

constructing a four-lane limited access highway on new location.

(Catalog of Federal Domestic Assistance Program Number 20.205, Highway Research, Planning and Construction. The regulations implementing Executive Order 12372 regarding intergovernmental consultation on Federal programs and activities apply to this program.)

Manuel A. Marks,

Division Administrator, Harrisburg, Pa.

[FR Doc. 88-13546 Filed 6-15-88; 8:45 am]

BILLING CODE 4910-22-M

UNITED STATES TRADE REPRESENTATIVE

[Docket No. 301-67]

Initiation of Section 301 Investigation; Korea's Restrictions on Access to Its Wine Market

AGENCY: Office of the United States Trade Representative.

ACTION: Notice of decision to initiate an investigation under Section 301.

SUMMARY: Pursuant to 19 U.S.C. 2412, the U.S. Trade Representative has determined to initiate an investigation of the Republic of Korea's Policies and practices with respect to the

importation, distribution and sale of wine products.

EFFECTIVE DATE: June 11, 1988.

FOR FURTHER INFORMATION CONTACT: Catherine Field, Associate General Counsel, (202) 395-3432, Office of the U.S. Trade Representative, 600 17th Street, NW., Washington, DC 20506.

SUPPLEMENTARY INFORMATION: On April 27, 1988, the Wine Institute and Association of American Vintners filed a petition under section 302(a) of the Trade Act of 1974, as amended ("Trade Act"), alleging that the Government of the Republic of Korea engaged in acts, policies and practices that are unreasonable or discriminate against imports and burden or restrict U.S. commerce. The import barriers complained of include, among others: (1) The combination of a 100 percent tariff applied to table wines and a quota on imports, creating a price escalation through the distribution system that prevents imported wine from being price competitive with domestically produced wine and other alcoholic beverages; (2) an absolute ban on imports of sparkling wine, wine coolers, brandy and dessert wines, and non-grape wine such as ciders; (3) labeling and packaging requirements, certification procedures, licensing and distribution restrictions

and business capitalization requirements that impede access to the Korean market.

On June 11, 1988, the U.S. Trade Representative initiated an investigation of the Korean government's policies and practices affecting efforts to obtain fair and equitable access to the Korean wine market. USTR will request consultations with the Government of the Republic of Korea, as required by section 303(a) of the Trade Act.

USTR will seek information and advice from the petitioner and the appropriate representatives provided for under section 135 of the Trade Act in preparing the U.S. presentations for such consultations. Any interested person is invited to submit comments on the issues raised in the petition. Comments should be filed in accordance with the regulations at 15 CFR 2006.6 and are due no later than July 8, 1988. Comments must be in English and provided in twenty copies to: Chairman, Section 301 Committee, Room 223, USTR, 600 17th Street, NW., Washington, DC 20506.

Judith Hippler Bello,

General Counsel, Chairman, Section 301 Committee.

[FR Doc. 88-13756 Filed 6-15-88; 8:45 am]

BILLING CODE 3190-01-M

Sunshine Act Meetings

Federal Register

Vol. 53, No. 116

Thursday, June 16, 1988

This section of the FEDERAL REGISTER contains notices of meetings published under the "Government in the Sunshine Act" (Pub. L. 94-409) 5 U.S.C. 552b(e)(3).

EQUAL EMPLOYMENT OPPORTUNITY COMMISSION:

DATE AND TIME: Monday, June 20, 1988, 2:00 p.m. (eastern time).

PLACE: Clarence M. Mitchell, Jr., Conference Room, No. 200-C on the Second Floor of the Columbia Plaza Office Building, 2401 "E" Street, NW., Washington, DC 20507.

STATUS: Part of the Meeting will be Open to the Public and Part will be Closed to the Public.

MATTERS TO BE CONSIDERED:

Open Session

1. Announcement of Notation Vote(s)
2. A Report on Commission Operations (Optional)

Closed Session

Litigation Authorization: General Counsel Recommendations

Note.—Any matter not discussed or concluded may be carried over to a later meeting. (In addition to publishing notices on the EEOC Commission meetings in the Federal Register, the Commission also provides a recorded announcement a full week in advance on future Commission sessions. Please telephone (202) 634-6748 at all times for information on these meetings.)

CONTACT PERSON FOR MORE INFORMATION: Frances M. Hart, Executive Officer, Executive Secretariat on (202) 634-6748.

Date: June 13, 1988.

Frances M. Hart,
Executive Officer, Executive Secretariat.
[FR Doc. 88-13705 Filed 6-14-88; 2:26 pm]
BILLING CODE 6750-06-M

FEDERAL ELECTION COMMISSION

"FEDERAL REGISTER" NO.: 88-13124.

PREVIOUSLY ANNOUNCED DATE AND TIME: Thursday, June 16, 1988, 10:00 a.m.

THE FOLLOWING ITEM WAS ADDED TO THE AGENDA: Draft Advisory Opinion 1988-25—Robert F. Bauer on behalf of General Motors Corporation.

* * * * *

DATE AND TIME: Thursday, June 21, 1988, 10:00 a.m.

PLACE: 999 E Street NW., Washington, DC.

STATUS: This meeting will be closed to the public.

ITEMS TO BE DISCUSSED:

Compliance matters pursuant to 2 U.S.C. 437g.
Audits conducted pursuant to 2 U.S.C. 437g, 438(b), and Title 26, U.S.C.
Matters concerning participation in civil actions or proceedings or arbitration.

Internal personnel rules and procedures or matters affecting a particular employee.

* * * * *

DATE AND TIME: Thursday, June 23, 1988, 10:00 a.m.

PLACE: 999 E Street NW., Washington, DC. (Ninth Floor).

STATUS: This meeting will be closed to the public.

MATTERS TO BE CONSIDERED:

Setting of Dates for Future Meetings.
Correction and Approval of Minutes.
Eligibility Report for Candidates to Receive Presidential Primary Matching Funds.
Dole for President Committee, Inc.—Payment of Costs for Production of Compatible Computer Tapes to be Used During Audit Fieldwork.

Draft AO 1988-22—J. Miles Reid on behalf of San Joaquin Valley Republican Associates.

Draft Notice of Proposed Rulemaking: Extension of Credit and Debt Settlement by Corporate and Noncorporate Creditors (11 CFR 114.10 and Proposed 110.9).

FEC Drug-Free Workplace Program.
Routine Administrative Matters.

PERSON TO CONTACT FOR INFORMATION: Mr. Fred Eiland, Information Officer, Telephone: 202-376-3155.

Mary W. Dove,
Administrative Assistant.

[FR Doc. 88-13755 Filed 6-14-88; 3:57 pm]

BILLING CODE 6715-01-M

Corrections

Federal Register

Vol. 53, No. 116

Thursday, June 16, 1988

This section of the FEDERAL REGISTER contains editorial corrections of previously published Presidential, Rule, Proposed Rule, and Notice documents and volumes of the Code of Federal Regulations. These corrections are prepared by the Office of the Federal Register. Agency prepared corrections are issued as signed documents and appear in the appropriate document categories elsewhere in the issue.

DEPARTMENT OF AGRICULTURE

Agricultural Marketing Service

7 CFR Part 916

[Docket No. AMS-FV-88-0561R]

Nectarines Grown in California; Size Requirements and Maturity Regulations

Correction

In rule document 88-12038 beginning on page 19226 in the issue of Friday, May 27, 1988, make the following correction:

§ 916.356 [Corrected]

On page 19232, in the third column, in § 916.356(a)(1)(i), in the table, under "Column B maturity guide", the last entry should read "G".

BILLING CODE 1505-01-D

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 253

[Docket No. 70905-8087]

Interjurisdictional Fisheries

Correction

In rule document 88-12557 beginning on page 20323 in the issue of Friday, June 3, 1988, make the following corrections:

1. On page 20324, the formula now appearing in the second column, should follow the last line in the third column.

§ 253.3 [Corrected]

2. On page 20326, in § 253.3(a)(1), the formula appearing in the second column should be removed. In the third column, in paragraph (a)(1) insert "A% + B% / 2 = state percentage used to determine State's share of the total available funds" after the second formula.

BILLING CODE 1505-01-D

DEPARTMENT OF DEFENSE

48 CFR Parts 227

Federal Acquisition Regulation Supplement; Patents, Data and Copyrights

Correction

In rule document 88-12621 beginning on page 20632 in the issue of Monday,

June 6, 1988, make the following correction:

On page 20632, in the third column, amendatory instruction 1 should read "1. Subpart 227.4 is corrected by correctly revising sections 227.481 through 227.481-2 to read as follows:".

BILLING CODE 1505-01-D

DEPARTMENT OF DEFENSE

48 CFR Part 252

Federal Acquisition Regulation Supplement; Contracting With Small Disadvantaged Business Concerns, Historically Black Colleges and Universities, and Minority Institutions

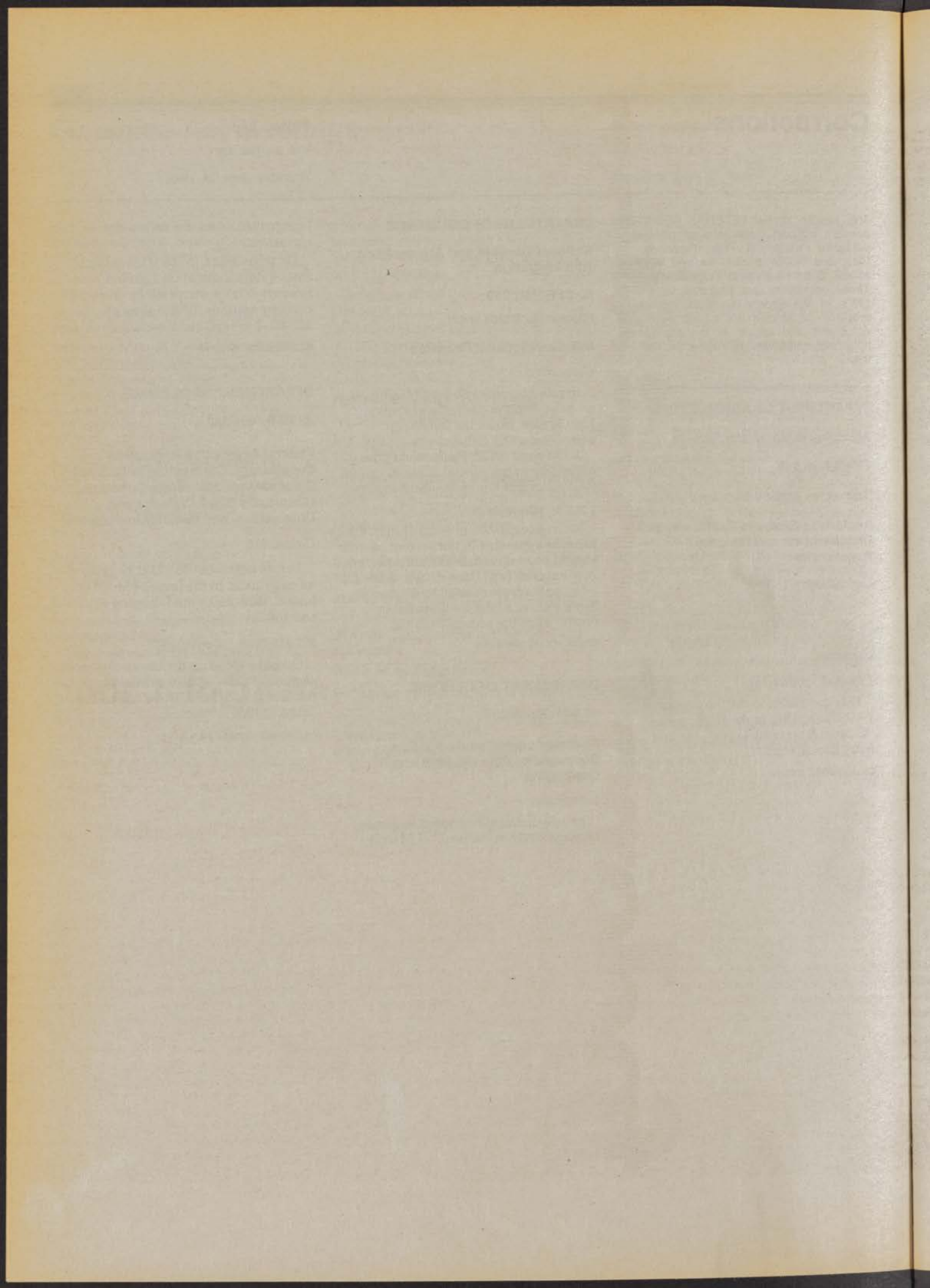
Correction

In rule document 88-12622 beginning on page 20626 in the issue of Monday, June 6, 1988, make the following correction:

252.219-7000 [Corrected]

On page 20630, in the third column, in section 252.219-7000, in paragraph 37, in the first line, "251.219-7000" should read "252.219-7000".

BILLING CODE 1505-01-D



federal register

**Thursday
June 16, 1988**

Part II

Department of Labor

**Occupational Safety and Health
Administration**

**29 CFR Part 1926
Concrete and Masonry Construction
Safety Standards; Final Rule**

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Part 1926

[Docket No. S-301A]

Concrete and Masonry Construction Safety Standards

AGENCY: Occupational Safety and Health Administration, Labor.

ACTION: Final rule.

SUMMARY: This rule revises OSHA's safety standards for Concrete and Masonry Construction (formerly *Concrete, Concrete Forms, and Shoring*) located in Subpart Q of 29 CFR Part 1926. The rule corrects problems related to the existing regulations, including ambiguities, redundancies, and gaps in coverage. Additionally, reference to the American National Standard A10.9-1970, "Safety Requirements for Concrete Construction and Masonry Work," has been removed and the applicable requirements from this standard and the more recent ANSI Standard for Concrete and Masonry Work, ANSI A10.9-1983, have been evaluated and used in developing this final rule. The revised rule is intended to reduce occupational fatalities and injuries in concrete and masonry construction work.

EFFECTIVE DATE: August 15, 1988.

FOR FURTHER INFORMATION CONTACT: Mr. James Foster, Office of Information and Consumer Affairs, Occupational Safety and Health Administration, Room N3647, U.S. Department of Labor, 200 Constitution Avenue NW., Washington, DC 20210, Telephone (202) 523-8148.

SUPPLEMENTARY INFORMATION:**I. Background**

Congress amended the Contract Work Hours Standards Act (40 U.S.C. 327 *et seq.*) in 1969 by adding a new section 107 (40 U.S.C. 333) to provide employees in the construction industry with a safer work environment and to reduce the frequency and severity of construction accidents and injuries. The amendment, commonly known as the Construction Safety Act (Pub. L. 91-54; August 9, 1969), significantly strengthened employee protection by providing for occupational safety and health standards for employees of the building trades and construction industry in Federal and federally-financed or federally-assisted construction projects. Accordingly, the Secretary of Labor issued Safety and Health Regulations

for Construction in 29 CFR Part 1518 (36 FR 7340, April 17, 1971) pursuant to section 107 of the Contract Work Hours and Safety Standards Act.

The Occupational Safety and Health Act (OSH Act) (84 Stat. 1590; 29 U.S.C. 651 *et seq.*), which was enacted by Congress in 1970, authorized the Secretary of Labor to adopt established Federal standards issued under other statutes, including the Construction Safety Act, as occupational safety and health standards. Accordingly, the Secretary of Labor adopted the Construction Standards, which were issued under the Construction Safety Act in 29 CFR Part 1518, in accordance with section 6(a) of the OSH Act (36 FR 10466, May 29, 1971).

The Safety and Health Regulations for Construction, Part 1518, were redesignated as Part 1926 at the end of 1971 (36 FR 25232, December 30, 1971). The standard entitled Concrete, Concrete Forms, and Shoring, § 1926.700 through 1926.702, was adopted as an OSHA standard as part of this process. Except for some minor amendments, Subpart Q has not been substantially changed since it was adopted in 1971. In spite of the promulgation in 1971 of these regulations to address hazards in concrete and masonry construction, accidents continue to occur.

II. Hazards in Concrete and Masonry Construction

OSHA examined a number of accidents that occurred in concrete and masonry work since OSHA's inception in 1971, including the accidents at Willow Island, West Virginia, where a cooling tower collapsed and 51 workers were killed, and the collapse of the Skyline Tower Plaza in Fairfax County, Virginia, which took 14 lives. Also included in OSHA's examination were many masonry wall collapses. Although many workers have been injured or killed in wall collapses, these accidents had not received the publicity or public attention that the structure collapses had received, probably because workers are killed one at a time rather than in large numbers at one time. OSHA identified hazards that contributed to these accidents which caused worker injury and death. OSHA then reviewed its existing regulations to determine if the hazards identified such as formwork failure and the collapse of masonry walls were adequately regulated.

The review revealed ambiguities, redundancies, gaps in coverage, and, in some cases, requirements which did not allow use of state-of-the-art technological changes. For example, the existing standard was ambiguous as to which provisions of ANSI A10.9-1970

were referenced by existing §1926.700(a). In particular, the OSHA requirement in §1926.700(a) states that employers shall comply with the "applicable provisions" of ANSI relating to equipment and materials, which could cause confusion as to which of the ANSI requirements are indeed the "applicable" ones.

Another example of ambiguity is the requirement that concrete buckets be equipped with hydraulic or pneumatic operated gates. The existing requirement states that the installation of positive safety latches or equivalent devices is to prevent aggregate and loose material from accumulating on the top and sides. This statement is misleading, as the real purpose of safety latches is to prevent the accidental or premature dumping of the contents of the bucket, not to prevent material accumulation.

Additionally, the existing standard recognizes only one method of testing concrete and yet there are several test methods approved by the American Society for Testing and Materials (ASTM) for testing concrete to determine the extent to which concrete has reached its designed strength.

Based on this review, OSHA determined that a revision of the existing standard was warranted to address more appropriately the hazards in concrete and masonry work. As a first step, OSHA published an Advance Notice of Proposed Rulemaking (ANPR) to gather information for developing a proposed standard. The ANPR, which was published in the *Federal Register* (47 FR 5910, February 9, 1982), requested public comment on the effectiveness of the existing standard in reducing accidents in the concrete and masonry construction industries. OSHA received 46 comments in response to the ANPR (Ex. 1), some of which confirmed OSHA's belief that the existing standard was inadequate for current construction methods.

OSHA then sought the advice and recommendations of OSHA's Advisory Committee on Construction Safety and Health (ACCSH) at its meeting November 30 and December 1, 1982.

