provide greater safety. Such modification shall not permit the specific dimension requirements of other Orders to be less restrictive than shown except as permitted by Section 1541(a)(6). This person shall examine the material under excavation and improve the shoring or other methods beyond the minimum requirements, as necessary, to insure protection of workers from moving ground.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD(g) Access.

(1) A convenient and safe means of access shall be provided for employees to enter and leave an excavated area. This shall consist of a stairway, ladder or ramp securely fastened in place at suitably guarded or protected locations where employees are working.

(2) When employees are required to be in trenches 4 feet or more in depth, a safe means of access shall be provided and located so as to require no more than 25 feet of lateral travel.

Exception: In utility trenches less than 5 feet in depth, earth ramps or steps are acceptable provided that they are not more than 75 feet on centers.

(h) Crossings.

(1) Trenches shall be crossed only where safe crossings have been provided.

(2) When walkways or bridges are provided across excavated areas, they shall be provided with standard guardrails and toeboards when the depth of excavation exceeds 7-1/2 feet.

(i) Excavators. An employee working in the vicinity of operating excavating equipment shall be required to work in a safe position such that the employee is not in danger of falling into or otherwise contacting the machine's moving parts.

(j) Undermining.

(1) No excavation work shall take place below the level of the base of an adjacent foundation, retaining wall or other structure until it has been determined by a qualified person that such excavation will in no way create a hazard to workers or until adequate safety measures have been taken for the protection of workers.

(2) Undermined sidewalks and/or pavements shall be supported to safely carry all anticipated loads.

(3) If the stability of adjoining buildings or walls is endangered by excavations, either shoring, bracing, underpinning, or other method affording equivalent protection for workers shall be provided as necessary to ensure their safety. All such systems shall be inspected daily or more often, as conditions warrant, by a qualified person and the protection effectively maintained.

*OR NEARBY SLOPE (FED. PROP.)*

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD(k) Retaining Walls.

(1) No existing wall or other structure shall be made by reason of an excavation or backfill, to function as a retaining wall until it has been determined that such wall will safely withstand all expected loads that otherwise might be a source of hazard to workers.

(2) Wherever a permanent retaining wall, in lieu of the temporary shoring system of this Article, is constructed to hold any part of an excavation that might endanger workers, such wall shall be designed and constructed to effectively resist all existing and expected loads. Standards of design shall be comparable to those of the California Administrative Code, Title 24, Building Standards, or any comparable local building code of equal or greater restrictiveness.

(l) Barriers at Unattended Work Locations.

(1) Means shall be provided to prevent mobile equipment from inadvertently entering excavations.

(2) Adequate physical barrier protection shall be provided to prevent employees from falling into excavations.

(A) All wells, pits, shafts, caissons, etc., shall be barricaded or securely covered.

(B) Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc., shall be backfilled.

(m) Water Accumulation.

(1) Diversion ditches, dikes, or other effective means shall be used to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation.

(2) Accumulations of water in excavations which endanger the stability of those excavations or pose a hazard to employees shall be controlled before further work progresses.

(n) Vibrations or Superimposed Loads. Special safety provisions consisting of additional bracing or other effective means shall be taken at excavations adjacent to streets, railroads, or sources of external vibrations or superimposed loads. Similar provisions shall be taken in excavations made in areas that have been previously filled.

**CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD**

Adopt new Section 1541 to read:

**1541. Shoring, Sloping and Benching Systems.****(a) General.**

(1) All materials of the shoring system used in complying with the provisions of this Article shall be free from defects and damage that might in any way impair their protection function.

(2) Where a shoring system is used it shall be designed and installed to sustain all existing and expected loads.

(3) Provisions shall be made by the employer to prevent injury to employees engaged in the installation of shoring for trenches and other excavations. In trench work this may be done by providing and requiring the use of devices that will allow upper cross braces to be placed from the ground surface before employees work in the trench at those points. In deep trenches requiring additional braces, workers shall then progress downward, protected by cross braces that have already been set firmly in place. The reverse procedure shall be followed when removing shoring.

(4) No part of the shoring system of any excavation shall be removed until effective means have been taken to avoid hazards to employees from moving ground.

(5) If a newly installed masonry or concrete wall is to be depended upon for protection against moving ground, it shall have attained adequate strength to sustain resulting pressures before employees are permitted to enter.

(6) If the excavation is deeper than 20 feet or an alternate shoring, sloping or benching system or combination thereof is to be used, a civil engineer, currently registered in California, shall prepare detailed plans showing the materials and methods to be used. See Appendix Plate C-22.

Exception: Sloping or benching as permitted by this Article.

(A) Where alternate shoring, sloping, or benching systems are used, the engineer's detailed plans shall be available for inspection by the Division at the work site.

(B) Employees must be adequately trained in the safety precautions and hazards associated with the alternate shoring, sloping, or benching systems used.

(C) The written Code of Safe Practices required by Section 1509 shall be revised as appropriate to incorporate the engineer's recommendations.