Using the information gathered in response to the ANPR and the recommendations received from the ACCSH, OSHA developed and published a Notice of Proposed Rulemaking (50 FR 37543; September 16, 1985) to seek public comment. While OSHA was conducting its rulemaking activities, accidents in concrete and masonry construction continued to occur.

OSHA received 51 comments on the NPRM from individuals, businesses,

labor unions, Federal agencies state governments, and trade associations.

Additionally, OSHA held an informal public hearing on June 17-18, 1986, to examine pertinent issues including those specified in a Notice of Informal Public Hearing published in the **Federal Register** on April 8, 1986 (51 FR 11945). Two expert witnesses testified at the hearing on behalf of OSHA, and seven additional witnesses who represented various interests such as labor, engineering firms, and formwork designers also presented testimony.

Following the hearing, Administrative law Judge Ellin O'Shea allowed 120 days for the submission of post-hearing comments and 30 days for the submission of arguments and briefs. Judge O'Shea certified the 332-page hearing transcript and all related submissions to OSHA and officially closed the record on December 8, 1986.

All of the comments and testimony were reviewed and analyzed for use in developing this final rule. Then, while OSHA was preparing the final rule, another tragic accident occurred. This time, a building in Bridgeport, Connecticut, collapsed, taking the lives of 28 workers. Like the other accidents, OSHA's investigation of this collapse revealed that there had been a failure to comply with the existing regulations, regulations that some thought were ambiguous and others thought needed more flexibility to provide an incentive for compliance—regulations that OSHA has revised in this Final Rule, except that the regulations for lift-slab operations, as discussed below, are not a part of this Final Rule. The existing requirements for lift-slab operations remain in effect.

The Final Rule removes ambiguities that have existed; closes gaps in coverage; recognizes technological changes; and finally, where possible, uses language that states the performance to be achieved by the employer without specifying unnecessary details as to how the employer must meet the requirement. OSHA believes that compliance with the revised regulations in Subpart Q will reduce the deaths and injuries that have plagued the workers in concrete and masonry construction. The revised regulations set forth requirements to protect construction workers from such hazards as those described above involving premature removal of formwork, failure to brace masonry walls, and other hazardous situations such as failure to support precast panels, inadvertent operation of equipment, and unguarded reinforcing steel.

Some of the revisions made in the final rule include the elimination of the reference to the ANSI A10.9-1970 standard. OSHA, instead, has promulgated many provisions that are identical or similar to provisions in either the ANSI A10.-1970 or the ANSI A10.9-1983 Standard for Concrete and Masonry Work.

OSHA has also revised its requirements for concrete testing, allowing employers to use methods other than the one specified in the existing rule. OSHA believes that all of the testing methods listed in Appendix A will provide the employer with the information necessary to determine if the concrete has reached its design strength, and therefore will reduce the hazards of premature formwork removal.

OSHA observes that it is not revising the existing requirements for lift-slab operations as a part of the Final Rule. Instead, OSHA is reopening the record to receive additional information and evidence. Additional information and evidence became available to OSHA as a result of its investigation of the collapse of a building under construction using the lift-slab construction method, and was not available to the public rulemaking record at the time OSHA was considering its revision to the Concrete and Masonry Construction Safety Standards. OSHA intends to repropose the section on life-slab operations as a separate rulemaking effort. OSHA has met with the ACCSH to obtain their recommendations and advice on the repropose rule and will publish a Notice of Proposed Rulemaking later this year. When the lift-slab operation requirements are promulgated, they will be located in Subpart Q.

OSHA appreciates the participation of the parties who contributed to the record during this rulemaking. OSHA has developed this final rule based on a full consideration of the entire record of this proceeding, including the recommendations of the ACCSH, the record of the hearing and all written comments and exhibits received.

III. Summary and Explanation of the Final Rule

The following discussion summarizes each of the provisions in the final rule and explains how they differ from the proposal and the existing rule. The discussion also includes an explanation of how the Agency arrived at its final decision.

OSHA requested comments on several specific issues in the preamble of the proposed rule (50 FR 37549) and in the hearing notice (51 FR 11945). All of

these issues, and the comments received on them, are discussed in conjunction with the appropriate provisions of this final rule.

Subpart Q Concrete and Masonry Construction

The title of Subpart Q is revised to read "Concrete and Masonry Construction," which properly reflects the construction operations regulated by the subpart. This title is identical to the title that was proposed. OSHA proposed to change the existing title, "Concrete, Concrete Forms, and Shoring" because it implied that the scope of Subpart Q covered only the hazards associated with concrete and the forms and shoring for concrete. The subpart also covers, however, the hazards of masonry construction. The revised title, therefore, reflects the entire scope of the standard.

OSHA received only one comment on the title. That comment was presented by a witness at the public hearing (Tr. I, 84). The witness, John Hanson, said that OSHA should consider changing the title to "Special Requirements for Concrete and Masonry Construction" so it would be emphasized that there were other requirements which are common to all construction operations that also would apply to employers performing concrete and masonry operations. The witness felt that there could be confusion—that employers engaged in concrete and masonry construction would think that only the requirements of Subpart Q applied to their work operations. OSHA agrees that this subpart does not contain *all* of the safety standards requirements that apply to employers engaged in concrete and masonry construction operations, and OSHA does not want employers to be confused about their obligations under the construction safety and health regulations. However, OSHA feels it is more appropriate to clarify the scope of the subpart in the scope and application paragraph rather than attempt a clarification through a change to the title of the subpart.

In addition, it should be pointed out that there are other subparts in the construction standards that address hazards which are unique to a particular trade or operation and those subparts do not use the title of the subpart to convey that information. Thus, to include "Special Requirements" in the title of Subpart Q could create confusion about the scope and application of other subparts not containing this type of qualification in the title.

Therefore, OSHA is promulgating the title as proposed.

Section 1926.700 Scope, application and definitions.

This section of the final rule describes the scope and application of Subpart Q and defines the major terms used in the final rule.

Paragraph (a) contains the scope and application of Subpart Q. The scope and application paragraph in the final rule states that the standard sets forth requirements to protect all construction employees from the hazards associated with concrete and masonry operations performed in workplaces covered under 29 CFR Part 1926. Part 1926 covers workplaces where construction, demolition, alteration and/or repair, including painting and decorating activities are performed. Additionally, OSHA has further indicated in the scope and application paragraph that other requirements throughout Part 1926 may have application to concrete and masonry construction operations. OSHA also observes that while this section addresses hazards unique to concrete and masonry construction, this section is not exclusive to employers in those operations. That is, employees of all trades must be protected from the hazards addressed in this subpart, just as concrete and masonry employees must be protected from the hazards addressed in other subparts of the 1926 regulations. For example, Subpart Q addresses the hazards associated with protruding rebar and collapsing masonry walls. While employees engaged in concrete and masonry operations would most likely be the employees primarily exposed to these hazards, other construction employees (engaged in other than concrete and masonry operations) could also be exposed to these hazards; thus, all exposed employees need protection from these hazards.

The proposed standard contained a scope and application paragraph which indicated that the standard addressed materials, equipment, and procedures for concrete and masonry construction operations. The proposal further identified the scope of the standard by listing some of the hazards associated with such materials, equipment and procedures. In proposing this particular language, OSHA was attempting to establish a uniform format with the scope and application section of all of the construction standards, beginning with Subpart Q. The existing standard does not have a scope and application paragraph. In fact, many of the existing subparts in the construction standards lack a scope and application paragraph. It was OSHA's intent in the proposal to highlight the hazards addressed in each

subpart of the construction standards by providing a list of hazards addressed in the standard. This list was, therefore, made a part of the proposed scope and application paragraph.

Upon further consideration, however, OSHA does not feel the intended purpose has been served by merely listing some of the hazards addressed in the standard. The highlighting of only some of the hazards may cause some confusion if employers depend on the scope and application paragraph alone to discover what hazards are addressed by the entire subpart. Therefore, in the final rule, OSHA has retained a revised scope and application paragraph for uniformity, but deleted the list of hazards.

In addition to this change, OSHA has added a new sentence to the language of the scope and application paragraph. This language was prompted by two comments. The first comment, discussed previously, was submitted by John Hanson (Ex. 18). The second comment was submitted by Technical Safety Associates (TSA) (Ex. 14-34). Both commenters recommended that OSHA add a sentence to the scope and application paragraph to make it clear that, in addition to the requirements of Subpart Q, many other requirements throughout Part 1926 apply to concrete and masonry construction operations.

OSHA agrees with the commenters that it is appropriate to make it clearly understood that other requirements in the construction standards (Part 1926) have application to concrete and masonry construction operations. Also, there are requirements in Part 1910, Safety and Health Standards for General Industry, that have been identified as having application to the Construction Industry that may also apply to concrete and masonry construction operations. (See 44 FR 8755; February 9, 1979 and corrected at 44 FR 20940; April 6, 1979). In light of these considerations, OSHA promulgates paragraph (a) as revised.

Paragraph (b) lists and defines eight terms of special application as used in the final rule. These terms are provided to assist employers and employees in understanding the requirements in the final rule. Each definition is discussed separately below.

Paragraph (b)(1) contains the definition for "bull float." OSHA had proposed to delete this definition since the requirement which dealt with bull float handles was proposed for removal and, thus, there would be no need to define a term not used in the standard. There were no comments received on the proposed removal of the term from

the definition paragraph. However, upon further consideration OSHA has decided to retain the requirements for bull float handles in the final rule, and, therefore, OSHA retains the term as defined in the existing standard. A complete discussion of why OSHA decided to continue the requirement for bull floats can be found in the summary and explanation for § 1926.702(h).

Paragraph (b)(2) contains the definition for "formwork." Formwork is defined as the total system of support for freshly placed or partially cured concrete, including the mold or sheeting that contacts the concrete as well as all supporting members including shores, reshores, hardware, and bracing.

The existing standard defines "formwork" or "falsework" to mean the total system of support for freshly placed concrete, including the mold or sheeting that is in contact with the concrete as well as all supporting members, hardware, and necessary bracing. OSHA, in proposed paragraph (b)(1), revised the existing definition by deleting the words "falsework" and "necessary." The term "falsework" was removed because the term is no longer widely used in the field or even understood to be synonymous with "formwork." The word "necessary" was removed because it was too vague. Further, the word "necessary" as used in the existing standard indicates that bracing is not always used with formwork, but if it is, it would be part of the "total formwork system." There were no comments on the removal of these words.

In addition, in Issue #9 of the proposed rule (50 FR 37550), OSHA requested specific comment on whether or not the definition of "formwork" should be revised to exclude shores and reshores. OSHA explained in the proposal that it considers shores and reshores to be supporting members and thus considered them part of the "total formwork system" even though the words shore and reshore were not specifically written into the existing definition. Based on a review of the comments on this issue, OSHA sought to determine if it were widely understood that shores and reshores are part of the total formwork system or whether shores and reshores should be defined separately and addressed separately when promulgating regulations for formwork. Several commenters (Exs. 14-2, 14-8, 14-10, 14-27, and 14-48) stated that shores and reshores should be part of the definition because they are part of the total formwork system. Three commenters (Exs. 14-16, 14-35 and 14-44) indicated that they felt shores and

reshores should be defined separately and not included within the definition of formwork. They based their comments on the distinction between the support function of the entire formwork system versus the independent support function of shores and reshores.

In addition, the Building and Construction Trades Department, AFL-CIO (BCTD) (Ex. 14-40) commented " * * * we see no need to redefine formwork to exclude the concept of shoring * * *." They further stated that OSHA should expand the definition to indicate clearly that the formwork system not only supports freshly placed concrete, but also partially cured concrete.

After careful consideration of the comments and testimony received on this definition, OSHA has determined that "shores" and "reshores" are generally considered as part of the total formwork system and has revised the final rule specifically to state this determination. This is accomplished by inserting the words "shore" and "reshoring" after the phrase "supporting members." In addition, OSHA agrees with the BCTD comment that formwork be capable of supporting both freshly placed as well as partially cured concrete. Therefore, OSHA has added language to the definition to make this intent clear. Finally, OSHA has made some editorial changes (the words "is in" have been added before "contact" and the word "with" has been added after "contact") for clarity. OSHA believes the revised definition more clearly describes what formwork is and what role it plays in supporting the concrete.

Paragraph (b)(3) contains the definition for "lift slab." Lift slab is defined as a method of concrete construction in which floor and roof slabs are cast on or at ground level and, using jacks, lifted into position.

OSHA, in proposed paragraph (b)(2), defined "lift-slab" to mean a method of concrete construction in which floor and roof slabs are cast on or at ground level and hoisted into position by jacking. There were no comments received on the proposed definition. The definition for this term in the final rule is essentially the same as definition in the proposal, except the words "by jacking" have been replaced with "using jacks" and "hoisted" has been replaced with "lifted." These revisions are simply editorial and made for the purpose of clarity. This term, however, is not defined in the existing OSHA standard because lift-slab operations are not specifically addressed. The existing standard, however, requires compliance with the American National Standards

Institute (ANSI) A10.9-1970 (Ex. 9) which addresses lift-slab operations. OSHA proposed to create a specific section on lift-slab construction, using the current ANSI standard as a base document, thus creating a need to define the term "lift-slab." Therefore, OSHA promulgates paragraph (b)(3) as revised.

Paragraph (b)(4) defines "limited access zone" as an area around one side of a masonry wall under construction which is clearly demarcated to limit access by employees. This term was not defined in the proposal nor is it defined in the existing standard because there were no specific proposed or existing requirements for establishing limited access zones.

After careful consideration of the comments and testimony received in response to the requirements proposed for masonry construction in § 1926.706 (see discussion below), OSHA is requiring a new work practice in the final rule which will require the employer to establish a limited access zone. Since this term is not used in the OSHA standards, OSHA has determined that it is necessary to define this term in the final rule. Therefore, OSHA promulgates paragraph (b)(4).

Paragraph (b)(5) contains the definition for "precast concrete." "Precast concrete" means concrete members (such as walls, panels, slabs, columns, and beams) which have been formed, cast, and cured prior to final placement in a structure.

OSHA proposed to define precast concrete to mean a concrete member which is formed, cast, and cured prior to placement in a structure. There were no substantive comments received on the proposed definition. However, the National Institute for Occupational Safety and Health (NIOSH) (Ex. 14-39) in commenting on the specific requirements section for precast concrete, questioned OSHA as to whether or not *slabs* were considered to be a precast member. OSHA observes that if the slab were formed, cast and cured prior to being placed in the structure; i.e., not cast in place, it would be considered to be "precast." However, to avoid any confusion, OSHA has identified several typical types of precast members in the definition. In addition, the word "final" has been added to indicate clearly that the concrete member is placed at a location different than the location where it was formed, cast, and cured. Again, the term "precast" is not defined in the existing standard because precast concrete operations are not specifically addressed. However, the existing standard requires compliance with ANSI A10.9-1970 (Ex. 9) which

addresses precast concrete operations. OSHA proposed to create a specific section on precast concrete, using the current ANSI standard as a base document, thus creating a need to define the term "precast concrete." Therefore, OSHA promulgates paragraph (b)(5) as revised.

Paragraph (b)(6) contains the definition for "reshoring." "Reshoring" means the construction operation in which shoring equipment (also called reshores or reshoring equipment) is placed as the original forms and shores are removed to support partially cured concrete and construction loads.

OSHA, in proposed paragraph (b)(4), defined "reshoring" to mean the construction operation in which the original shoring is removed and replaced in such a manner as to prevent collapse of the concrete structure. This term is not defined in the existing standard. However, since reshoring operations are specifically addressed in the regulatory text of the final rule, OSHA has determined that it should be defined.

OSHA received only one comment on the proposed definition. That comment was received from the Washington Metropolitan Area Construction Safety Association (WMACSA) (Ex. 14-29). They recommended that "reshoring" be defined to mean the placement of shores after forms are stripped to support members and construction loads safely. In addition, the WMACSA and the BCTD (Ex. 14-40) both commented on the reshoring requirement contained in § 1926.703(b)(10) indicating concern with how OSHA described the time/sequence for erecting reshoring.

After careful consideration of the comments received, OSHA has determined that the proposed definition should be rewritten to more accurately describe when reshoring operations take place—as the original forms and shores are removed. Therefore, OSHA promulgates paragraph (b)(6) as revised.

Paragraph (b)(7) contains the definition for "shore." "Shore" means a supporting member that resists a compressive force imposed by a load. There were no comments received on the definition proposed in paragraph (b)(5), which is identical to the definition contained in the existing standard. OSHA notes that when performing reshoring operations, shores are often referred to as "reshores." Thus, this definition is applicable to both shores and reshores. OSHA, therefore, promulgates paragraph (b)(7) as proposed.

Paragraph (b)(8) contains the definition for "vertical slip forms." "Vertical slip forms" means forms which

are jacked vertically during the placement of concrete. In proposed paragraph (b)(6) OSHA did not change the existing definition, which is essentially the same as the final definition except the words "and continuously" have been deleted. There were no comments received on the definition. However, OSHA did receive one comment on the specific vertical slip form requirement which caused OSHA to revise the definition. That commenter, the National Chimney Construction Safety and Health Advisory Committee (NCCSHAC) (Ex. 14-16), took exception to OSHA's use of words which implied that vertical slip forms move continuously. Rather, they described the process as distinct, discrete steps that occur as the jack moves vertically. OSHA acknowledges that "continuously" is not quite accurate and has decided to delete the word because it appears unnecessary to convey the rate of movement in the definition. Therefore, OSHA promulgates paragraph (b)(8) as revised.

Finally, the existing standard contains the term "guy" to prescribe a method of supporting reinforcing steel in walls, piers, and columns. OSHA proposed to delete the definition for "guy" since the proposal used the words "laterally supported" instead of "guy." OSHA had proposed this change to enable employers to use other methods of supporting the reinforcing steel. There were two comments received on the proposal to delete the definition for "guy." The BCTD (Ex. 14-40) commented that the term "laterally supported" should be defined in the final rule because it is a substitute for the term "guy."

In addition the WMACSA (Ex. 14-29) commented that the definition for the term "guy" should be retained. They further commented, "When bracing reinforcing steel, a tension load is normally applied. A cable, chain, or rod may be used. Lateral implies sideways or horizontal bracing."

However, the final rule for supporting reinforcing steel does not contain either term. Therefore, neither of these terms are defined. A more complete discussion of the reason for deleting these words can be found in the discussion of § 1926.703, cast-in-place concrete.

Section 1926.701 General requirements.

This section of the final rule contains general work practice requirements related to construction loads, reinforcing steel, concrete buckets, working under loads, and personal protective equipment. The proposed rule also

contained a section on general requirements, but it contained only one provision. To promote a more logically organized standard, the final rule relocates all "general" type work practice requirements applicable to both concrete and masonry work to the general requirements section.

Paragraph (a) of the final rule prohibits the placement of construction loads on a concrete structure or portion of a concrete structure until the employer makes a determination on the basis of information received from a person qualified in structural design that the structure or portion of the structure is capable of supporting the loads.

The intent of this final rule requirement is to prevent accidents such as the one that occurred on April 27, 1978, in which 51 employees were killed. In that accident, concrete was being placed in the forms for a cooling tower under construction at Willow Island, West Virginia. The formwork collapsed when the third bucket of concrete was being hoisted up to the working platform. All the employees on the formwork fell to the ground below. The National Bureau of Standards, in a report for OSHA, concluded that the most probable cause of the collapse was due to the imposition of construction loads on the tower before the structure had gained the strength to support the loads. Observance of either §§ 1926.701(a)(1) or 1926.701(a)(4) of the existing rules could have prevented this accident. Likewise, observance of the final rule requirements of this paragraph and § 1926.703(a)(1), which address the hazard described above, will prevent these types of accidents.

The final rule is essentially the same as the proposed § 1926.701, except the phrase "engineer/architect" was replaced with "until the employer makes a determination on the basis of information received from a person qualified in structural design." The proposed rule was based on existing § 1926.701(a)(4), which prohibits the placement of any construction load on the partially completed structure unless such loading has been considered in the design and approved by the engineer-architect. OSHA proposed to revise the existing rule by deleting that portion of the provision which required that construction loads be "considered in the design," leaving only the requirement that the engineer/architect approve the placement of loads on partially completed structures. OSHA proposed this revision because engineers/architects are not always aware of all construction loads that will ultimately be placed on the structure, and thus,

they would not be able to properly consider all such construction loads in the design stage. However, OSHA believes that the employer, as the person who has the ability to take corrective action and as the person with ultimate responsibility for the safety and health of the workers, also has the responsibility for making such decisions. OSHA also believes that the employer must make the determination about whether or not to place construction loads on the basis of information made available by a person qualified in structural design. Thus, OSHA proposed continuing this part of the provision.

Several comments were received on the proposed provision. Dun-Par Engineered Form Company (Dun-Par) (Ex. 14-10) commented that the proposed provision would prevent any activity on partially completed structures because the engineer or architect will not approve the placement of construction loads because they believe that they may be held liable if a failure occurs. The Milwaukee Construction Industry Safety Council (MCISC) (Ex. 14-19) recommended that the provision be revised to read: " * * * construction loads exceeding 75 percent of the design load shall not be placed on the partially completed structure unless such loading has been approved by an engineer or architect * * *." However, the commenter did not specify why the 75 percent number was selected, or if the limit only applied to concrete structures which had reached the design strength. The WMACSA (Ex. 14-29) commented that the words "engineers" and "architects" are ambiguous and they should be licensed or registered professionals rather than "qualified persons." The BCTD (Ex. 14-40) commented that the engineers and architects should not only consider construction loads in the design, but should also approve their placement on the structure. However, they provided no additional information for the basis of their comment.

Because the comments were not accompanied by supporting data, OSHA sought additional comment in the hearing notice on the placement of construction loads on partially completed concrete structures. OSHA explained that sometimes construction loads are supported by partially completed concrete structures which may not be designed to carry such loads, even if the structure had reached full design strength. Through review of the comments, OSHA sought to determine whether engineers or architects incorporate all the construction loads which may be placed on the structure

into the design of the structure, and if they in practice approve or disapprove the placement of such loads during construction. OSHA also sought to determine who should be responsible for determining whether the structure will support itself and any superimposed loads prior to placement of such loads.

There were three comments received on this issue. Two of the commenters (Exs. 14-47 and 18) argued that engineers or architects do not consider construction loads in the design of the structure. Ceco Industries, Inc. (Ceco) (Ex. 14-47) stated that construction procedures and the nature and magnitude of loads applied to structures are normally left to the contractor. Ceco further stated that the method of concrete construction is the responsibility of the employer. Testimony at the hearing by John Hanson, an OSHA expert witness (Tr. I, 86), addressed this issue.

Mr. Hanson testified that engineers and architects do not consider all construction loads on partially completed concrete structures in the design phase because they cannot envision every possible method of construction or source of construction load. Ingvar Schousboe, the other OSHA expert witness (Ex. 19), commented that construction loads may or may not be considered specifically in the design phase. Mr. Schousboe stated that contractors [employers] should know what construction loads were assumed in the design and should not attempt to place larger loads without competent engineering approval or advice. Mr. Schousboe also stated that this approval or advice was once referred to the project engineer on the design team, but current practice makes it necessary for the contractor to have an in-house engineer or obtain a consultant service.

After carefully considering all the comments and testimony received, OSHA has decided to delete the requirement for the specified engineer-architect services. This decision is based on the comments and testimony received which indicates that engineer-architects frequently do not consider construction loads in the design, nor do they approve their placement on partially completed structures. However, OSHA believes that it is still important that someone be responsible for performing this service. Therefore, OSHA is requiring that the employer make the determination that the structure or portion of the structure is capable of supporting the construction loads. The employer must make this determination on the basis of information received from a person

qualified in structural design. This revision also places responsibility for employee safety with the person directly responsible for the concrete operations. In addition, the language in the final rule will allow the employer to consult with engineers or architects or whomever the employer chooses to make the determination, providing the person is, in fact, qualified in structural design. In some cases, the employer or an employee may possess the qualifications necessary to make such determinations on the basis of his or her own qualifications in structural design and may not need to consult with others. Therefore, OSHA promulgates paragraph (a) as revised.

Paragraph (b) of the final rule requires the employer to guard all protruding reinforcing steel to eliminate the hazard of impalement whenever there is a danger that employees will fall onto or into the reinforcing steel. The intent of this provision is to prevent accidents such as the one that occurred on June 11, 1976, in which one employee was killed. The employee was operating a powered concrete buggy to transport concrete when he lost control of the buggy. The employee then fell, landing on protruding reinforcing steel which pierced his shoulder and ear. (Ex. 5). Observance of the requirement in the existing rule in § 1926.700(b)(2) to guard the rebar could have protected the employee from the hazard described. Likewise, observance of this final rule provision will protect employees from the hazard of protruding reinforcing steel.

The final rule differs from the proposed provision which was located in § 1926.702(a) and the existing provision in § 1926.700(b)(2). Under the proposed rule, employers could either protect the reinforcing steel or, in the alternative, protect the employee from falling onto the steel by requiring the employee to use fall protection devices. The existing rule required only that the employer guard vertically protruding reinforcing steel when employees are working above it.

Several comments were received on the proposed revision. The National Erectors Association (NEA) (Ex. 14-22) commented that they agreed with the proposed revision allowing the option of using a fall protection system in lieu of covering, shielding, or bending over the protruding reinforcing steel. The NEA further stated that the proposed rule would eliminate compliance problems at multi-employer work sites where one employer may be required to provide protection for employees of other employers.

Three other commenters (Exs. 14-40, 19, and 24) argued that OSHA should drop the fall protection alternative because it would provide less protection than the existing rule. In particular, the BCTD (Ex. 14-40), said that " * * * permitting fall protection as a substitute for protecting protruding reinforcing steel provides significantly less protection than the current standard does * * *. Moreover, permitting the use of fall protection as a substitute divides responsibility among the various subcontractors on the site whose employees may, at different times, be exposed to the protruding steel rods." BCTD concluded that, " * * * fall protection is an unsatisfactory substitute for actually guarding the steel." They recommended that fall protection be dropped as an alternative.

In addition, the United Brotherhood of Carpenters and Joiners of America (Carpenters) (Tr. I, 38) testified as follows:

A recent BLS study (Ex. 24A) of falls from elevations showed that in construction, 89 percent of the workers surveyed were not using fall protection at the time of the accident. Of those workers, 32 percent said they were not high enough to need any, 43 percent said it was not practical to use in that type of work. Of those using fall protection, 26 percent fell from the side or area not protected by the guardrail. For nine percent of those using fall protection, the guardrail broke. Three percent of those workers fell over the guardrail, and another three percent fell under the guardrail. In 28 percent of these cases, the fall protection was not connected because the worker was moving around.

The Carpenters, in their post-hearing comment (Ex. 30), further stated that both fall protection and rod covering should be required.

The National Constructors Association (NCA) (Ex. 14-36) stated that the words "to work" should be stricken so that employees are prohibited above protruding reinforcing rods, unless protection is provided. NCA further states that there should be no difference between "working" and "walking" surfaces. OSHA notes that it considers employees who are walking in the area of vertically protruding reinforcing steel to be "working" and thus covered by the proposed rule. However, to avoid any misunderstanding, the revised rule excludes the words "to work" and applies the provision to workers who may become impaled as a result of falling onto or into protruding reinforcing steel.

Finally, Technical Safety Associates (TSA) (Ex. 14-34) commented:

This portion of the standard is not clear to many people. This again appears to refer only to working up in the air above rebar and that protruding rebars from the ground need not be covered or protected. Many accidents occur when employees are walking along ground level, trip, and are impaled on protruding rebar.

The comments received prompted OSHA to seek additional information in the hearing notice on the proposed rule to protect employees working above vertical protruding reinforcing steel. OSHA explained in the notice that the proposal required employers to protect the reinforcing steel or prevent the employee from falling. Through review of the comments, OSHA sought to determine whether fall protection provided less protection against the hazards of impalement than guarding the reinforcing steel.

In response to that notice, John Hanson (Tr. I, 88) testified at the hearing that fall protection is needed to prevent impalement when employees are working above adjacent working surfaces, irrespective of whether the reinforcing steel has been protected.

After careful consideration of the comments received, OSHA agrees that the use of fall protection systems should not be allowed as an alternative to the requirement to guard protruding reinforcing steel, because employee safety will not be adequately provided. The record (as evidenced by the BLS statistics on falls which were presented in testimony and discussed above) demonstrates that even when employees are provided fall protection, fall protection systems, for various reasons, do not always prevent or stop employees from falling. In some cases, employees fall over or under guardrails that should have provided the needed fall protection. In some other cases, employees were required to be in motion and had disengaged from the provided fall protection systems. In other words, fall protection systems are not 100 percent effective in preventing employees from falling and unless the employees are prevented from falling, the hazard of impalement on rebars is not controlled or eliminated. On the other hand, if rebar is guarded at all times (covered or bent over), the hazard of impalement is always controlled or eliminated. In fact, OSHA does not know of a single case where an employee was impaled after having fallen into rebar that had been guarded. Therefore, the proposed option of providing fall protection in lieu of guarding rebar is deleted in the final rule in order to afford the greater employee protection.

In addition, OSHA believes that comment of TSA has merit and that all employees should be protected from being impaled. OSHA's intent is to eliminate the hazard of impalement completely. OSHA did not intend that the use of the word "above" would be construed to mean that the entire body of an employee would have to be "above" the protruding steel. OSHA realizes that employees could be, in fact, often are, in a position where only part of their body is above the protruding steel, such as walking alongside of protruding rebar where as TSA points out, the employee could trip and then fall into the steel. Likewise, there are situations where the steel is protruding from a horizontal direction and employees could fall or trip into the steel and become impaled. To properly protect employees from the hazard of impalement, OSHA has revised the provision to state clearly that all protruding reinforcing steel is to be guarded whenever employees could fall into or onto the steel and thereby become impaled. In light of the above considerations, therefore, OSHA promulgates paragraph (b) as revised.

Paragraph (c) contains provisions related to post-tensioning operations. Paragraph (c)(1) requires the employer to prohibit employees (except those essential to the post-tensioning operations) from being in the area behind the jack during tensioning operations.

Paragraph (c)(2) requires the employer to erect signs and barriers to limit employee access to the post-tensioning area during tensioning operations.

Although there were no specific provisions proposed to address post-tensioning operations, OSHA observes that the existing standard (the referenced ANSI A10.9-1970 standard) prescribes requirements to protect employees from hazards associated with post-tensioning operations. Because OSHA felt that the hazards associated with post-tensioning were adequately addressed by other sections in the 1926 standards, it decided that instead of proposing additional requirements, it would raise an issue regarding this subject. In particular, in Issue #8 of the NPRM, OSHA asked questions regarding pre-stressing and post-tensioning operations. Specifically, OSHA asked what are the hazards associated with such operations and what standards are needed to protect employees performing such operations?

In response to the issue, OSHA received a wide variety of comments, many of which focused on hazards addressed elsewhere in Part 1926—the Construction Safety and Health

Standards. For example, fall hazards which are regulated by Subparts E and M were cited; fire hazards which are regulated by Subparts C and F were cited; and the need to establish good work practices (training) which are regulated by Subpart C were cited. Some of the specific comments included the following.

Gilbane (Ex. 14-28) commented on the similarities of erecting pre-stressed concrete and compared it to steel erection, noting the fall hazards associated with the erection process. On post-tensioning, Gilbane noted that in addition to the hazard of falling, the employee could be struck by items falling from above. Gilbane also commented:

Also of concern is the practice of cutting the post-tension in strands. They are torched cut. This could cause a fire hazard to those below. As they are not supposed to be torched cut, but cut with a hydraulic cutter, this should not be a problem. The elements that are being cut cannot be allowed to fall unrestrained to the lower levels. Only trained personnel should perform these hazardous operations.

CAL/OSHA (Ex. 14-2) in commenting on the need for good workmanship in tensioning wires noted that a qualified person should have a good quality control inspection before the concrete is poured into the slab. Likewise, the AGCA (Ex. 14-31) commented, "Any hazards resulting from tensioned wire rope elements (pre or post) have as their root cause poor installation. As is the case with most components associated with concrete placement, proper inspection and good workmanship during installation will avoid mishaps related to tensioned wire rope."

Several commenters noted that employees should not work directly in line with the wire rope being tensioned, that employees should work from the side and that warning signs or audible warning should be used. For example, Bechtel (Ex. 14-35) commented, "No significant hazard exists. Good practice is to avoid working directly behind or in front of wires being tensioned to eliminate the potential for injury if a break of slip occurs. No regulation is required." The Philadelphia Electric Co. (Ex. 14-27) commented that personnel should not be permitted in the vicinity of the tendons during the tensioning process.

NIOSH (Ex. 14-39) commented, "The greatest risk of serious injury is associated with the sudden release of energy from the tensioned element. These elements, rods or wire rope, are oftentimes subject to loads of 200,000 psi. Should a rope or rod fail and strike

an employee, serious injury is likely to occur."

The BCTD (Ex. 14-40) commented, "The process of tensioning the wire rope elements is among the most dangerous of the concrete construction operation. It exposes the workforce to a number of hazards, the most serious of which is getting hit by snapped cables." The BCTD further commented that they believed it was necessary to set standards to protect workers from these hazards. They recommended barriers and signs during post-tensioning as required in the ANSI A10.9-1970 which was formerly incorporated by OSHA.

OSHA expert witness, Ingvar Schousboe (Ex. 19), testified that most pre-tensioning takes place in prefabrication plants. He recommended that warning signals such as flashing red lights and horns or klaxons signify that stressing is to commence so all nonessential persons could leave. He also said, "Nobody ever stands in the line of a strand," adding that, "I know of no case where a strand has been broken after the stressing was completed and the strand properly anchored." On post-tensioning he said, "Nobody should be permitted to be in line with the strand being stressed."

The Carpenters (Ex. 24), when testifying on OSHA's cost figures for the signs and barriers during pre- and post-tensioning operations, commented that these provisions are in the ANSI standards and accepted industry practice which indicated to them that they are a part of any good safety program and could not be considered burdensome. They also said that most of the industry will continue to provide protection from these hazards, OSHA regulation or not.

The NCA (Ex. 14-36) commented that this subject deserves separate and full attention because of the numerous hazards associated with such operations. They suggested that OSHA reserve a section in Subpart Q and seek public comments through an Advance Notice of Proposed Rulemaking. NCA did not elaborate on the "numerous hazards."

The WMACSA (Ex. 14-19) commented that pre-stressed concrete is generally fabricated off the job and post-tensioning is completed on the job. They also commented that the 1983 version of ANSI should be included as part of the OSHA standard. Finally, the AGC of Dallas (Ex. 14-8) commented, "No standards are necessary."

Based on a careful review of the comments and testimony, OSHA has determined that while most of the hazards associated with both pre-tensioned and post-tensioned concrete

are adequately covered throughout Part 1926, there is a need for further regulation. In particular, the evidence and testimony demonstrate that during post-tensioning operations, it is critical that all non-essential employees be kept out of the tensioning area. Because construction sites are typically occupied by several trades at the same time, it is virtually impossible to tell each potentially affected employee exactly where the post-tensioning operations will be conducted so that they will stay clear of the area. Additionally, OSHA does not believe that it is feasible for the post-tensioning employer to station an employee at potential entrances to the post-tensioning areas to keep non-essential employees out of the area, yet OSHA is requiring that non-essential employees be prohibited from the area. OSHA believes, as supported by the comments, that the existing requirement located in section 9.5 of the ANSI A10.9-1970 standard to erect signs and barriers is an effective way to communicate with all workers at the site that the area is "off limits." The signs and barriers will limit employee access and therefore employees will not be behind the jack during tensioning operations.

Therefore, to provide a proper level of employee safety, OSHA is continuing the existing requirement that no employee (except those essential to the post-tensioning operations) be permitted to be behind the jack during tensioning operations and that signs and barriers be erected to limit employee access to the post-tensioning area. Based on these considerations, paragraphs (c)(1) and (c)(2) are promulgated.

Paragraph (d) of the final rule prohibits employees from riding concrete buckets. This paragraph was relocated from § 1926.703(a) of the proposal and is based on existing § 1926.700(d)(7)(ii), which prohibits riding concrete buckets for any purpose. The final rule is essentially the same as the proposed rule, except it has been reworded to clarify that the employer cannot permit employees to ride the buckets.

Two comments were received on the provision to prohibit the riding of concrete buckets. The NEA (Ex. 14-22) stated that employees should be able to ride properly equipped buckets to avoid enormous scaffold and ladder problems which could expose employees to potentially more danger than riding the bucket. However, the NEA did not provide any data to support this position. The BCTD (Ex. 14-40) commented, "Since the OSH Act places the responsibility for compliance with standards on employees, 29 U.S.C. 654, this paragraph should be amended to

require that employees shall not be permitted to ride concrete buckets."