**(b) Standard Shoring System - General.**

(1) Shoring shall be installed in accordance with Tables 1 or 2 of these Orders or as detailed in plans and specifications prepared by a civil engineer currently registered in California. See Appendix Plate C-22 for engineering criteria.

**CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD**

(2) Solid wood sheeting or wood sheet-piling shall be not less than 2-inches in thickness. However, plywood 1 1/8-inch in thickness may be substituted.

(3) Wood uprights shall be not less than 2 inches by 8 inches.

(4) Wood braces and diagonal shores (struts) shall not be less than 4-inch by 4-inch material and not subjected to compressive stress in excess of values given by the following formula:

$$S = 1300 - (20L/D)$$

Maximum Ratio (L/D = 50)

Where L = length, unsupported, in inches  
and D = least side of the timber in inches  
S = allowable stress in pounds per  
square inch of cross section.

(5) Diagonal shores (struts) shall be wedged or cleated at the bulkhead end, and, if bearing on the ground, shall not impose loads in excess of test-determined soil-bearing values, or in the absence of test data, those given in Plate C-22 of the Appendix.

NOTE: Allowance should be made for the horizontal component of force.

(6) Diagonal shores (struts) shall not be placed at an angle greater than 45 degrees with the horizontal.

(7) When tie rods are used to restrain the top of sheeting or other retaining systems, the rods shall be securely anchored.

(8) When tight sheeting or sheet-piling is used, full loading due to ground water table shall be assumed, unless prevented by weep holes, drains or other means.

(9) Additional stringers, ties, and bracing shall be provided to allow for any necessary temporary removal of individual supports.

(10) If nonstress grade lumber is used for sheeting and lagging, the following thickness and spacing requirements shall be observed:

Minimum rough thickness  
of sheeting or lagging

2 inches  
3 inches

Maximum spacing  
of shoring

4 feet  
7 feet

(11) All hydraulic shoring systems shall be installed, tested and maintained in accordance with the manufacturers' recommendations or in accordance with good engineering practice.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD(c) Trench Shoring Systems.

(1) Trench shoring systems shall be installed in compliance with Section 1541(b) and Tables 1 and 2 of this section.

(2) Shoring systems in trenches shall consist of uprights held rigidly opposite each other against the trench walls by jacks or horizontal cross members (braces) and, if required, longitudinal members (stringers/walers) as required in Tables 1 and 2.

(3) Uprights shall be installed parallel with each other.

(4) A shored trench shall not be sloped in excess of 15 degrees from vertical.

(5) Uprights shall not be less than 2 inches in nominal thickness.

Exception: Plywood panels at least 3/4-inch thick may be used behind the uprights in order to hold loose material not likely to impose heavy loads.

(6) Uprights shall extend to at least the top of the trench and to as near the bottom as permitted by the material being installed, but not more than 2 feet from the bottom.

Exception: When running soil is encountered, shoring shall extend to the bottom.

(7) Cross braces shall consist of metal screw-type trench jacks with a foot or base on each end of pipe, or timbers placed horizontally and bearing firmly against uprights or stringers. Hydraulic metal braces may also be used. See Tables 1 and 2.

(8) The minimum number of horizontal braces, either jacks or timbers, required for each pair of uprights shall be determined by the number of 4-foot zones into which the depth of the trench may be divided. One horizontal brace shall be required for each of these zones, but in no case shall there be less than 2 braces. Trenches, the depths of which cannot be divided equally into these standard zones, shall have an extra horizontal brace supplied for the short remaining zone, if such zone is greater than 1/2 the 4-foot unit. In no case, however, shall the vertical spacing of horizontal braces be spaced greater than 4 feet center to center. Minor temporary shifting of horizontal bracing will be permitted when necessary for the lowering of materials into place.

(9) The dimensions and spacing of the elements of the shoring system shall be governed by the depth of the trench, type of soil encountered, and other special conditions of the site, but in no case shall they provide less strength than the members listed in the following tables which are to be considered as a minimum requirement.