After careful consideration of the comments received, OSHA has decided to revise the proposed rule using language to reflect the concerns of the BCTD. Therefore, OSHA promulgates paragraph (d) as revised.

Paragraph (e) of the final rule contains two requirements concerning working under loads. The requirements pertain to working under concrete buckets.

Paragraph (e)(1) requires the employer to prohibit employees from working under concrete buckets while the bucket is being elevated or lowered into position. Paragraph (e)(2) requires that when concrete buckets are being routed overhead, the employer must, to the extent practical, route elevated concrete buckets so that no employee, or the fewest number of employees, are exposed to the hazards associated with falling concrete buckets.

The final rule is a revision of the proposed provision in § 1926.703(b), which was based on the existing provision in § 1926.700(d)(7)(ii). Like the existing provision, the proposed rule only afforded protection to workers of vibrating crews. Clearly, overhead concrete buckets pose the greatest hazard to vibrating crews. However, other workers on the site are faced with the same hazard, albeit less often, when concrete buckets pass over their heads. For example, on October 13, 1977, two carpenters were killed when a bucket containing wet concrete dropped and crushed the two workers. On September 29, 1980, a pile driver was killed when he was struck by a bucket filled with concrete. Observance of this provision of the final rule will protect all employees from the hazard of falling concrete buckets, not just the vibrating crew which is afforded protection under the existing requirements in § 1926.700(d)(7)(ii).

Because of the lack of protection to other workers, OSHA decided to request specifically, in Issue #7 of the NPRM, information on the need to expand the proposed provision to prohibit all employees from being under concrete buckets. OSHA explained that concrete buckets have fallen while transporting concrete from the concrete trucks or other source to its placement and crushed employees working below. Several comments were received on the proposed provision and in response to the specific questions asked in Issue #7. Several commenters (Exs. 14-29, 14-36, and 14-40) stated that employees should be kept out from under concrete buckets. The BCTD (Ex. 14-40) commented, "A falling concrete bucket

is a recognized hazard in the industry, against which all employees should be protected." Another commenter (Ex. 14-19) stated that it is not always possible to prevent vibrator crews from working under concrete buckets. Three commenters (Exs. 14-20, 14-21, and 14-35) stated that a requirement to keep all employees out from under concrete buckets would have an adverse impact on construction procedures. For example, Alabama Power (Ex. 14-20) commented, "In some cases, all [concrete] placement and possibly finishing personnel would be required to stop work and move." The commenter also stated that this would disrupt the placing and finishing operation of any concrete placement and would increase costs. Six commenters (Exs. 14-8, 14-16, 14-17, 14-28, 14-31, and 14-45) stated that it was not always practical to keep all employees out from under concrete buckets. For example, the NCCSHAC (Ex. 14-16) commented as follows:

Proper workplace assignments should strive to assure that loads are not swung directly over working areas. The operator of the equipment must be continually aware of personnel working in the area and govern his operations accordingly. In some operations, however, such as the pouring of slabs, a concrete bucket is swung over the area where concrete is being placed and vibrated. While personnel should not be assigned to work directly under such areas, nevertheless, there may be times when it is unavoidable. Three commenters (Exs. 14-2, 14-33, and 14-36) recommended that all employees should be kept from under concrete buckets. For example, the NCA (Ex. 14-36) commented, "Reasonable efforts should be taken by employers to keep all employees from under suspended loads, including concrete buckets."

The comments received prompted OSHA to seek additional comment in the hearing notice on whether or not it is practical to keep all employees from under concrete buckets.

Four comments were received in response to this issue. The four commenters (Exs. 14-47, 18, 19 and 21) stated that it would not be reasonable or practicable to keep everyone out from under concrete buckets. For example, Ceco (Ex. 14-47) stated that it would be difficult to remove everyone from the path of the load because this requirement would become very disruptive to the construction process. John Hanson (Ex. 19) stated his agreement with other comments to the effect that it is not reasonable or practical to keep everyone out from underneath concrete buckets. Hanson further stated that, "It would be my view that danger to employees in working underneath overhead loads, and in

particular in working underneath concrete buckets, occurs as the load is first being lifted or as the load is brought to its final position." Hanson explained his view, saying that "The hazard comes mainly from sudden or unexpected movement of the load and also the risk of that load hitting some other element on the construction site." Hanson also recommended that § 1926.21(b) should contain a specific requirement for employers to inform and instruct employees of the need to be conscious of overhead loads and to avoid unnecessary exposure to overhead loads. Further, Hanson suggested that the provision in question be revised to require employees to be kept out from under a concrete bucket whenever it is less than 20 feet in height or closer laterally than 10 feet to any other element of the construction. Mr. Hanson acknowledged that the numbers represented his personal judgment, indicating that other persons may have different numbers.

Finally, Ingvar Schousboe (Ex. 19) stated, "It is not always practical to keep everyone out from under concrete buckets" and suggested, "Very careful planning of the bucket's path may help: try to avoid coming in above steel setters and finishers, ahead of and behind the delivery spot, respectively."

OSHA has determined, based on the record, that it is not possible to keep all employees out from under suspended concrete buckets at all times. However, OSHA believes that there are certain precautions that must be taken to eliminate or control the hazard when the greatest potential for exposure exists. The record indicates that the most critical times during the lifting cycle occur when the bucket is initially raised and when it is being lowered into position for unloading. Therefore, employees must be kept out from under concrete buckets while buckets are being elevated or lowered into position.

At other times, i.e., when the bucket is suspended over workers while in route to its placement destination, OSHA believes that employers must take other steps to eliminate or minimize employee exposure. OSHA has determined that total evacuation of the structure, while obviously an effective way to eliminate or minimize the hazard, is not always a practical alternative. However, OSHA has determined that other employer efforts to control the hazard are capable of being done and must be taken. Thus, OSHA is requiring that the employer, to the extent practical, select a routing path so that no employee, or the fewest number of employees, are exposed to the hazard of falling concrete buckets.

Additionally, OSHA observes that other requirements in the construction standards which pertain to rigging equipment must also be observed to afford the greatest level of safety to workers who are working beneath suspended loads. Therefore, OSHA promulgates paragraphs (e)(1) and (e)(2) as revised.

Paragraph (f) of the final rule contains requirements for personal protective equipment. Paragraph (f)(1) requires the employer to prohibit employees from applying a cement, sand, and water mixture through a pneumatic hose unless the employee is wearing protective head and face equipment. This paragraph was relocated from § 1926.703(c) of the proposal and is based on existing § 1926.700(d)(9). OSHA proposed that nozzlemen who are applying a cement, sand, and water mixture through a pneumatic hose shall be required to wear protective head and face equipment.

The final rule is essentially the same as the proposed requirement except the word "nozzlemen" was replaced with "employees." There was only one comment received on the proposed provision, and that was from the NCA (Ex. 14-36) who suggested that OSHA delete the words "be required to." OSHA observes that to remove these words as NCA suggests, would create language similar to the language that the BCTD objected when it was used in proposed § 1926.703(b) (relocated to § 1926.701(d)(1)) which prohibits employees from riding concrete buckets. The BCTD took objection to the proposed provision regarding concrete buckets because they felt the way the provision was written made it appear that OSHA was placing responsibility for safety and health with the worker, rather than the employer. Although it has been clearly established that the employer is responsible for compliance with the OSHA requirements, OSHA revised the provision for riding concrete buckets so that there would be no misunderstanding that it is the employer who must prohibit such tasks. Thus, to accept the NCA suggestion in this provision would be to restructure the provision so that it would appear that it was the responsibility of the employee to wear personal protective equipment. Therefore, OSHA rejects the suggestion of the NCA, and instead promulgates paragraph (f)(1) as revised by rewriting the provision in plain language to state that no employee shall be permitted to apply a cement, sand, and water mixture through a pneumatic hose unless the employee is wearing protecting head and face equipment.

Paragraph (f)(2) requires that the employer prohibit employees from placing and tying reinforcing steel more than six feet above any adjacent working surface unless the employee is protected by the use of a safety belt or equivalent fall protection in accordance with Subpart E of this part. This paragraph was located from § 1926.702(b) of the proposal, and is based on existing § 1926.700(b)(1) which requires that employees working more than six feet above any adjacent working surface, placing and tying reinforcing steel in walls, piers, columns, etc., be provided with a safety belt or equivalent device in accordance with Subpart E of this part. OSHA proposed to delete the words "in walls," "piers," "columns," "etc.," and the phrase "in accordance with Subpart E of this part." In addition, the words "provided with" were replaced with "protected by the use of" and the word "device" was replaced with "protection."

No comments were received on exact revisions proposed except the deletion of the reference to Subpart E. The BCTD (Ex. 14-40) recommended that reference to Subpart E be retained in the rule to provide employers with guidance regarding what protective measures are considered equivalent to safety belts. Finding merit in this argument, OSHA has incorporated this comment. Other comments received including comments from the MCISC (Ex. 14-19) and the Associated General Contractors of America (AGC) (Ex. 14-31). Both the MSISC and the AGC commented that fall protection should begin at heights greater than 10 feet. The commenters stated that this height would bring the proposal into conformance with other existing fall protection standards. However, only § 1926.451(a)(4), which requires guardrails on scaffolds, contains such a 10-foot rule. All other fall protection requirements provide that employees be provided with fall protection equipment when they are six feet or more above lower levels, except for roofers performing built-up roofing work.

In connection with the proposed provision, OSHA requested, in Issue #5 of the NPRM, specific comment on what requirements are needed to protect employees while climbing erected reinforcing steel. OSHA explained that employees are often required to climb reinforcing steel during construction and their weight could cause the steel connections to break, thus exposing the employees to fall hazards. Through review of the comments on this issue, OSHA sought to determine whether additional requirements are necessary

to protect workers who place and tie reinforcing steel in vertical structures. OSHA received 14 comments on this issue. Ten commenters (Exs. 14-2, 14-8, 14-16, 14-20, 14-28, 14-31, 14-33, 14-35, 14-40, and 14-45) stated that employees who climb erected reinforcing steel are adequately protected by the proposed rule. For example, the BCTD (Ex. 14-40) commented, " * * * safety belts or equivalent protection, as required by paragraph .702(b), will adequately protect employees who must climb the steel." Two commenters (Exs. 14-1 and 14-27) stated that recommendations on typical reinforcing wire size, number of turns, and frequency of ties could be made. Finally, two commenters (Exs. 14-28 and 14-29) stated that work platforms could be erected to support the workers.

After careful consideration of the comments received, OSHA decided that no additional requirements were needed in this Subpart to protect employees while they erect reinforcing steel. While it is true that OSHA could specify the number of turns and the frequency of ties to be made, and OSHA could require the erection of work platforms which in turn could enhance employee safety, OSHA observes that such requirements would require employers to expose other employees to the same hazard for a greater period of time to provide a safer work station for the employees placing and tying reinforcing steel. For this reason, OSHA has determined that paragraph (f)(2) will be promulgated as revised with no change to the provision as proposed, except to restructure it so the provision, as discussed above, clearly places the responsibility for safety with the employer rather than the employee. Further discussion of this topic can be found in the proposed fall protection rule § 1926.501(b)(5). (See 51 FR 42737.)

Issue #6 of the proposed rule was not directly related to any particular provision in the general requirements section. Rather, it was raised so that OSHA could gain specific comment on whether or not it should require employers to have engineers inspect concrete construction operations. OSHA explained in the NPRM that concrete construction operations are often inspected by engineers and local building officials to evaluate conformance with plans, specifications, and building codes. OSHA sought information to determine whether engineering inspections would improve worker safety. There were several comments in response to Issue #6. Seven commenters (Exs. 14-8, 14-10, 14-21, 14-31, 14-33, 14-36, and 14-45) stated that engineering inspections would not

improve worker safety. For example, the National Constructors Association (NCA) (Ex. 14-36) stated that concrete employers are in the best position to affect job site conditions positively and immediately because of their direct involvement and observations. Also, Dun-Par (Ex. 14-10) stated that most engineers are experts at design and not experts at construction safety, suggesting that the concrete employer is more knowledgeable in construction safety matters. The other commenters voiced similar concerns.

Three commenters (Exs. 14-17, 14-40, and 14-42) stated that engineering inspections would improve worker safety. For example, C.K. Stope (Ex. 14-17) commented as follows:

* * * enforcement of construction procedures should be shared by the designer, the constructor, and the owner of the completed project. Especially, for unique structures, the designer and the constructor understand the requirements for this specific type of construction and they are bound to provide a safe work place. The owner also would normally share in this responsibility.

After careful consideration of the comments on this issue, OSHA has determined that convincing record evidence does not exist that engineering inspections as stated in Issue #6 would improve worker safety. Therefore, no further action was taken with regard to Issue #6.

Section 1926.702 Requirements for equipment and tools.

This section of the final rule contains specific requirements to address the hazards associated with equipment and tools used in concrete and masonry construction. The format of the final rule is different from the proposed rule. In the proposed rule, OSHA had placed all concrete equipment requirements in § 1926.704, while masonry equipment requirements were placed in § 1926.707 along with other masonry requirements. The final rule relocates all requirements related to equipment and tools used in both concrete and masonry construction into the same section—§ 1926.702. As each provision is discussed, its paragraph location in the proposed standard will be noted to facilitate comparison between the proposed and final standards.

Paragraph (a)(1) of the final rule contains two requirements related to cement storage facilities. The provisions in paragraphs (a)(1)(i) and (a)(1)(ii) require that bulk storage bins, containers or silos be equipped with conical or tapered bottoms, and mechanical or pneumatic means to start the flow of material. The intent for these

provisions is to eliminate the need to place employees inside a storage facility to start the flow of materials, thereby exposing employees to suffocation or injury.

These requirements are identical to the provision in § 1926.704(a) of the proposed standard, and differs from the existing standard only in formatting (i.e., two paragraphs instead of one). The reason for the reformatting is to clarify the requirements by enabling employers to identify quickly and easily their obligations under the standard.

OSHA received only one comment on the proposed paragraph. The WMACSA (Ex. 14-29) commented that OSHA had based its existing standard on the ANSI A10.9-1970, but that OSHA has changed an "or" used in the ANSI standard (to separate the two equipment requirements) to an "and" in the existing standard. OSHA notes that a review of the ANSI A10.9-1970, the original source standard, did not reveal the change alleged by WMACSA. Therefore, since there was no substantive comment on this provision, OSHA promulgates paragraph (a)(1) as proposed.

Paragraph (a)(2) of the final rule prohibits employees from entering storage facilities unless the ejection system has been shut down, locked out, and tagged to indicate that it is unsafe to operate the ejection system. This is a revision of proposed § 1926.704(b) which only required the employer to shut down and lock out the ejection system. The proposed rule did not require a tag to be used in conjunction with the lockout procedure. As explained in the proposed rule, the existing standard did not specifically contain a requirement to shut down and lock out the storage facility, but it did require compliance with the ANSI A10.9-1970 which contained this requirement.

OSHA received several comments on this provision. One commenter, the WMACSA (Ex. 14-29), said that "Allowance should be made for access to repair the ejection system, with proper safeguards, when adjustments are needed." However, the WMACSA did not make any recommendations on what the proper safeguards should be. Another commenter, the NCA (Ex. 14-36), suggested that OSHA consider protecting employees who enter storage facilities from sinking into material present on the inside of the facility. The NCA also did not make any specific recommendations on the type of protection needed. OSHA notes, however, that Subpart H, § 1926.250(b)(2), contains a requirement that employees working on stored material in silos, hoppers, tanks, and similar storage areas shall be equipped

with lifelines and safety belts meeting the requirements of Subpart E of Part 1926.

In addition to the above comments, OSHA received a comment from the National Institute for Occupational Safety and Health (NIOSH) (Ex. 14-39). NIOSH stated that OSHA should be consistent with its other lockout requirements, noting that OSHA requires tags to be used in conjunction with other proposed lockout procedures such as those set forth in § 1926.704(k) of the proposal, but yet had only required locking out of ejection systems. OSHA agrees with NIOSH that tags should have been included in the proposal in order to provide a proper level of protection to employees. Additionally, OSHA is specifying that the tags should indicate that the equipment is not to be operated. Therefore, OSHA promulgates paragraph (a)(2) as revised.

Paragraph (b) of the final rule contains two requirements relating to concrete mixers. Paragraphs (b)(1) and (b)(2) require that employers equip concrete mixers that have one cubic yard or larger loading skips with a mechanical device to clear the skip of materials, and that guardrails should be erected on each side of the skip. The intent of these requirements is to protect employees from the hazards associated with the manual clearing of materials from the skip, and to prevent employees from entering the area beneath the skip while the skip is elevated. These requirements are identical to the provisions of proposed § 1926.704 (c)(1) and (c)(2), which are not substantively different from the existing standard. The only difference is that the proposed paragraph was rewritten for clarity, eliminating some of the introductory text. The substantive portion of the provision has not been altered.

One comment was received on these provisions. The WMACSA (Ex. 14-29) said that the "skip" type of mixer is not normally used on building construction. However, WMACSA did not make any recommendation as to whether OSHA should make some change based on their comment. Therefore, OSHA promulgates paragraphs (b)(1) and (b)(2) as proposed.

Paragraph (c) of the final rule requires that employers equip manually-guided powered and rotating type concrete troweling machines with a control switch that will automatically shut off the power whenever the operator removes his or her hands from the equipment handles. The intent of this requirement is to prevent unattended powered concrete troweling machines from striking employees, or otherwise causing injury. This requirement is

identical to the provision in § 1926.704(d) of the proposed standard, and is also identical to the existing standard. Since there were no comments received on this requirement, OSHA promulgates paragraph (c) as proposed.

Paragraph (d) of the final rule requires the employer to ensure that concrete buggy handles do not extend beyond the wheels on either side of the buggy. The intent of this requirement is to ensure that buggy handles do not contact other objects, causing employee injury. This requirement is identical to the provision in § 1926.704(e) of the proposal. The proposed standard differs from the existing standard in that OSHA proposed to delete a sentence from the existing rule which *recommended* that knuckle guards be installed on buggy handles. OSHA stated in the proposed rule that it believes knuckle guards are unnecessary because the hazard of employee contact with fixed objects would be eliminated if the buggy handles were not extended beyond the wheels on either side of the buggy.

There were three comments on this requirement. WMACSA, NIOSH, and BCTD (Exs. 14-29, 14-39, and 14-40) indicated that even if the buggy handles were positioned so that they did not extend beyond the wheels, an employee could still be injured. In particular, the WMACSA stated, "This becomes important on a power buggy where a blow could affect control."

These comments prompted OSHA to seek additional comment in the hearing notice on concrete buggy handles. In the notice, OSHA stated that one commenter recommended that knuckle guards be installed to prevent injury while the concrete buggy is turning. OSHA sought injury data to demonstrate that concrete buggies without knuckle guards present a hazard to employees. OSHA received no comment on the request for injury data. Additionally, Ingvar Schousboe (Ex. 14-19) said, "I have not seen a power buggy in use for many years. I have not seen or heard of knuckle injuries in connection with hand buggies." As no injury data was received to justify a requirement for knuckle guards, OSHA promulgates paragraph (d) as proposed.

Paragraph (e) of the final rule contains two requirements relating to concrete pumping systems. The first requirement in paragraph (e)(1) requires employers to provide pipe supports, which are designed for 100 percent overload, on concrete pumping systems using discharge pipes. The intent of this provision is to prevent the pipes from collapsing. The second requirement in paragraph (e)(2) requires employers to

use positive, fail-safe joint connectors on compressed air hoses. The intent of this provision is to prevent separation of compressed air hose sections. These two requirements are identical to proposed provisions § 1926.704 (f) and (g), and are the same as the existing requirements for concrete pumping systems in existing § 1926.701(d)(6).

There was one comment on paragraph (e), and that related to the provision in paragraph (e)(1). The Southern Co. Services (Ex. 14-15) commented that the requirement for 100 percent overload for supports seemed excessive except in some instances. The commenter did not, however, make any specific recommendation for preventing pipe collapse. OSHA believes the requirement to be reasonable and, lacking any substantive information or evidence to the contrary, promulgates paragraph (e) as proposed. Paragraph (e) is substantially identical to the existing standard and creates no new burdens.

Paragraph (f) of the final rule contains two requirements relating to concrete buckets. The first requirement in paragraph (f)(1) requires that positive safety latches or similar safety devices be installed on concrete buckets which are equipped with hydraulic or pneumatic gates to prevent premature or accidental dumping. The second requirement in paragraph (f)(2) requires that concrete buckets be designed to prevent concrete from hanging up on the top and the sides. These two requirements are identical to proposed provisions § 1926.704 (h) and (i), which are revisions of existing requirements. In the proposed rule, OSHA explained that the existing standard requires concrete buckets to be equipped with positive safety latches or similar safety devices to prevent the accumulation of aggregate and loose materials on the top and sides of the buckets. However, the requirement was not clearly stated in the existing standard. The purpose of the safety latches is to prevent premature or accidental dumping and not to prevent the accumulation of aggregate and loose material. To clarify the intent of the provision and to continue the requirement to prevent the accumulation of aggregate and loose material, OSHA proposed to revise the existing standard by creating two provisions, each addressing a different hazard associated with the concrete buckets.

There were no comments on the proposed provisions. However, NIOSH (Ex. 14-39) commented on the preamble discussion of why concrete buckets must be designed to prevent material from hanging up on the top and sides.

NIOSH suggested that OSHA erred in stating in the preamble to the proposed rule that the reason buckets should be designed to prevent material from hanging up is to prevent loose material from falling onto workers. NIOSH suggested that the reason buckets should be so designed is to prevent an employee from having to enter the buckets to loosen materials that have become attached to the sides. OSHA agrees that the provision is also intended to prevent employees from having to enter the bucket. However, no change to the language is necessary to respond to NIOSH's concern and, therefore, OSHA promulgates paragraph (f) as proposed.

Paragraph (g) of the final rule requires employers to secure sections of tremies and similar concrete conveyances with wire rope (or equivalent material) in addition to the regular couplings or connections. This requirement is identical to proposed § 1926.704(j), which was based on the ANSI A10.9-1970 standard. The requirement is intended to prevent separation of sections of tremies and similar concrete conveyances. Although the ANSI standard does not specify materials other than wire rope for use in preventing the separation of the sections, OSHA, as discussed in the proposed rule, feels that other materials, such as steel chains, could be used to secure the sections. There were no comments received on the proposed paragraph. In light of the above, OSHA promulgates paragraph (g) as proposed.

Paragraph (h) of the final rule requires that when bull floats are used where they could contact energized electrical conductors, the bull float handles shall be constructed of nonconductive material or insulated with a nonconductive sheath whose electrical and mechanical characteristics provide the equivalent protection of a handle constructed of nonconductive material. It is the same provision as existing § 1926.700(d)(3). OSHA had proposed to delete the existing requirement for bull float handles. OSHA proposed this deletion because the requirement addresses electrical hazards while using bull floats, and electrical hazards are already addressed by § 1926.400 of the construction standards.

OSHA received only one comment on the proposed deletion of this requirement. The commenter, BCTD (Ex. 14-40), objected to OSHA's removal of this provision for several reasons. The BCTD recommended that OSHA retain the requirements for bull floats, stating the following:

* * * we believe it is more effective to make the standards for a particular industry or operation as comprehensive as possible, rather than relying on the employer to be equally familiar with the standards for all construction. The operation with which the employer is here concerned is the placement of concrete—an operation seemingly unrelated to electrical work. It is more likely that workers will be protected if the provision requiring insulation of bull float handles is included in Subpart Q, with other standards with which the employer is concerned, than if the employer must refer to Subpart K.

OSHA acknowledges that Subpart K, the electrical standards, does not specifically mention bull float handles and that in the interest of employee protection OSHA should retain the more specific requirement as it appears in the existing standard. Therefore, OSHA promulgates paragraph (h) as it appears in the existing standard.

Paragraph (i) of the final rule contains two requirements relating to masonry saws. Paragraph (i)(1) requires that the saws be guarded with a semi-circular enclosure over the blade. Paragraph (i)(2) requires that a method of retaining fragments of shattered blades be incorporated into the enclosure. The intent of these requirements is to prevent contact between the employee and the blade or blade fragments. The requirement in paragraph (i)(1) is identical to proposed § 1926.707(b)(1)(i). However, the requirement in paragraph (i)(2) differs from the requirement in proposed § 1926.707(b)(1)(ii). In the proposed rule OSHA required that masonry saws be guarded with a semicircular enclosure over the blade and that a slotted horizontal hinged bar be mounted underneath the guard enclosure to retain fragments of shattered blades.

OSHA received several comments concerning the provisions required for masonry saws (Exs. 14-3, 14-14, 14-19, 14-24, and 14-26). These commenters said the proposed language would render most saws in violation of the regulations because masonry saws are no longer manufactured with the "slotted hinged bar mounted underneath the guard" as prescribed in the proposed standard. In addition to these comments, testimony was presented at the public hearing by George Miller, representing the Mason Contractors Association of America (Tr. I, 162 and 168), reaffirming the written comments and informing OSHA of the problematic ramifications of such a specification. OSHA finds merit with the commenters' position and has revised the requirement to allow any method which achieves the stated performance—to retain blade fragments.

OSHA believes the revised language responds to the concerns of the commenters and also allows the Agency to address the hazards appropriately. Therefore, OSHA promulgates paragraph (i)(1) as proposed, and paragraph (i)(2) as revised.

Paragraph (j) of the final rule requires the employer to lock out and tag equipment before allowing employees to perform any activities such as maintenance or repairs where unexpected, inadvertent operation could occur and cause injury. The intent of this requirement is to prevent employee injury due to operation of equipment by persons who may be unaware that an employee is maintaining or repairing the equipment.

In proposed § 1926.704(k), OSHA has essentially the same requirement, except that it was not clear that lockout/tagout was only being required where a potentially hazardous situation existed. And, the proposal made no distinction between a "repair" versus a "maintenance" activity. The final rule differs from the proposed rule in that it clarifies the deficiencies in the proposed language as outlined above.

There were three comments on the proposed requirement. The PCA (Ex. 14-9) commented that OSHA should change *cement* pumps to concrete pumps. OSHA notes that it based the proposed requirement on an ANSI provision which was directed specifically to cement pumps at bulk cement transfer facilities. In addition, OSHA relied on another ANSI provision which required other equipment such as compressors, mixers, conveyors, screens, etc., to be locked and tagged out prior to making repairs. By combining these two ANSI provisions, OSHA intended to require that any piece of equipment that could be inadvertently started up and possibly cause employee injury, be locked out and tagged before employees are permitted to perform maintenance or repair work. Since OSHA does not wish to cause any confusion, the word "cement" has been deleted in the final rule so the requirement will apply to any pump where the hazard of inadvertent operation is present. OSHA notes that this revision is not a substantive change because the proposed requirement applied to all equipment and mentioned cement pumps only as an example of equipment addressed by the provision.

The NCA (Ex. 14-36) commented that OSHA should strike the general requirement to lock out equipment, leaving only the requirement for tags. They further suggested substitute language to require equipment to be locked out in addition to the tag if the power supply has facilities for lockout.

The NCA supported their comment by pointing out that some equipment, such as liquid fuel powered compressors, pumps and mixers are started by a pull rope. OSHA realizes from this comment that some confusion could result from the wording used in the proposed requirement. Specifically, employers may be under the false impression that it was OSHA's intent in the proposal that all equipment be locked out and tagged before work was performed on the equipment, regardless of the presence of a hazard, when in fact OSHA intended to impose the requirement only when a potential hazard existed. It is OSHA's belief that most equipment operated by a pull rope would not expose an employee to a hazard as a result of inadvertent operation and, if that were the situation, lockout/tagout measures would not be required. However, such equipment may need to be shut down prior to making repairs or performing maintenance. Because of the apparent confusion, OSHA has revised this provision by rewording it in the final rule to reflect more clearly the intent of the provision and the action to be taken when the hazard of inadvertent activation is present.

A final comment received from NIOSH (Ex. 14-39) questioned whether workers entering mixers to chip out dried concrete would be performing a "repair," implying that OSHA may have overlooked this kind of "maintenance" activity when restricting the lockout/tagout measures to equipment being "repaired." It was, and is, OSHA's intent to protect employees who enter mixers (or any other equipment) for any reason from the inadvertent activation of equipment. To further clarify OSHA's intent, OSHA has revised the proposed requirement to include all activities, including maintenance and repair. Additionally, OSHA is specifying what information should be included on the tag to eliminate any misunderstanding. Upon consideration of all the comments, OSHA promulgates paragraph (j) as revised.

Section 1926.703 Requirements for cast-in-place concrete.

Section 1926.703 presents the requirements for cast-in-place concrete. This section addresses formwork in general, shoring and reshoring, vertical slip forms, reinforcing steel, and removal of formwork. The requirements of this section were relocated from proposed § 1926.705 (Formwork) and from proposed paragraph (c) of § 1926.702 (Reinforcing Steel) to promote a more logically organized standard.

Paragraph (a) of the final rule contains the general requirements applicable to all formwork. The intent of these requirements is to prevent accidents such as the one that occurred on September 29, 1978, in which one employee was killed. In that accident, an employee was removing the cables suspended from a crane which temporarily held a section of concrete formwork in place. The formwork fell on the employee after the cables were removed. The formwork was not properly braced to prevent collapse (Ex. 8). Observance of the existing requirements in § 1926.701(a)(1) could have prevented this accident. Likewise, observance of the final rule requirements in this paragraph will prevent these types of accidents.

Paragraph (a)(1) requires formwork (which has been defined to mean the total system of support including forms, shores, reshores, hardware and braces) to be designed, fabricated, erected, supported, braced, and maintained so that it is capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork. This provision was relocated from § 1926.705(a)(1) of the proposal which was based on the existing provision in § 1926.701(a)(1). OSHA observes that the ANSI A10.9-1983 standard contains an essentially similar provision in section 7.1.1. OSHA also observes that the ANSI A10.9-1983 standard contains a number of specific provisions designed to guide employers on how to meet this general, performance requirement. In particular, formwork safety factors are prescribed for various types of shoring systems. In fact, OSHA has indicated in the final rule that formwork which has been designed, fabricated, erected, supported, braced and maintained in conformance with the ANSI requirements in sections 6 and 7 for Formwork and Shoring shall be deemed to meet the requirements of this paragraph. However, the ANSI standard does not provide all the information necessary to meet completely the requirements of § 1926.703(a)(1); i.e., the ANSI standard does not specify every detail of formwork design, fabrication, erection, support, bracing, and maintenance. Therefore, the employer is still responsible for the design, fabrication, erection, support, bracing and maintenance of formwork to ensure that it meets the requirements of § 1926.703(a)(1). OSHA believes the ANSI standard will be of particular assistance in guiding smaller employers who may not engage the services of formwork designers or engineers.

The existing rule, similar to the final rule, requires formwork *and shoring* to be "designed, erected, supported, braced, and maintained so that it will safely support all vertical and lateral loads that may be imposed upon it during placement of concrete." OSHA proposed to revise the existing requirement by deleting the words "and shoring" and "safely" and by deleting the phrase "upon it during place of concrete" [emphasized above]. OSHA proposed to delete the words "and shoring" because it had proposed to define formwork as inclusive of "shoring." OSHA proposed to delete the word "safely" because it is a term that cannot be defined with sufficient clarity to be of benefit to employers in complying with the provisions of this paragraph, nor does the word "safely" clarify the rule to a measurable degree greater than the language used in the final rule. Finally, OSHA proposed to delete the phrase "upon it during placement of concrete" because OSHA's intent is that formwork support anticipated loads at all times, not just during the placement of concrete.

OSHA received no comment on the specific revisions it proposed. However, comments were received to suggest that further revision was necessary. Three commenters (Exs. 14-9, 14-36, and 18) suggested that the phrase "that may be imposed" in the proposed standard should be replaced with a phrase such as "normally expected loads," "intended loads" or "normal loads" to indicate clearly the loads for which the formwork must be designed to support. OSHA agrees that the proposed language may be misinterpreted as requiring employers to design, fabricate, erect, support, brace and maintain formwork to support loads *beyond* those which the employer can reasonably anticipate will be applied to the formwork. Therefore, OSHA has revised the provision by substituting the language "may reasonably be anticipated" to describe the loads which the formwork must support.

Other comments were received concerning formwork safety factors and design responsibilities. The WMACSA (Ex. 14-29) commented that OSHA should include the minimum factors of design that are covered in ANSI A10.9-1983 (Ex. 11).

The Scaffolding, Shoring, and Forming Institute (SSFI) (Ex. 14-44) also commented on the need to include formwork safety factors. In addition, a representative from the SSFI testified (Ex. 21 and Tr. I, 173-174) that he felt very strongly that specific safety factors must be included within the body of the

standards, stressing that these safety factors are needed to provide additional protection for unknown loads that may be imposed. He also noted that safety factors have been part of the ANSI standards to which OSHA referred but were not included in the proposed standard. When asked if he were aware of any circumstances where safety factors would have prevented worker injury had they been adhered to, the SSFI representative replied, "Well it's my feeling that the safety factors are presently adhered to. If the standard doesn't have a safety factor, then I would be afraid that the contractor is going to start cutting into the safety factors and designing to a 1 to 1 safety factor, and then we're going to see a rash of accidents." (*Id.*)

On the other hand, OSHA's expert witness, John Hanson, (Ex. 18) stated the following:

I believe that there is a strong tendency in construction, unfortunately, to not pay sufficient attention to shoring. An approach that is often taken, and accepted, is to use a larger-than-customary factor of safety in design of the formwork, and pay less attention to details. Experience shows, however, that the details are essential to safety. In the case in which I was involved, compliance with (a)(1) would have prevented the failure. In my view, bracing is the most essential requirement.

OSHA has not included specific requirements for formwork safety factors in the final rule. However, as stated above, the ANSI A10.9-1983 standard does prescribe formwork safety factors, among other recommendations, which the employer may use as a guide in meeting the provisions of this paragraph. OSHA notes that it did not propose any safety factors in the NPRM, although safety factors were required in the existing standard through reference to the 1970 ANSI A10.9 standard. The removal of requirements for safety factors in the NPRM prompted little information or evidence in the form of written comments or testimony. In fact, the record shows that when formwork safety factors were discussed, the result was disagreement over what the proper factors of safety should be (Tr. I, 192).

Additionally, OSHA believes the performance language of the final rule provides for the proper level of employee protection. OSHA observes, once again, that this paragraph requires that formwork be capable of supporting *without failure* all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork. OSHA believes the language of the final rule states clearly the employer's obligation while allowing the

employer to determine how to accomplish the stated performance. If OSHA were to specify safety factors for each type of shoring, employers may falsely believe that they have met their obligations in so far as compliance with the general requirements for formwork by simply adhering to the specified safety factors. Employers must decide whether or not to use the safety factors prescribed by ANSI or the SSFI, or to vary from those factors as they believe necessary so long as formwork can meet the regulatory intent—to support without failure. OSHA interprets "without failure" to mean the breakage and separation of any component part of the formwork system or load refusal, which is the point where the ultimate strength of a component is exceeded. This is the point where structural members lose their ability to carry loads. Therefore, OSHA believes the revised language properly states the expected level of performance for the total formwork system without being overly specific.

Finally, BCTD (Ex. 14-40) suggested that OSHA require formwork to be designed by the structural engineer and included in the original construction specifications. The BCTD explained that such a requirement coupled with a requirement for the engineer to determine what testing is appropriate to determine when formwork may be stripped will address both structural integrity and worker safety, since both concerns will be integrated into the underlying design.

OSHA has not incorporated the BCTD's suggestion to require that all formwork be designed by a structural engineer. This decision is based on OSHA's determination that the requirement of the final rule very clearly states the performance to be achieved by the employer with regard to formwork and, as stated above, that the employer must decide how best to comply with the stated performance. Additionally, there was no evidence submitted to the record to demonstrate a danger to employee safety if employers were not required to have all formwork designed by a structural engineer. Also, at the public hearing there was testimony regarding who should be assigned responsibility for the formwork. A representative from Dun-Par (Tr. II, 8), in putting forth his position that the formwork designer or contractor should have that responsibility rather than an engineer, entered two sets of formwork plans into the record (Ex. 23A and 23B) on which an engineer had written "We have no comments on the drawings and calculations in this

submittal." Dun-Par's representative further stated that the specifications place responsibility for formwork design on the contractor, a practice with which he agrees (Tr. II, 9). Finally, the Dun-Par representative said "The engineer doesn't want to be involved in this, and you can't force him. They are not the experts in the business [of formwork design]."