TABLE 1  
SHORING FOR HARD COMPACT SOIL

Depth (ft)	Uprights		Beams							Stringers (Walers)	
	Horizontal Spacing (ft)	Size (in)	Horizontal Spacing (ft)	Wood		Aluminum Pipe and Hydraulic Systems		Steel Pipe and Hydraulic Systems		Vertical Spacing (ft)	Wood Size (in)
				Size (in)	Max. Trench Width (ft)	Min. Dia. (in)	Max. Trench Width (ft)	Min. Dia. (in)	Max. Trench Width (ft)		
0 to 3	0	3x8	0	4x4	0	2 1/2	0	1 1/2	3	None	--
	4	3x10	4	4x4	0	2 1/2	0	1 1/2	3	0	4x4
	2	2x8	2	4x4	0	2 1/2	0	1 1/2	3	0	4x4
3 to 6	0	4x10	0	4x4	0	2 1/2	6	2	6	None	--
	4	3x10	4	4x4	11	3	10	2 1/2	12	0	6x8
	2	3x10	2	4x4	11	3	10	3	15	0	6x8
6 to 12	0	4x12	0	4x4	6	2 1/2	6	2	8	None	--
				6x6	15	3	8	2 1/2	12		
	4	3x12	4	4x4	8	2 1/2	9	2	10	0	8x10
				6x6	15	3	10	2 1/2	11		
	2	2x8	2	4x4	10	2 1/2	10	2 1/2	13	0	8x10
12 to 15				6x6	15	3	10	3	15		
	0	6x8	0	4x4	2	2 1/2	5	2	6	None	--
				6x6	15	3	8	2 1/2	10		
	4	4x10	4	4x4	4	2 1/2	6	2	8	0	8x8
				6x6	15	3	10	2 1/2	12		
15 to 20	2	2x10	2	4x4	4	2 1/2	10	2 1/2	13	0	8x8
				6x6	15	3	10	3	15		
	0	6x10	0	6x6	0	2 1/2	3	2 1/2	0	None	--
				8x8	15	3	6	3	12		
	4	6x8	4	6x6	10	2 1/2	6	2 1/2	10	0	8x10
20 to 25				8x8	15	3	9	3	15		
	2	4x10	2	6x6	12	2 1/2	8	2 1/2	12	0	8x10
				8x8	15	3	10	3	15		
				8x8	15	3 1/2	10	3	15		



TABLE 2  
SHORING FOR RUNNING SOIL

Depth (ft)	Uprights		Braces							Stringers (Members)	
	Horizontal Spacing (ft)	Thickness (in)	Horizontal Spacing (ft)	Wood		Aluminum Pipe and Hydraulic Systems		Steel Pipe and Hydraulic Systems		Vehicle Spacing (ft)	Wood Size (in)
				Size (in)	Max. Trench Width (ft)	Min. Dia. (in)	Max. Trench Width (ft)	Min. Dia. (in)	Max. Trench Width (ft)		
0 to 8	Solid	2	6	4x4 6x6	8 10	2 1/2 3	8 10	1 1/2 2	3 6	6	8x8
8 to 10	Solid	3	6	6x6 8x8	9 15	2 1/2 3	6 8	2 2 1/2	6 12	4	8x10
10 to 12	Solid	3	4	6x6 8x8	8 15	2 1/2 3	4 6	2 2 1/2	6 10	4	10x10
12 to 15	Solid	3	4	6x6 8x8	6 15	2 1/2 3	3 6	2 1/2 3	8 15	4	10x12
15 to 20	Solid	4	4	8x8 8x10 10x10	10 15 20	3 3 1/2 4	6 8 10	2 1/2 3 3 1/2	6 12 15	4	12x12
<p><b>GENERAL NOTES</b></p> <ol style="list-style-type: none"> <li>1. Metal pipe braces permitted by these Orders shall be Schedule 40, or equivalent, and installation shall be as required by these Orders.</li> <li>2. Timber to be "Selected Lumber" quality. (See Definitions - Section 1504)</li> <li>3. The braces specified in Tables 1 and 2 apply only to trenches as defined in these Orders.</li> <li>4. Timber members of equivalent "Section Modulus" (required) may be substituted for uprights and stringers.</li> <li>5. In lieu of the above metal shoring systems, the use of properly maintained hydraulic metal shoring units with equivalent strength is acceptable.</li> </ol>											

## CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

(d) Protective Shields and Welding Huts.

(1) If protective shields or welding huts are used to protect workers, they shall be constructed of steel or other material that will provide protection at least equivalent to that afforded by the materials specified in Tables 1 and 2.

(2) Plans and calculations prepared by a civil engineer currently registered in California shall be made available for field inspection at the site where the shield or welding hut is used.

(e) Bell or Pot Holes.

(1) Bell (or pot) holes shall provide adequate clearance for the work to be done, and shall be supported by shoring and bracing as required by these Orders for trenches unless protective shields or welding huts are used.

(2) If the operation performed in the bell (or pot) hole requires that an employee use welding equipment from a reclined position on the bottom, the bell (or pot) hole excavation shall be of such shape that the employee will have adequate space for the performance of this operation without removing any of the required shoring system.

(f) Sloping or Benching Systems. In lieu of a shoring system, the sides or walls of an excavation or trench may be sloped or benched, provided equivalent protection is thus afforded. Where sloping is a substitute for shoring that would otherwise be needed, it shall be 3/4 horizontal to 1 vertical except where the instability of material requires a slope greater than 3/4 to 1.