Furthermore, OSHA notes that the Occupational Safety and Health Act, the primary responsibility for employee safety rests solely with the employer as it is the employer who has control over the worksite and the authority to take corrective action when necessary. In the case of formwork design, employers may determine that the only way they can achieve compliance with this particular requirement is to have a structural engineer design the formwork. In other instances, however, the employer may determine that the formwork can be designed by others who are qualified in formwork design, but who are not structural engineers. OSHA believes there may be situations where the job is so small and so routine that the employer has the knowledge and skills necessary to meet the intent of this requirement without the aid of others.

After careful consideration of all of the comments and testimony received, OSHA has determined that the rule, as revised, provides proper protection for employees while allowing employers flexibility in determining the best way to provide this protection. Therefore, OSHA promulgates paragraphs (a)(1) as revised.

Paragraph (a)(2) requires that drawings or plans, including all revisions, for the jack layout, formwork (including shoring equipment), working decks, and scaffolds be available at the jobsite. This paragraph has been relocated from proposed § 1926.705(a)(2). It is essentially the same requirement as the proposed rule and the existing rule in § 1926.701(a)(2), except the words "including all revisions" has been added. OSHA observes that a similar provision is prescribed in Section 7.4.9 of ANSI A10.9-1983.

OSHA received two written comments, in addition to testimony at the hearing, on this provision. The Technical Safety Associates (TSA) (Ex. 14-34) and SSFI (Ex. 21 and Tr. I, 176) supported the proposed rule. The SSFI testified as follows:

The Institute strongly endorses the provisions of 1926.705 that require drawings or plans for the jack layout, formwork, shoring, working decks and scaffolding to be available at the job site. Without the

drawings or plans immediately accessible at the job site, questions regarding the design and integrity of the forms or shoring layout cannot be properly addressed.

WMACSA (Ex. 14-19) commented that the drawings or plans also should reflect all approved changes. OSHA agrees that it is necessary to have complete drawings or plans and that includes all revisions made to the original drawings or plans. Therefore, OSHA has added the words "including all revisions" to the provision. Additionally, because OSHA is now defining formwork as a total system, including forms, shores, reshores, and hardware, it is not necessary to include the term "shoring" which appears in both the existing and proposed provision. However, in order to be consistent with the other provisions in this section, OSHA has added the words "includes shoring equipment" to avoid any misunderstanding. Therefore, OSHA promulgates paragraph (a)(2) as revised.

Whereas paragraph (a) applies to all formwork, paragraph (b) of the final rule contains requirements that apply only to shoring and reshoring operations. Paragraph (b)(1) requires that all shoring equipment (including equipment used in reshoring operations) be inspected prior to erection to determine that the equipment meets the requirements specified in the formwork drawings. Paragraph (b)(2) prohibits the use of shoring equipment found to be damaged such that its strength is reduced to less than that required by § 1926.703(a)(1).

These provisions were relocated from §§ 1926.705(c)(2)(i) and 1926.705(c)(2)(ii) of the proposed rule, which were based on an existing provision in § 1926.700(e)(1)(iii). OSHA observes that the ANSI A10.9-1983 standard contains essentially similar provisions in Sections 6.3.1 and 6.3.2.

OSHA proposed to revise the existing rule by replacing the words "shoring layout" with "formwork drawings" for clarity, and by setting forth the two provisions separately.

OSHA did not receive any comment on the changes proposed. However, it did receive one comment questioning the meaning of "damaged shoring equipment" as used in paragraph (b)(2). The Portland Cement Association (PCA) (Ex. 14-9) stated that the word "damaged" was not sufficiently descriptive. Although they did not make any recommendations on how OSHA might describe "damaged" so that it would be clearly understood by all, they did pose two hypothetical situations to illustrate their concern. Specifically, PCA questioned whether a notch in a timber post or a small dent in a pipe

shore would be considered damaged sufficient to reject its use as shoring. OSHA believes that the employer (or his designated competent person who makes inspections of equipment as required in § 1926.20(b)(2)) should determine whether or not, for example, a notch in a timber post constituted damage to such an extent that the post could not provide the support needed for its role in meeting the requirements of § 1926.703(a)(1). OSHA observes that final rule § 1926.703(a)(1) requires that formwork, now defined to include shoring equipment, be designed, fabricated, erected, supported, braced, and maintained to support all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork. Thus, it is OSHA's intent that if the employer cannot ensure that the shoring equipment, which is part of the total formwork system, will provide the support necessary for its role in the overall formwork system because it has a notch in it, then the equipment cannot be used for shoring. OSHA has included language in the final rule to clarify this point. OSHA believes that with the revised language, employers will understand the requirement in (b)(2) and thus be able to determine whether or not shoring has been damaged to such an extent that its use for shoring is questionable.

Additionally, paragraph (b)(1) has been revised to indicate that shoring equipment includes equipment used in reshoring operations. This provision was made simply to serve as a reminder that equipment used in reshoring operations are also subject to the requirements of this paragraph. Therefore, OSHA promulgates paragraphs (b)(1) and (b)(2) as revised.

Paragraph (b)(3) of the final rule requires that erected shoring equipment be inspected immediately prior to, during, and immediately after the placement of concrete.

The final rule is identical to the proposed rule in § 1926.705(c)(3)(i) and the existing rule in § 1926.700(e)(1)(iv). OSHA observes that the final rule is also consistent with Section 6.3.3. of the ANSI A10.9-1983 standard.

Only one comment was received on this provision. The SSFI stated (Tr. I, 177) that "With respect to 1926.705(c)(3), it is the Institute's interpretation that those provisions require the contractor to inspect shoring equipment * * * to assure that the shoring complies with the shoring layout." OSHA observes that in the NPRM it was stated that the purpose of this provision is to determine if any shoring equipment has been damaged or weakened after it had been

erected and that § 1926.703(b)(1) requires inspection to determine that the shoring is as specified in the formwork drawings. Therefore, there being no substantive comment made on this provision, OSHA promulgates paragraph (b)(3) as proposed.

Paragraph (b)(4) of the final rule requires that erected shoring equipment (again, shoring equipment includes equipment used for reshoring) found to be damaged or weakened, such that its strength is reduced to less than required by § 1926.703(a)(1), be immediately reinforced.

This paragraph is essentially the same as proposed § 1926.705(c)(3)(ii) and existing § 1926.700(e)(1)(iv) except it is more clearly written. OSHA observes that Section 6.3.6 of the ANSI A10.9-1983 standard contains an essentially similar provision.

The final rule differs from the proposed rule in that the words "or reshored" used in the proposed and existing rules as an alternate to the word "reinforced," are not carried forward to the final rule and the meaning of the terms "damaged or weakened" has been clarified.

The elimination of the words "or reshored" was made in response to the Ceco (Ex. 14-45) comment that the word "reshored" was misleading. Ceco felt that the requirement to reshore damaged equipment might be confused with the reshoring operation performed after the removal of shores and forms. Ceco also said the concept of immediate reinforcement would be adequate to communicate the correct response. OSHA agrees with Ceco that the use of the word "reshored" could cause confusion, especially since OSHA has noted that equipment used for reshoring is also subject to this requirement. Therefore, OSHA has removed the term "reshored" from the final rule.

Another commenter, SSFI (Ex. 14-44) said that OSHA needed to modify the language of the proposed provision "to insure the degree of appropriate reinforcement." Specifically, the SSFI suggested that OSHA revise the language to read, " * * * reinforced, reshored, or replaced to carry its maximum intended loads that may be imposed."

Again, OSHA reminds employers that the general requirement for formwork in § 1926.703(a)(1) must be met and the requirement in this provision, which is specific to shoring, is only part of the total effort that an employer must put forth to achieve compliance with the requirement for formwork to be " * * * capable of support without failure all * * * loads * * * applied to the formwork." In order to address the

concerns of the SSFI and the concern raised by the PCA and discussed in § 1926.703(b)(2) regarding the meaning of "damaged," OSHA has included language to clarify the meaning of damaged or weakened shoring equipment. OSHA believes this makes it clear that when the employer determines that it is necessary to reinforce erected shoring, it is for the purpose of insuring that the strength of the shoring meets the requirements of § 1926.703(a)(1). Therefore, OSHA promulgates paragraph (b)(4) as revised.

Paragraph (b)(5) of the final rule requires that sills for shoring be sound, rigid, and capable of carrying the maximum intended load. This provision is identical to proposed § 1926.705(c)(1) and existing § 1926.700(e)(1)(ii). OSHA observes that the ANSI A10.9-1983 standard contains a similar provision in Section 6.2.6. OSHA received no comments on the proposed rule, indicating to OSHA that commenters, like OSHA, find merit with the existing rule. OSHA, therefore, promulgates paragraph (b)(5) as proposed.

Paragraph (b)(6) of the final rule requires that all base plates, shore heads, extension devices and adjustment screws be in firm contact with the foundation and the form. This paragraph is identical to proposed § 1926.705(c)(4). The proposed paragraph was a combination of existing rules for tubular welded frame shoring in § 1926.700(e)(v), tube and coupler shoring in § 1926.701(c)(4), and single post shores in § 1926.701(d)(2)—all of which contain essentially the same requirement. OSHA proposed to combine the existing rules into one rule which then would be applicable to all types of shoring. However, two changes to the resulting rule were proposed. First, OSHA proposed to replace the word "or" in the existing standard with the word "and" which clarifies OSHA's regulatory intent—that the top of the shore is in firm contact with the form material and that the bottom of the shore is in firm contact at the foundation (formerly referred to as the footing sill) of the shore, rather than the presently implied intent that firm contact need be made only at one or the other end of the shore. And, secondly, OSHA proposed to replace the words "footing sill" with "foundation" to include other types of shoring supports.

OSHA received no comments on the proposed editorial revisions, but it did receive two written comments and oral testimony at the hearing on the topic of securing shores to both the form and foundation. The PCA (Ex. 14-9) recommended that the proposed rule be revised to read as follows: "The ends

(top or bottom) of the completed shore shall be in firm contact with either the foundation or the form." The PCA, however, did not provide a basis or reason for recommending this method of shoring erection. OSHA observes that this recommendation would provide firm contact only at one end of the shore, and OSHA believes that both shore ends must be in firm contact with other surfaces to prevent the shores from falling over or otherwise losing their ability to provide support during concrete placement.

The BCTD (Ex. 14-40) recommended that shoring equipment, in order to provide adequate protection, should be "snugged up" or secured to the foundation and form, not just in "firm contact." Like the PCA, BCTD failed to state specifically the reason for their recommendation. OSHA, therefore, decided to seek additional comment by raising an issue in the hearing notice to elicit information to determine whether it was necessary to secure shoring to the foundation and form.

At the hearing, John Hanson, OSHA's expert witness, (Tr. I, p. 91 and Ex. 18) testified as follows:

In my view, the question of whether or not it is necessary to secure the shoring depends on the type of shoring. Some deformation or movement of the formwork should be expected during the casting operation because of unbalanced loading or perhaps because of some temporary construction load. If the shoring is such that it could become loose, and hence be displaced laterally as a result of the operation, it certainly should be secured. However, if the shoring is such that it is impossible for it to be displaced laterally or to be rendered ineffective, then securing the shoring is unnecessary and I would add a statement to that section to that effect.

Another OSHA expert witness, Ingvar Schouseboe, in his prepared statement (Ex. 19), commented that the proposed requirement is reasonable because the mentioned elements cannot transfer loads in bearing without such contact. He also stated that "If the loads just mentioned can be counted on always to induce compression in bearing and shores, anchoring to forms and foundations are theoretically unnecessary." At the hearing, Mr. Schouseboe also gave testimony on this matter, (Tr. I, p. 138) stating the following:

* * * if the concrete that comes in weighs 15 times as much per square foot as the form does, it will indeed lift. But, if it weighs only five times that the form does, it will never lift it * * *. So it depends on * * * whether we are talking about a 4-inch slab or a 12-inch slab * * *.

The SSFI (Tr. I, 176) agreed with OSHA that shoring equipment should be in firm contact with the foundation and the form. SSFI testified as follows:

The Institute agrees that * * * all base plates, shore heads, extension devices, and adjustment screws shall be in firm contact with the foundation and the form. In not every case, however, should base plates and heads be secured to the foundation and form unless special engineering or circumstances warrant such action.

Dun-Par (Tr. II, 8) testified, "Under certain forming conditions you can have a problem with that, and it should be designed and accounted for under those conditions. To have a blanket statement that all formwork should have it [securing of the shoring members to the form and foundation] is way beyond reason."

Later, upon cross examination, the Dun-Par representative (Tr. II, 25) said he agreed with the proposal language, but that he disagreed with the language [discussed in the hearing notice] suggesting that "everything had to be attached."

A review of all the comments and testimony received indicated that there are circumstances under which it may be necessary to "secure" shores at the top and bottom in order to insure that the formwork system does not fail. However, since these circumstances vary, depending on several factors, it would not be possible for OSHA to identify each situation where securing of the shoring would be necessary. Nonetheless, OSHA believes it has adequately addressed the concerns of the commenters because the general requirement of this section states that formwork (which, as stated before, includes shoring) must be able to support "without failure" all reasonably anticipated vertical and lateral loads. Through this provision, the Agency feels that it has adequately addressed the employer's obligation with regard to formwork. Simply meeting the provision of this paragraph for "firm contact" does not release an employer from the obligation to meet the general requirements for formwork. Thus, when an employer encounters a shoring system that requires "securing" rather than "firm contact," the employer must secure the formwork, as necessary, so that firm contact is maintained, providing the proper level of employee protection, or the employer has not met its obligations under § 1926.703(a)(1). Therefore, OSHA promulgates paragraph (b)(6) as proposed.

Paragraph (b)(7) of the final rule prohibits eccentric loads on shore heads and similar members unless these members have been designed for such

loading. This paragraph was relocated from § 1926.705(c)(6) of the proposal where OSHA proposed to continue the existing rule as referenced in the ANSI A10.9-1970 standard (Ex. 9). OSHA observes that section 6 of the ANSI A10.9-1983 standard also contains similar provisions for shoring. The final rule is essentially the same as the proposed rule except that an editorial revision—replacing the word "they" with the words "these members" has been made.

OSHA received a comment on this provision from the Patent Scaffolding Company (Ex. 14-41), a member of the SSFI. Patent commented that the proposed provision had serious deficiencies and referred OSHA to the SSFI comment for specific details. The SSFI (Ex. 14-44) commented that eccentric loads should be prohibited on single post shores because they are relatively unstable.

OSHA's expert witness, John Hanson, in his prepared statement (Ex. 18) commented, "In a technical sense, there is always some eccentricity in the loading applied to a shore head, if for no other reason than the friction between parts used to introduced the load into the shore head. The intent of the provision is clear, that it is important to avoid significant eccentricity in introducing loads onto a shore head, but to fully satisfy the requirement as now written would be virtually impossible * * *."

OSHA agrees with its expert witness that, in the strictest technical sense, it is impossible to avoid all eccentric loading when loads are introduced onto a shore head. The very act of loading will itself produce eccentric loading. Such eccentric loads are inherent and, normally, incidental to the eventual total load to be placed on a shoring system. As Mr. Hanson testified, the concern is with "significant eccentricity," that is, eccentric loading which is so large that it is no longer incidental when compared to the designed and actual capacity of the shoring system. Such loading can result when too large an amount of concrete is placed in one area of the formwork without proper distribution. Or, it can result when a load of concrete is placed too rapidly causing an additional shock loading to be applied. Whatever the cause of this eccentric loading, the term "significant" is a relative term and is too ambiguous to be incorporated into the language of the final rule. Instead, OSHA believes that, absent appropriate design, all eccentric loading has the potential of being "significant." It is for these reasons that OSHA, like ANSI, places a prohibition on eccentric loads on shoreheads unless

they have been designed for such loading. OSHA believes the requirements of this provision, as proposed, adequately address worker protection, are readily understood, and that no revision is necessary. Employers are once again reminded that the requirements of this provision must be met in conjunction with the general requirements of § 1926.703(a)(1) that formwork must be capable for supporting "without failure * * *." Therefore, OSHA promulgates paragraph (b)(7) as revised.

Paragraph (b)(8) of the final rule requires that whenever single post shores are used one on top of another (tiered), the employer shall comply with certain specific requirements in addition to the general requirements for formwork. These requirements include (i) that the employer shall have a qualified designer prepare the design of the shoring and shall have an engineer, qualified in structural design, inspect the erected shoring system; (ii) that the shore be vertically aligned; (iii) that the shores be spliced to prevent misalignment; and (iv) that the shores be adequately braced in two mutually perpendicular directions at the splice level and that each shore (tier) also be diagonally braced in the same two directions.

The final rule is considerably different than the proposed rule located at § 1926.705(c)(5). The proposed rule, like the existing rule, only required that the layout be designed and inspected by a structural engineer if single post shores were to be used in more than one tier. In the proposed rule, OSHA stated that the intent of this provision is to prevent the collapse of formwork due to improper design and erection of single post shores in more than one tier. OSHA also noted that the Advisory Committee on Construction Safety and Health (ACCSH) and recommended that OSHA prohibit the use of single post shores in more than one tier (Ex. 2, p. 175). Finally OSHA stated that it had reviewed accident investigation records involving the failure of double tiered single post shoring systems and found that the employer failed to comply with the existing regulations; thereby leading OSHA to believe that single post shores could be used in more than one tier if they were properly designed and inspected as required by the existing regulations.

OSHA received a number of comments in response to this provision. The WMACSA (Ex. 14-29) recommended that the term "structural engineer" be changed to "registered engineer." The NCA (Ex. 14-41)

recommended that "structural engineer" be changed to "qualified engineer." Additionally, several comments were received recommending that OSHA prohibit the use of tiered single post shores. The BCTD (Ex. 14-40) commented, "With regard to proposed subparagraph .705(c)(5), we concur with the ACCSH recommendation that single-post shoring be prohibited for use on more than one tier."

Mr. Charles W. Borden (Ex. 14-1), the former Corporate Manager of Safety for Ceco Corporation, stated, "It is recommended that the use of single post shores in more than one tier be prohibited * * *." Mr. Borden supported his statement saying that the use of single post shores in more than one tier is an inherently unstable shoring system for formwork. He further stated that regardless of the requirement to use a structural engineer to design and inspect this system, it is highly sensitive to any design error or construction error, and that lateral forces on the system or buckling of any shore can cause complete failure of the entire shoring system. Mr. Borden also said that this system has caused the most failures in the past 30 years. In conclusion, Mr. Borden said that if OSHA approves the use of single post shoring systems, he recommends a full floor be erected between tiers of this system that has the stability equal to that of the supports on which the first tier of shores is resting, and that the design and inspection of the system be done by a structural engineer as well as a qualified formwork designer.

The SSFI (Ex. 14-44) recommended, " * * * the entire requirement of this section be deleted and be replaced with a statement prohibiting the use of post shores in more than one tier." They further stated that they knew of no manufacturer represented in the SSFI that permits use [of single post shores] over one tier and, therefore, do not test equipment for such conditions. They also said that the complexities of plumbness, bracing, and adjustment of each post shore in each successive tier increase the risk of producing an unstable structure.

These comments prompted OSHA to seek additional information on this topic in the hearing notice. OSHA wanted to know whether or not a properly designed and erected tiered single post shoring system can safely transfer loads to lower levels.

In response to the hearing notice, OSHA received written comments and oral testimony, including the following.

The Construction Safety Association of Ontario (CSAO) (Ex. 14-46) stated the following:

Our experience with single post shoring systems in general and tiered systems in particular when they were more extensively used, was that they were extremely sensitive to errors and omissions in construction as well as errors in design. This is in contrast with more modern techniques such as shoring frames which are much less sensitive to construction errors especially.

Ceco Industries, Inc. (Ex. 14-47) commented as follows:

Yes, it is possible to safely design and construct such systems but they require design knowledge, construction and inspection care far in excess of what is required for other supporting systems. Systems such as these have been involved in several failures. Safer alternative methods are easily constructed. It is recommended that this type of system be prohibited.

John Hanson (Ex. 18), OSHA's expert witness, in his prepared testimony commented as follows:

Single-post shores are certainly capable of safely transferring loads to lower levels, where those levels are the floors in a building. This is a very common method of construction. However, single-post shores may not be capable of safely transferring loads to lower levels if those levels are temporary platforms in the construction, which by themselves have no resistance to lateral loading. Indeed, it is difficult for me to conceive of such a system being used. Thus, it would seem that this section could be deleted.

Mr. Hanson also questioned if there was a difference in the structural engineer referred to in this provision and the engineer referred to in other sections, stating his preference that the requirement call for a "registered engineer" if that was the intent, otherwise just use "engineer." When questioned at the hearing on single-post shores, Mr. Hanson responded, "Single-post shores, themselves, I think, are capable of transferring a certain load from a point above to a point below if that point above or for that matter the point below are both properly braced laterally; i.e., if it is between existing floors in a building, I think then that those single-post shores will work." He also said that if you are putting one single-post shore on top of another without bracing of that junction, then in his view it would be a violation of the general requirements for formwork. When asked specifically if he thought it was possible to come up with a design in a construction procedure where one post is put on top of another in an area where a floor is skipped, Mr. Hanson responded, "Yes, I think anything is possible." (Tr. I, 122-123).

Ingvar Schousboe (Ex. 19), OSHA's other expert witness, in his prepared statement said that "Tiered single-post shores should be properly braced, and it

may require an engineer to calculate what constitutes proper bracing." He also stated that properly braced single-post shores could safely transfer loads to lower levels under the following conditions: The posts must be accurately lined up vertically; spliced to prevent any misalignment; braced laterally in two orthogonal directions at the splice level; and, each tier must be diagonally braced in the same two directions. At the hearing (Tr. I, 139), Mr. Schousboe testified, "About [the tiering of] single-post shores, I have stated that without any bracing in it, the system, of course, is dangerous, unsatisfactory, and has no resistance to the inevitable forces." He further testified that "Two-tier shores have to be braced totally, not only where they come in and rest upon one another, but also in both directions, in both tiers, they will have to be braced to make sure that any lateral forces that we can expect will not overturn."

SSFI (Ex. 21) also testified at the hearing to reaffirm their position as it appeared in their earlier written comment (Ex. 14-44) opposing the use of single-post shores for multi-tiered construction (Tr. I, 177).

On the other hand, a representative from Dun-Par (Tr. II, 10) agreed with the proposed rule but acknowledged that "Double tier shoring can be very dangerous." But, he also said, "It is a good alternative if it is properly designed and constructed." The Dun-Par representative pointed to the fall hazards associated with erecting a 60 foot scaffold to explain his position that prohibiting tiered single-post shores could pose a greater hazard to workers erecting other shoring systems.

After considering all of the comments and testimony received on this provision, OSHA has decided to allow the use of single post shores in more than one tier provided the employer has a qualified designer prepare the shoring design, and that after the shoring is erected, the employer have an engineer who is qualified in structural design, inspect the shoring. In addition, several criteria for bracing the shoring, as discussed above, have also been made a part of the single post shoring requirements. Additionally, the general requirement in § 1926.703(a)(1) that all formwork (which includes shores) be " * * * capable of supporting without failure * * *" must be met when tiering single post shores. Because of a lack of information and evidence submitted to the record, OSHA has rejected the recommendations of those who sought to have tiered single post shoring prohibited. Although many commenters recommended that OSHA prohibit that

type of shoring, the overwhelmingly stated reason was that tiered single post shores needed special attention; that bracing was critical; and that only qualified designers and engineers could design and erect a system so that it would be safe. OSHA believes all of these concerns have been addressed in the final rule. In addition, OSHA observes that Ceco and Dun-Par (both formwork contractors) as well as both its expert witnesses testified that it is possible to design a safe system. Therefore, OSHA promulgates paragraph (b)(8) as revised.

Paragraph (b)(9) of the final rule prohibits the adjustment of single post shores to raise formwork after the placement of concrete. This is identical to the existing requirement in § 1926.701(d)(5), which OSHA proposed to delete. OSHA explained in the proposal that it felt this rule was not needed for employee protection because it did not believe there was a danger of concrete collapse due to adjustment of single post shores and that the rule was intended to protect property. However, several commenters disagreed with the proposed deletion of this rule. Conshor Incorporated (Ex. 14-11) commented as follows:

With reference to the proposed elimination of existing Paragraph 701(d)(s) [sic] which prohibits the adjustment of single post shores after placement of concrete, this paragraph should not be eliminated. Adjustment could cause overloading of shore. It is possible that stability or structural lacing would have to be moved in order to adjust shores, creating a very dangerous situation after concrete has been placed.

The WMACSA (Ex. 14-29) commented that § 1926.701(d)(5) in the current standard should be retained. Patent (Ex. 14-41) noted in their comment that there were serious deficiencies in the provision regarding adjustment of forming system after pouring the concrete. Patent referred OSHA to the SSFI comment for details.

The SSFI (Ex. 14-44) commented, "The Institute recommends that a requirement similar to .701(d)(5) of the existing rules should remain in the proposed rules and expanded to cover all shoring." The SSFI explained their belief, "that employee protection can be affected if adjustments either increase or decrease intended loads on that element and/or adjacent members so as to put those elements in danger of immediate or subsequent progressive failure of the formwork."

In addition, the ANSI A10.9-1983 standard (section 6.7.5) also recognizes the potential hazard of adjusting single post shores after the initial set of the concrete. After careful consideration of

the comment received, OSHA agrees that the adjustment of shores will likely involve the moving of key bracing elements which are critical for formwork stability. The resulting lack of bracing could lead to formwork collapse and, therefore, pose a danger to employees. Consequently, OSHA has determined that it is necessary to regulate this hazard which could cause formwork collapse. Therefore, OSHA redesignates existing § 1926.701(a)(5) as paragraph (b)(9).

Paragraph (b)(10) of the final rule requires the employer to erect reshoring whenever the concrete is required to support loads in excess of its capacity. It also specifies that the reshoring operation is to be carried out as the forms and shores are removed.

This provision was relocated from § 1926.705(e)(1) of the proposed rule which was based on the existing provision in § 1926.700(e)(1)(v). The existing provision requires that reshoring be provided when necessary to safely support slabs and beams after stripping, or where such members are subjected to imposed loads due to construction work done. OSHA proposed to revise the existing rule to require reshoring to be erected after the removal of forms to transfer loads to other members whenever the concrete is required to support loads in excess of its capacity.

OSHA received two substantive comments on the proposed rule both of which indicated concern with the sequence (timeframe) in which reshoring operations were conducted. The WMACSA (Ex. 14-29) commented that reshoring operations were conducted. The WMACSA (Ex. 14-29) commented that reshoring should be placed *immediately after* form removal because "the placement of reshores is critical and in direct relationship to the time factors involved in form removal." They also suggested that time intervals between stripping and reshoring be in the written program and in no case shall unsupported concrete be left after the end of the working day. OSHA observes that it did not propose a written program and thus has not responded to this portion of the comment.

On the other hand, the BCTD (Ex. 14-40) commented that reshores should be placed *during* the removal of forms. They felt that the proposed language would allow the employer to remove the entire formwork system before any reshoring takes place. They also recommended that the reshoring system, like the initial formwork, should be included in the engineer's design specification and erected under the engineer's supervision.

After careful consideration of the comments received, OSHA has determined that the final rule should indicate clearly that reshoring operations are conducted *as* the original forms and shores are removed rather than *after* all the forms and shores have been removed. Therefore, OSHA promulgates paragraph (b)(10) as revised.

Paragraph (c) of the final rule contains the specific requirements for vertical slip forms. Paragraph (c)(1) requires that the steel rods or pipe on which jacks climb or by which the forms are lifted be specifically designed for that purpose and adequately braced where they are not encased in concrete. The final rule is identical to § 1926.705(b)(1) of the proposed rule and § 1926.701(b)(1) in the existing rule. OSHA observes that similar provisions are contained in Section 6.5.2 of the ANSI A10.90-1970 standard and section 7.5.2 of the ANSI A10.9-1983 standard.

OSHA received one comment on this provision and that was from the BCTD. The BCTD (Ex. 14-40) commented, that in keeping with the concerns they expressed in their comment on the general formwork provision that OSHA should specify that the slip form systems should be designed by the structural engineer. OSHA notes that it has already responded to the BCTD concerns in its discussion of § 1926.703(a)(1), above, and the reasons that OSHA put forth in rejecting the BCTD's suggestion for formwork in general are the same reasons why OSHA has not incorporated their suggestion as it pertains to vertical slip forms in particular. After careful consideration of the singular comment received, OSHA has determined that no revision to the proposed requirement is necessary. Therefore, OSHA promulgates paragraph (c)(1) as proposed.

Paragraph (c)(2) requires that forms be designed to prevent excessive distortion of the structure during the jacking operation. The final rule is essentially the same as the requirement proposed in § 1926.705(b)(5) and the existing rule in § 1926.701(b)(5), except that it has been rewritten in performance language. Specifically, instead of specifying that the forms have to be laterally and diagonally braced to prevent excessive distortion, the final rule allows the employer the flexibility to decide how best to prevent excessive distortion. This change from specification language to performance language is accomplished by removing the words "lateral and diagonal bracing" from the proposed rule and stating the

performance to be achieved—that the forms be designed to prevent excessive distortion of the structure. This revision was prompted by a suggestion by the NCCSHAC in their comment (Ex. 14-16).

The NCCSHAC pointed out that slip forms for tapered columns cannot be rigidly braced because the forming system must decrease in diameter during the placement of concrete. NCCSHAC suggested that the proposed rule be rewritten in more performance type language.

OSHA agrees with NCCSHAC that the proposed language is too specific and, therefore, has revised the provision using language to express the performance to be achieved. OSHA believes the revised language will provide employees the same degree of protection as the proposed requirement while allowing employers flexibility to design the forms in a manner that will prevent excessive distortion of the structure. Therefore, OSHA promulgates paragraph (c)(2) as revised.

Paragraph (c)(3) of the final rule requires that all vertical slip forms be provided with scaffolds or work platforms where employees are required to work or pass. This paragraph was relocated from § 1926.705(b)(7) of the proposal. The proposed rule was based on an existing rule in § 1926.701(b)(7) which requires that all vertical lift forms be provided with scaffolding or work platforms that completely encircle the area of concrete placement. OSHA observes that an essentially similar provision is contained in Section 7.5.9 of the ANSI A10.9-1983 standard.

OSHA proposed two revisions to the existing standard. First, OSHA proposed to replace the word "lift" with "slip" for clarity. Second, OSHA proposed to replace the phrase "completely encircling the area of placement" with the phrase "where employees are required to work or pass." The latter revision was proposed because OSHA had determined that scaffolds and work platforms were needed only in areas where employees would be present, either working or passing through. Since the existing rule required the erection of scaffolds or work platforms completely encircling the area of placement, regardless of whether or not employees were using them, OSHA felt it appropriate to revise the provision to address solely, the issue of employee safety. OSHA observes that a recommendation to effect this change was made by a public participant representing the NCCSHAC at the ACCSH meeting held on November 30, 1982, at which a draft concrete and masonry standard was discussed (Tr. 218). The transcript of the ACCSH

meeting did not reveal any objection to the recommendation.

OSHA received no comment on the proposed substitution of the word "slip" for "lift." However, OSHA received three comments on the proposed revision regarding where scaffolds or work platforms should be required. The SSFI (Ex. 21) supported the proposed rule to provide scaffolds or work platforms where employees are required to work or pass. However, they commented that they were concerned that the proposed rule would prohibit the erection of scaffolds on slip forms where the scaffolds are needed for stability. The WMACSA (Ex. 14-29) stated that scaffolds or work platforms that completely encircle the area of placement were required for strength, in addition to being necessary for concrete placement and finishing. The BCTD (Ex. 14-40) commented, "As for OSHA's elimination of the current requirement that scaffolding be placed on both sides of the forms, the agency should consider whether this revision will throw the formwork system out of balance, thereby creating hazards to the employees' safety."

Because the WMACSA and BCTD raised an issue of reduced employee safety if scaffolds or work platforms were not erected to completely encircle the area of placement, OSHA decided to seek additional information in the hearing notice. In that notice, OSHA stated the concerns of the commenters regarding stability and asked for additional information. OSHA sought to determine whether full perimeter access was needed for stability as well as for the use by employees placing and finishing concrete. OSHA received only one comment on this issue. That comment was made by John Hanson, OSHA's expert witness (Ex. 18), who expressed his belief that nearly full perimeter access would be required for proper placement of concrete. Mr. Hanson also commented that he felt elimination of unnecessary scaffolds would not throw the formwork out of balance since the unbalanced condition would be considered in the design of the scaffold.

After careful consideration of the comments received, OSHA has determined that no further revision of the proposed provision is necessary. Since slip form stability is adequately addressed in § 1926.703(a)(1) in the final rule, it need not be addressed again in this provision. OSHA notes that § 1926.703(a)(1) requires all formwork (which includes slip forms) to be designated, fabricated, erected, supported, braced, and maintained to support, without failure, all vertical and

lateral loads that may reasonably be anticipated to be applied to the formwork. Additionally, OSHA does not agree with the concern of SSFI that the provision would prohibit erecting scaffolds in areas other than where they were specifically required. If employers wish to erect additional scaffolds or work platforms to provide stability, this requirement is not intended to prohibit it. This provision specifies the particular areas, where, at a minimum, scaffolds or work platforms must be erected. As with any OSHA requirement, employers are always free to go "beyond" the minimal requirements imposed by OSHA. Therefore, the final rule, like the proposal, requires that scaffolds or work platforms must be erected where employees are required to work or pass. If the scaffolds or work platforms are part of the slip form design, the final rule does not prohibit their erection in any area where the employer deems them necessary. Therefore, OSHA promulgates paragraph (c)(3) as proposed.

Paragraph (c)(4) of the final rule requires that jacks and vertical supports be positioned in such manner that the loads do not exceed the rated capacity of the jacks. This paragraph was relocated from § 1926.705(b)(2) of the proposal which contained a similar provision requiring that jacks and vertical supports be positioned in such a manner that "vertical loads are distributed equally." It is also identical to a provision in Section 7.5.3 of the ANSI A10.9-1983 standard.

OSHA received two comments on this provision. The PCA (Ex. 14-9) recommended that OSHA change the word "equally" to "uniformly." The NCCSHAC (Ex. 14-16) pointed out that vertical loads could not be equally distributed on the jacks because during the lifting process some of the jacks retract while others are lifting. They, therefore, recommended that the wording of the proposed rule be revised to reflect their concern. OSHA agrees with the NCCSHAC in that it recognizes that it is almost impossible to distribute the vertical loads equally on the jacks and vertical supports. For example, the weight of concrete as it is placed and the moving weight of employees places unsymmetrical loads on the slip form. The jacks would have to be repositioned every time these loads are moved in order to equally distribute these vertical loads. Therefore, OSHA has revised the provision to delete the specific requirement for equal distribution of the vertical loads. OSHA believes the revised rule will provide protection to employees equivalent to that of the

proposal since the revised rule prohibits employers from exceeding the rated capacity of the jacks. Therefore, OSHA promulgates paragraph (c)(4) as revised.

Paragraph (c)(5) of the final rule requires that jacks or other lifting devices be provided with mechanical dogs or other automatic holding devices to support slip forms whenever failure of the power supply or the lifting mechanism occurs. This provision is identical to § 1926.705(b)(3) of the proposed rule. OSHA observes that Section 7.5.4 of the ANSI A10.9-1983 standard contains an essentially similar provision. The proposed rule was based on an existing rule in § 1926.701(b)(3) which requires jacks or other lifting devices to be provided with mechanical dogs or other automatic holding devices to provide protection in case of failure of the power supply or the lifting mechanism. OSHA proposed to replace the phrase "provided protection in case of" with "support the slip forms whenever failure of the power supply or lifting mechanism occurs." This revision was an editorial change made for the purpose of clarity. OSHA did not receive any comments on the proposed provision and, based on the earlier rationale, promulgates paragraph (c)(5) as proposed.

Paragraph (c)(6) of the final rule requires that the form structure be maintained within the design tolerances for plumbness during the jacking operation. This paragraph was relocated from § 1926.705(b)(6) of the proposal which required the form structure to be maintained in line and plumb during the jacking operation. OSHA observes that Section 7.5.7 of the ANSI A10.9-1983 standard contains an essentially similar provision. The final rule is the same as the proposed rule except the phrase "in line and plumb" has been revised to read "within all specified design tolerances." OSHA received two comments on the proposed provision.

The NCA (Ex. 14-29) commented, "If the primary concern is quality control rather than safety, [this] requirement should be deleted." The NCCSHAC (Ex. 14-16) commented that since "in line" and "plumb" must necessarily have working tolerances, OSHA should rephrase the provision to read as follows: "The form structure shall be maintained within the design tolerances for plumbness during the jacking operation."