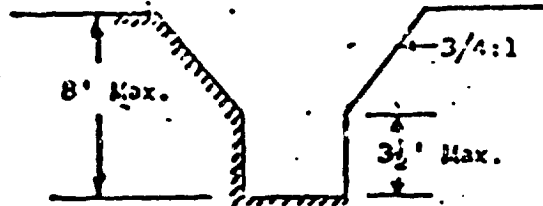


flatter than  
3/4 to 1

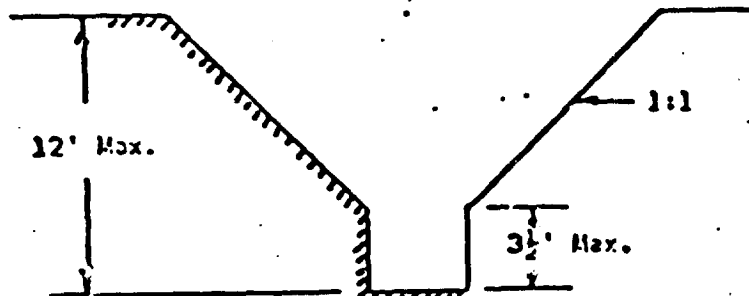
## CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Exceptions:

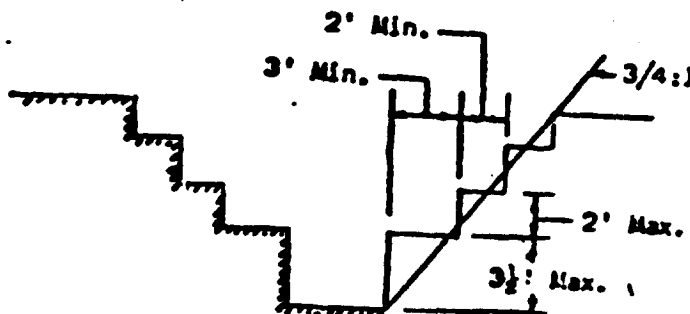
(1) In hard, compact soil where the depth of the excavation or trench is 8 feet or less, a vertical cut of 3 1/2 feet with sloping of 3/4 horizontal to 1 vertical is permitted.



(2) In hard, compact soil where the depth the excavation or trench is 12 feet or less, a vertical cut of 3 1/2 feet with sloping of 1 horizontal to 1 vertical is permitted.



(3) In hard, compact soil, benching is permitted provided that a slope ratio of 3/4 horizontal to 1 vertical, or flatter, is used.



CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Amend Section 1542 to read:

1542. Shafts.

(a) General.

(1) All wells or shafts over 5 feet in depth into which employees are permitted to enter shall be retained with lagging, spiling, spiling, or casing.

(2) The lagging, spiling or casing shall extend at least one foot above ground level and shall be provided the full depth of the shaft or at least five feet into solid rock if possible.

NOTE: See pertinent portions of Section 1548 for additional requirements relating to wells and shafts.

(b) Small Shafts Dry-Cemented Hard- Compact Ground. Two-inch (nominal) cribbing may be used in square shafts not over 4 feet square in dry-cemented hard compact ground. Each member shall be cut 1/2 way through the width of the member and dovetailed into position so each member will act as a shore as well as lagging. Strips shall be nailed in each corner to prevent the boards from dropping down.

(c) Shafts in Other Than Dry-Cemented Hard- Compact Ground.

(1) A system of lagging supported by braces and corner posts shall be used for square or rectangular shafts. Corner posts of 4-inch by 4-inch material are normally acceptable in shafts 4 feet square, or smaller, if they are braced in each direction with horizontal 4-inch by 4-inch members at intervals not exceeding 4 feet. Braces and corner posts in larger shafts shall be correspondingly larger.

(2) Round shafts shall be completely lagged with 2-inch material which is supported at intervals not greater than 4 feet by means of adjustable rings of metal or timber that are designed to resist the collapsing force, or cased in a manner that provides equivalent protection. ~~Means shall be provided to hold rings and lagging in place.~~

## CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

~~(d) -- Shafts over 150 feet in depth shall have a manway partitioned off with 2-inch material or equivalent and shall have a ladderway with railed platforms every 30 feet.~~

~~(e) Belled Excavation. No workman shall be required or permitted to enter any well or shaft, particularly those drilled for foundation footings, for the purpose of enlarging the bottom by hand or similar work, unless the walls of the shaft are supported as described in these Orders, or unless a casing affording equivalent protection is in service. The belled section of any additional shaft excavation in which men work shall also have equivalent bracing if the shaft casing does not provide protection. The shaft casing or shoring is not acceptable for belled excavation protection where the height of the bell exceeds 4 feet or its horizontal dimension extends 3 feet or more beyond the shaft wall line. Additionally, men entering such shafts shall wear a body harness securely fastened to a line individually manned and separated from any line used to remove materials from the excavation.~~

~~Note: Refer to Section 1532 for requirements prior to entering confined spaces.~~

~~History: 1 Amendment of subsection (e) filed 5-21-75, effective thirtieth day thereafter (Register 75, No 21).~~

(d) Bell Excavations. Provisions for the protection of workers that are engaged in belling or enlarging the bottoms of shafts by hand shall include at least the following elements:

- (1) Sufficient physical protection from potential ground movement or collapse.
- (2) Adequate mechanical ventilation.
- (3) A line, suitable for instant rescue, securely fastened to a shoulder harness and worn by each employee entering the shaft(s).
- (4) A properly equipped hoist and platform for hoisting or lowering workers in shafts over 50 feet in depth.
- (5) Barriers that prevent materials from falling into the shaft(s).

**CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD**

Amend Subsections (a), (d) and (u) of Section 1544 to read:

**1544. Earthwork and Excavating.**

NOTE: See pertinent portions of Section 1540 for additional requirements relating to earthwork and excavating.

(a) ~~Whenever the Division considers that the height and condition of the face constitutes a serious hazard to employees, it shall require the installation of a bench or other suitable method of working shall be required.~~

(b) ~~When a bench or multiple-bench method of operation is required, a setback of at least  $\frac{1}{2}$  the height of the single face or bank for each section of the face or bank shall be required.~~

(c) ~~When determining the maximum permitted slope of the face, consideration shall be given to:~~

- (1) Nature of the material being excavated.
- (2) Extent to which the material is cemented or consolidated.
- (3) Height of the face.
- (4) Type and size of equipment used at the face and amount of protection this equipment affords the operator.
- (5) Safety of employees who are not protected by such equipment.

(d) ~~Where the face is composed of loose or unstable materials, the slope of the face shall not exceed 3/4 horizontal to 1 vertical where the height is greater than that which can be reached by the dipper-or bucket of the excavator or loader being used.~~

(e) ~~Where the face is composed of moderately compacted materials that are not firmly cemented or consolidated but which experience indicates will stand well in place, the slope shall not exceed 1/2 horizontal to 1 vertical where the height is greater than can be reached by the dipper-or bucket of the excavator or loader being used.~~

Amend Subsection (a) of Section 1545 to read:

**1545. Overburden.**

(a) ~~No person shall be permitted under a face or bank where stripping or other similar operations constitute a hazard.~~

**CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD**

Amend Subsections (a), (d) and (e) of Section 1546 to read:

**1546. Face Inspection and Control.**

(a) A daily physical inspection shall be made of faces and banks, including the tops, where men employees are exposed to falling or rolling materials. The inspection shall be made by a competent-man qualified person who shall dislodge or make safe any material dangerous to employees, or shall cause such material to be dislodged or made safe.

(b) No person shall be permitted to work near a face made unsafe by primary blasting, rains, freezing or thawing weather, or earthquakes until the face has been inspected and made safe.

(c) Overhanging banks are forbidden, except:

(1) Where material is moved away from the face by mechanical equipment having controls located at a safe distance so that no employee is required to approach the face in the course of normal operation.

(2) Where the bank is undercut with a stream of water and the monitor is located at a safe distance from the bank.

(d) Where necessary, a-competent-trained an employee shall be employed at the face, and instructed to give warning when loose rock or other materials are about to fall.

(1) The employee shall be provided with a whistle, siren, or other devices that will give adequate warning to employees.

(2) The employee shall have no other work to distract his attention from his duties as defined above.

(e) When working at night, sufficient illumination shall be provided throughout the working area so that movement of men employees and equipment can be readily observed.

**CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD**

Amend Section 1547 to read:

**1547. Protection of Workers at the Face.**

(a) No work shall be permitted above or below ~~men~~ employees at the face if such work endangers their safety.

(b) Workers at the face shall be protected as follows:

(1) On top of the bank, by fencing with guardrails or ropes; by using railed platform; or by using safety belts and life lines. This does not apply where the bank is less than 20 feet high or the slope below is less than 3/4 horizontal to 1 vertical or where no work is performed within 10 feet of the edge.

(2) On the face, by removing loose rock from over the working place and by the use of safety belts and life lines, portable staging, boatswain's chair or skips especially designed for use at faces. If a boatswain's chair is used, the employee shall be attached thereto with a safety belt and life line equipped with an approved effective descent control device.

~~When-necessary-for-safety,~~ Two or more persons shall be employed in cooperation with each other in drilling, blasting, or removing loose rock.

Life lines used for scaling or inspection shall be protected from excessive fraying or damage ~~or~~ and shall have a wire center rope.

(3) At the foot of the bank by removing loose rock from above the working place, and maintaining a ready way of exit to a place of safety.



## CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Amend Appendix Plate C-22 to read:

PLATE C-22  
BEARING VALUE OF SOIL

Shores and similar members that depend upon earth for support will probably require foot blocks or sills to distribute the load. In the absence of test data that establish the sustaining power of the soils in question, the following information should be helpful in determining the size of ~~fill~~ sill needed to assure adequate support from the soil

Soil type	Tons allowable per square foot
Soft clay -----	1
Wet clay -----	2
Sand and clay, mixed in layers -----	2
Fine dry sand -----	3
Hard dry clay -----	4
Coarse compact dry sand -----	4

DESIGN CONSIDERATIONS  
EXCAVATIONS, SLOPES AND BENCHES

The determination of the slope or bench configuration or design of the shoring system shall be based upon careful evaluation of such pertinent factors as the following:

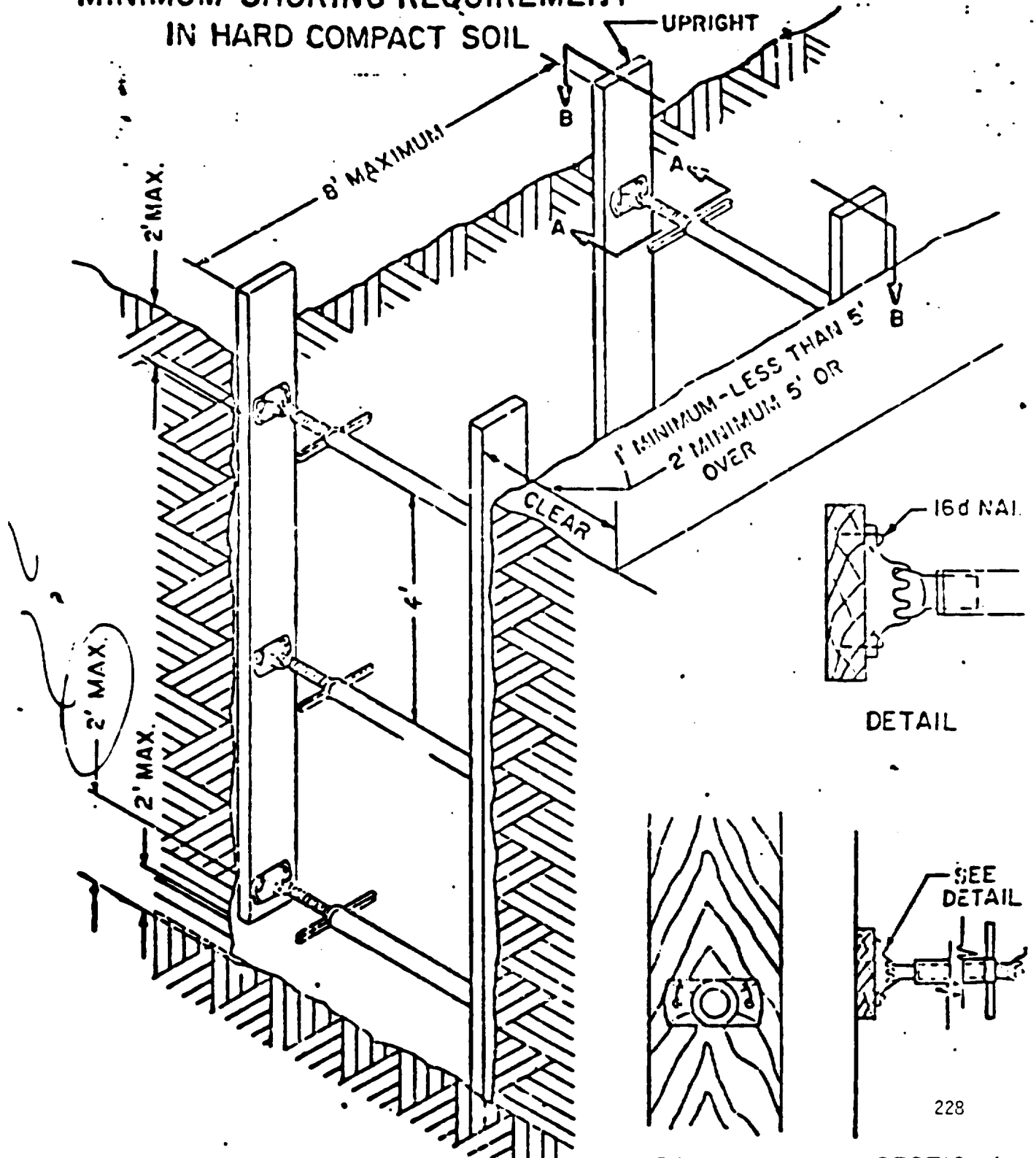
- (1) Depth and width of cut.
- (2) Possible variation in water content of the material while the excavation is open.
- (3) Anticipated changes in materials from exposure to air, sun, water or freezing temperatures.
- (4) Loading imposed by structures, equipment, overlaying material or stored material.
- (5) Vibration from equipment, blasting, traffic, trains or other sources.
- (6) Existing underground facilities.
- (7) New or old adjacent excavations.
- (8) A minimum coefficient of active earth pressure of 35 pcf (K=35) shall be used in all calculations unless a soils evaluation indicates otherwise.

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Adopt new Appendix Plate C-24-a to read:

Plate C-24-a

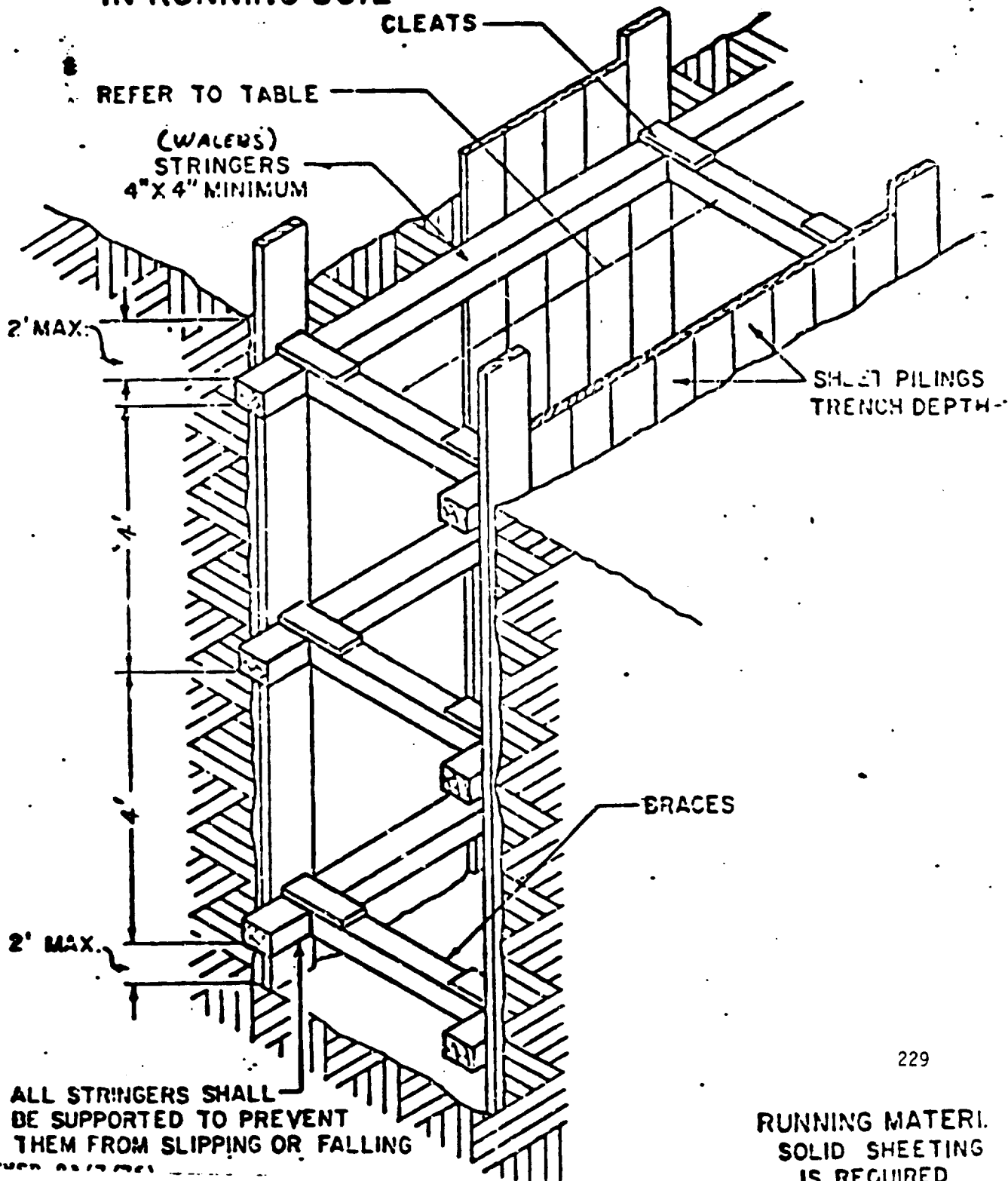
MINIMUM SHORING REQUIREMENT  
IN HARD COMPACT SOIL



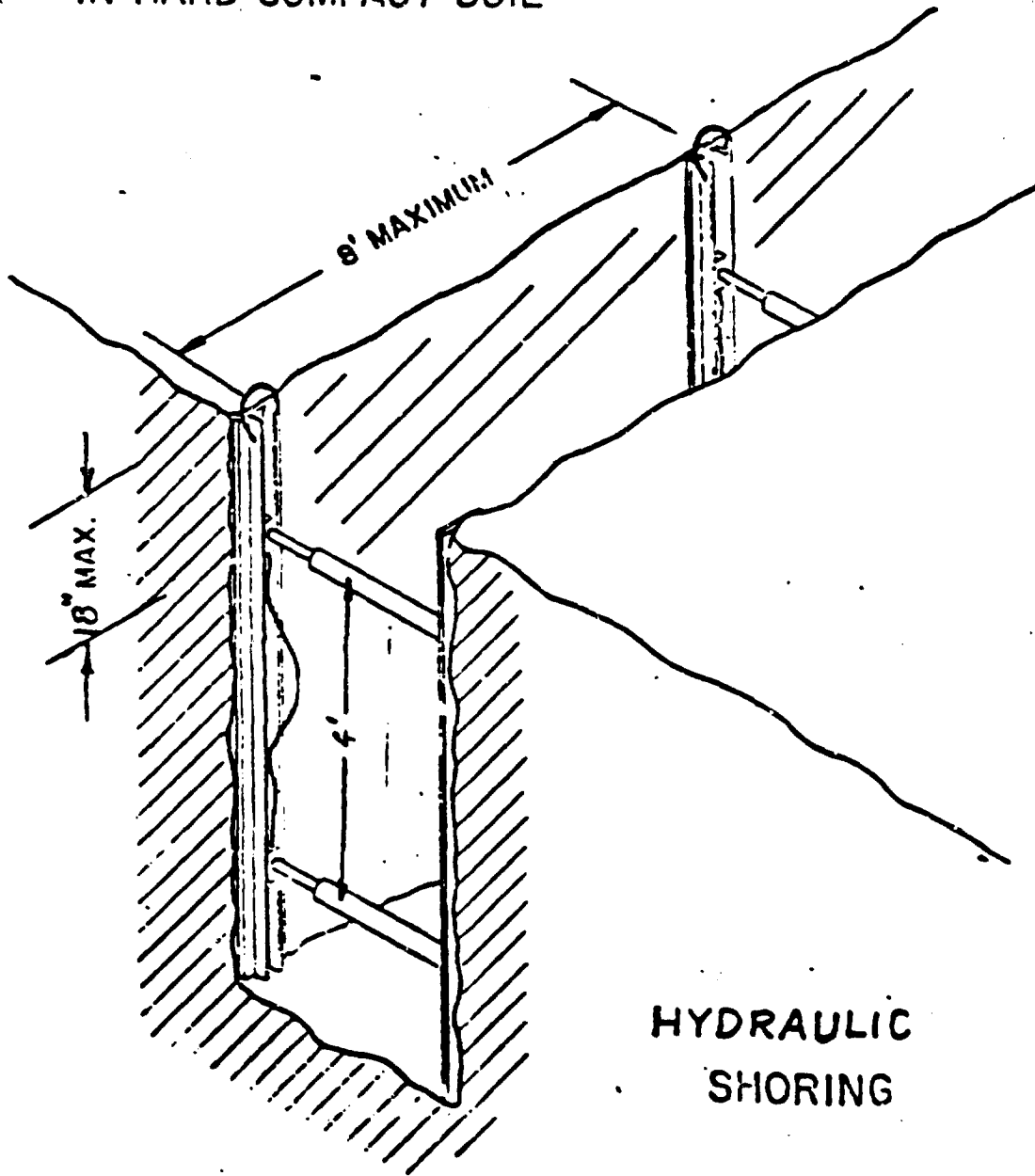
CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Adopt new Appendix Plate C-24-b to read; Plate C-24-b

CLOSE SHEETING METHOD  
IN RUNNING SOIL



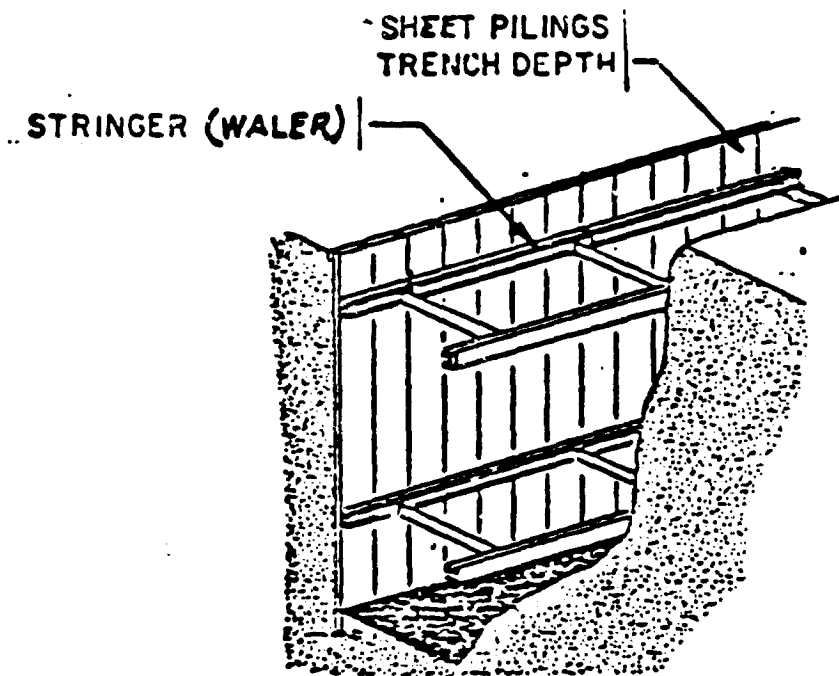
Adopt new Appendix Plate C-24-c to read:  
Plate C-24-c  
**MINIMUM SHORING REQUIREMENT  
IN HARD COMPACT SOIL**



Adopt new Appendix Plate C-24-d to read: <sup>Plate C-24-d</sup>

**CLOSE SHEETING METHOD**

**1. IN RUNNING SOIL**



**HYDRAULIC  
SHORING**

**RUNNING MATERIAL  
SOLID SHEETING  
IS REQUIRED**