OSHA agrees with the NCCSHAC and recognizes that construction practices permit formwork lines, grades, and dimensions to vary from those in the design. In fact, a list of such recommended tolerances for vertically slip formed structures can be found in

The Recommended Practice for Concrete Formwork (Ex. 12). In view of the foregoing, OSHA decided to revise the proposed rule to require that slip form structures be maintained within all design tolerance specified for plumbness during jacking operation. Therefore, OSHA promulgates paragraph (c)(6) as revised.

Paragraph (c)(7) of the final rule requires that the predetermined safe rate of lift not be exceeded. This paragraph was relocated from § 1926.705(b)(4) of the proposal which required that lifting proceed steadily and uniformly and not in excess of the predetermined safe rate of lift. The final rule is the same as the proposed rule except the phrase "proceed steadily and uniformly" was deleted. OSHA observes that Section 7.5.5 of the ANSI A10.9-1983 standard contains an essentially similar provision.

OSHA received two comments on the proposed provision. The NCCSHAC (Ex. 14-16) pointed out that jacking operations in slip form construction are not "continuous" in the true sense of the word in that the operation proceeds in distinct, discrete steps with the jacks individually extending and retracting within their working length. In view of this, the commenter recommended that the proposed rule be revised to read as follows: "Lifting shall not exceed the predetermined rate of lift." OSHA recognizes that, in fact, slip forms do not move continuously during concrete placement; therefore, the words "proceed steadily and uniformly" were deleted.

Another commenter, the BCTD (Ex. 14-40), wanted an additional requirement for determining the rate of lift. They stated, "The standard itself should make clear that the employer must make decisions regarding the rate of lift in consultation with, and on the approval of the engineer." However, the BCTD did not explain why it felt that it would be appropriate for employers to consult with and obtain the approval of engineers. There being an absence of support or explanation for the recommended change, OSHA has decided not to take any action with regard to the BCTD's suggestion. Therefore, OSHA promulgates paragraph (c)(7) as revised.

Paragraph (d) contains two requirements relating to reinforcing steel. Paragraph (d)(1) requires that reinforcing steel for walls, piers, columns, and similar vertical structures be adequately supported to prevent overturning and to prevent collapse. OSHA observes that Section 3.3 of the ANSI A10.9-1983 standard contains a similar provision. This paragraph

combines and relocates §§ 1926.702(c)(1) and 1926.702(c)(2) of the proposed rule. The proposed rule was based on an existing provision in § 1926.700(b)(3) that requires reinforcing steel for walls, piers, columns, and similar vertical structures to be guyed and supported to prevent collapse. OSHA proposed to revise the existing requirement by replacing the words "guy and" with the word "laterally" in order to allow employers the flexibility to support the reinforcing steel by any method of lateral support. OSHA also proposed to add the phrase "to resist overturning forces" to state the purpose of the lateral support. Finally, OSHA proposed, as a separate requirement in § 1926.702(c)(2), a provision that the lateral supports be capable of withstanding the forces that would be applied during construction. OSHA received several comments on the proposed requirements.

The BCTD (Ex. 14-40), recommended that two changes be made to the proposal. First, they noted that OSHA, in the preamble to the proposed rule, had explained that the purpose of lateral supports was to protect against overturning forces and construction forces. The BCTD recommended that this explanation be made a part of the actual requirement. They further suggested how OSHA could rewrite the provision to incorporate the purpose of the requirement. Specifically, they suggested the provision read identical to the proposal with the following language added: "(such as the wind) and to prevent collapse." OSHA agrees that the purpose of the supports, which provides the performance to be achieved by the employer, should be clear in the final rule and, therefore, has revised the final requirement accordingly. Second, the BCTD recommended that lateral support be defined to mean "any properly anchored means of steadying a piece or structure by pulling against or resisting an off-center load."

The WMACSA (Ex. 14-29) stated that the wording in proposed § 1926.702(c)(1) should be changed to permit guying in addition to lateral support.

Another commenter, Ceko (Ex. 14-45), suggested that OSHA omit the word "lateral" which implied "coming from the side." Ceko pointed out that reinforcing steel can be supported from other directions and cited examples where lateral support coming from the side was impractical. This divergence of comment prompted OSHA to seek additional information through the public hearing notice.

In the hearing notice OSHA explained the various viewpoints of commenters

and asked for additional information to enable OSHA to determine whether or not the proposed requirement should be revised to permit other methods of support (other than lateral support) to prevent the collapse of erected reinforcing steel. OSHA received three comments on this issue.

Ceco (Ex. 14-47) again commented that "lateral" support should not be specified and offered two examples of how to provide support in other than a "lateral" direction.

Ingvar Schousboe, OSHA's expert witness (Ex. 19), commented that "Any kind of bracing that can deliver the lateral force to resist overturning of reinforcing steel cages erected for vertical building elements can be employed." He also stated, "The bracing may be horizontal or inclined as long as the horizontal component of the axial force in the bracing is adequate."

In addition, John Hanson, another OSHA expert witness (Tr. I, 88), testified that guying often is not used because it interferes with the construction process. Instead, he felt that it is more common to use either supplemental pieces of reinforcing steel to crossbrace the erected steel, or to erect one side (or some portion) of the formwork and then brace the steel against it.

After careful consideration of the comments and testimony received, OSHA has decided to revise the proposed rule to allow any method of support so long as it is adequate to resist overturning forces and to prevent collapse. OSHA believes the revised language provides a level of safety equivalent to that of the proposed language, while at the same time providing employer flexibility to select a method of support that will not interfere with other construction operations. Therefore, OSHA promulgates paragraph (d)(1) as revised.

Paragraph (d)(2) of the final rule requires the employer to take measures to prevent unrolled wire mesh from recoiling. Such measures include securing the ends or turning over the mesh. This paragraph was relocated from § 1926.702(d) of the proposal. The proposed rule was essentially the same as the existing rule in § 1926.700(b)(4), except the existing rule contains the word "dangerous" to describe the effect of the recoiling action. OSHA proposed to revise the existing rule by deleting, as unnecessary, the word "dangerous." OSHA observes that Section 3.4 of the ANSI A10.9-1983 standard also addresses the hazards associated with the recoiling of wire mesh.

OSHA received only one comment on the proposed rule. The MCISC (14-19) pointed out that a common practice in

the industry is to unroll wire mesh and then flip it over before installation. They also stated that this procedure effectively prevents recoiling action and it should be considered equally safe as securing each end of wire mesh rolls.

OSHA agrees that methods other than "securing each end" are effective in preventing the mesh from recoiling, and therefore, has revised the provision to state the performance to be achieved and to allow employers to take whatever measures they feel are necessary to prevent recoiling action. OSHA feels the revised requirement provides a level of safety equal to that of the proposed rule and, therefore, promulgates paragraph (d)(2) as revised.

Paragraph (e) of the final rule sets forth requirements for the removal of formwork. Paragraph (e)(1) addresses the removal of the original forms and shores and paragraph (e)(2) addresses the removal of reshoring. The intent of these requirements is to prevent accidents such as the one that occurred on March 2, 1973, where 14 employees were killed and 34 employees were injured. In that accident, employees were removing the concrete forms supporting the 23rd floor of an apartment building under construction. The 23rd floor collapsed which caused the progressive failure of other floors of the apartment building. The fatalities and injuries resulted from the collapse of these floors. The National Bureau of Standards in a report for OSHA, concluded that premature removal of forms was a contributing factor to the building collapse (Ex. 3, p. 85). Observance of the existing provisions in the ANSI A10.9-1970 standard could have prevented this accident.

Observance of the final rule requirements in this paragraph, which eliminate the reference to ANSI and instead clearly set forth the requirements for formwork removal, will prevent similar accidents of this nature.

Paragraph (e)(1) prohibits the removal of forms and shores until the employer determines that the concrete has gained sufficient strength to support its weight and superimposed loads. To make this determination, compliance with one of the following alternatives is required. The first alternative is that the plans and specifications stipulate conditions for removal of forms and shores, and that such conditions have been followed. The second alternative is that the employer has tested the concrete with an appropriate ASTM standard test method designed to indicate concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

The proposed rule also sets forth two alternatives from which the employer could choose to determine the appropriate time for removal of forms and shores. As explained above, one of the alternatives in the final rule is essentially the same as one of the proposed alternatives, and the other is different. Further, both alternatives in the final rule differ from the existing rule (which OSHA incorporated by referencing the ANSI A10.9-1970 standard).

The existing rule (the ANSI standard) prohibits the premature removal of forms and requires that engineer's specifications and local building codes shall be adhered to in determining the length of time forms should remain in place following concrete placement. *In addition*, the existing rule requires that tests shall be made on field-cured concrete specimens [this typically meant that several cylinders would be filled with concrete from the same mix that was being placed at the jobsite, left to cure, and then later, the cylinders would be tested in a laboratory to determine the compressive strength of the concrete] in order to insure that the concrete has obtained sufficient strength to safely support the load prior to the removal of forms. The existing rule also provides a table that can be followed in those situations where engineer's specifications or local building codes are not used to control form removal time. This table is identified by OSHA in the proposed rule and discussed in the final rule as Table Q-1.

OSHA proposed in § 1926.705(d) to revise the existing rule allowing employers to choose between following the times listed in Table Q-1 or performing a test, using any ASTM test method that was designed to indicate the concrete compressive strength before removing forms and shores. If the test were chosen, the results would have to indicate that the concrete had gained sufficient strength to support its weight and superimposed loads. OSHA also proposed to revise the existing rule by changing the phrase "field-cured" to "appropriate ASTM standard," thereby allowing the employer to use any one of several test methods currently available to demonstrate compressive strength. This change recognizes technological changes made in testing for concrete strength and provides worker protection equivalent to the existing standard which recognizes only one method of testing the concrete (see discussion above on the cylinder test method). In addition to requesting comment on the proposed language, OSHA also raised four issues in the NPRM specific to

concrete testing. Each issue is discussed below. Because the comments received on the proposed provision are all directly related to one of the four issues raised in the NPRM, the comments will be set forth following each issue.

In Issue #1 OSHA asked for specific comment on whether or not it should require written procedures for testing concrete. OSHA explained that the Advisory Committee on Construction Safety and Health (ACCSH) (Ex.1) recommended that employers prepare written test procedures for testing concrete and make the test results available to the Secretary of Labor. Through this issue OSHA sought to determine the problems and benefits of a requirement for written test procedures. Several comments were received on this issue addressing written procedures. Four commenters (Exs. 14-29, 14-33, 14-36, and 14-40) stated that written test procedures would serve a useful purpose and would be beneficial. For example, Fred Berglund and Sons, Inc. (FBS) (Ex. 14-33) commented, " * * * test results for concrete would serve to show documentation for strength and material content * * * ." The BCTD (Ex. 14-40) commented as follows.

" * * * we believe that testing should be required before the formwork is removed; that the type of test may be prescribed by the engineer, but should provide accurate information about the condition of the concrete; that the procedures and results should be written and available * * * ."

" * * * making the test results available will act as a sort of check, to guarantee that the tests are properly and timely performed, and will let the employees know that they are working on a safe job * * * ."

However, many commenters (Exs. 14-8, 14-10, 14-20, 14-21, 14-27, 14-31, 14-35, 14-36, and 14-45) stated that written test procedures would serve no useful purpose, nor produce any benefit. For example, Scott Bridge Company (Ex. 14-21) commented, "If [concrete] tests are required, there are enough standardized procedures available that would make preparation of separate procedures by an employer an exercise in duplication." Bechtel (Ex. 14-35) also commented, " * * * few compliance officers are qualified or capable of reviewing plans and test data to determine their adequacy * * * ." Finally, the NCCSHAC (Ex. 14-16) commented as follows:

Each employer should be responsible for establishing form removal criteria specific to their equipment and requirements. Making such information available to others could entail publishing what may be considered proprietary information regarding procedures and equipment. Conscientious employers

who devote (or have devoted) time and financial resources toward establishing safe equipment and construction procedures should not be penalized by having to make this information available to less conscientious competitors.

It is apparent to OSHA, after reviewing the comments received on this issue, that it did not properly phrase Issue #1, since its intent was widely misunderstood. Specifically, the question was not, "Should employers have to develop a test method (procedures)?" as some commenters apparently thought. OSHA notes that it had already specified that an ASTM test method would have to be used. Rather, the question was, "Should the employer have a plan (procedure) for testing the concrete and should the results of the test(s) be kept at the jobsite for review? In asking this question, some assumptions were made; i.e., that tests would actually be performed and that ASTM test methods would be used. What OSHA sought to determine was *whether or not OSHA should require the employer to have a defined procedure to follow*. Such a procedure might give the following information: what ASTM test method was to be employed, when to conduct the test, and by whom the test would be performed. For example, a procedure might state that 4 days after floor number 1 was placed the concrete would be tested using ASTM Test Method "X" by XYZ Test Company to determine the strength reached. Such a procedure could, of course, be much more detailed. With this information established in written form, along with the results of the test, the employer should be able to determine whether the formwork could safely be removed.

After careful consideration of the comments received in response to Issue #1, OSHA has decided that no additional requirements will be added to this section. Because the majority of the commenters misunderstood the question being asked by OSHA, the information and evidence that was forthcoming was not useful to OSHA in determining whether or not employee safety would be enhanced if employers were required to document their testing procedures and if employers were required to document their test results. However, OSHA notes that its failure to require employers to document their test procedure or to document the results of their test does not, in any way, alter the requirements set forth in § 1926.703(e). Section 1926.703(e) requires that the forms and shores remain in place until the employer determines that the concrete has gained sufficient strength to support its weight and superimposed loads. The employer is given two

alternatives, one of which the employer must perform, to make such a determination. One alternative is to follow the plans and specifications (performing whatever tests are specified) and the other is to test the concrete using an appropriate ASTM test.

In Issue #2, OSHA requested specific comment on in-place testing methods—those methods in which the concrete is tested while it is still in the forms. OSHA indicated when raising this issue that it had received comments from interested individuals who recommended that only in-place testing of concrete should be permitted to evaluate the strength of concrete.

OSHA sought to determine whether there were any reasons related to employee safety that it should restrict concrete testing to in-place testing methods rather than allowing employers to conduct a compressive strength test on cylinders which is the typical practice. In response to Issue #2, the AGC (Ex. 14-31) commented as follows:

" * * * in-place method of concrete testing is not practical. In-place testing methods are not readily available to contractors, particularly small contractors. Cylinder testing when properly performed and in conformance with engineering specifications and building codes provides the necessary safeguards. Additional testing and training requirements would be redundant and require extra costs."

The State of California (Ex. 14-2) stated that both cylinder and in-place testing should be permitted because in-place testing may not be feasible in some cases such as underwater construction. Two other commenters supported in-place testing procedures. Miller and Long Concrete Construction, Inc. (MLCC) (Ex. 14-42) commented that in-place testing is the most accurate form of concrete testing because the test is performed on the concrete in the forms. The other commenter, BCTD (Ex. 14-40), commented as follows.

It is our view that in-place testing can most adequately determine whether the particular pour of concrete, in the particular location, under the particular circumstances, has reached the proper structural strength to permit the removal of the forms. However, other kinds of tests, prescribed by the engineer, which provide the same information, may also be adequate.

In consideration of the comments received in response to Issue #2, OSHA has determined that both in-place and cylinder tests are equally effective and both should be allowed as acceptable methods of testing concrete. This determination has been reflected in the final rule which allows the employer to perform any appropriate ASTM test

method designed to indicate the compressive strength of the concrete as one way of determining when to remove formwork.

In Issue #3, OSHA requested specific comment on the current industry practice for determining when forms may be removed. OSHA explained that the existing standard requires the concrete forms to be left in place for the length of time indicated by the engineering specifications, local building codes, or as specified in Table 2 of ANSI A10.9-1970 (Ex. 9) (identified as Table Q-1 in the NPRM) and then the concrete is to be tested. Through this issue OSHA sought to determine the current industry practice for determining when to remove forms.

In Issue #4, OSHA requested comment on whether or not it should require the employer to leave the forms in place for the time specified in Table Q-1 and also require the employer to test the concrete for strength before form removal. OSHA explained that the NPRM allowed the employer to choose either one of these methods to determine form removal time.

Several comments were received on these issues. Two comments indicated that the engineer or architect establishes the criteria for determining when the forms may be removed. For example, the AGC (Ex. 14-31) commented:

Industry practice with regard to concrete form removal has been to conform with engineering specifications. There are many factors which affect concrete strength, and thus concrete form removal. A minimum strength is generally set out in engineering specifications and that strength is determined through cylinder tests and/or required or specified periods of time.

Scott Bridge Company (Ex. 14-21) also stated that the current practice for highway bridge form removal is usually set forth in the specifications of highway or transportation departments.

Three commenters (Exs. 14-2, 14-27, and 14-33) stated that both the time table and concrete testing should be required to provide assurance that the concrete has attained sufficient strength to support loads safely; for example, FBS (Ex. 14-33) stated that allowing for both methods will reduce any error that may surface due to extraneous elements affecting one method and not the other.

Other commenters (Exs. 14-20, 14-21, 14-28, 14-31, 14-36, 14-37, and 14-45) stated that requiring the use of Table Q-1 and concrete testing before form removal would be redundant and delay project completion. For example, the AGC (Ex. 14-31) commented as follows.

With regard to provisions within the standard to require both testing and time, AGC believes that this requirement would be

unnecessarily restrictive. Concrete pours are made in accordance with specifications and in most cases entail testing. Requiring both methods (time and testing) would cause undue cost and possibly impact schedules.

John Hanson, OSHA's expert witness (Tr. I, 92) testified:

* * * minimum times given in Table Q-1 should not apply if the engineer, or in other words, the responsible person, has established longer times in the project documents. For that matter, in my opinion, they should not have to apply if the responsible engineer or architect has established a shorter time.

Dun-Par (Ex. 14-10) commented, " * * * the engineer of record should have the authority to deviate from those requirements [Table Q-1]. He [the engineer] is the one who designed the structure. He knows more about that building than anybody else." Finally, the AGC (Ex. 14-31) commented that industry practice with regard to concrete form removal has been to conform with engineering specifications.

After careful consideration of the comments and testimony received in both Issues #3 and #4, OSHA has determined that the engineering specifications or formwork plans often stipulate the conditions to be followed, including whatever tests are necessary, prior to the removal of formwork. This determination has caused OSHA to revise the proposed requirement for removal of forms and shores. In particular, OSHA has revised the provision to require that forms and shores (except for slabs on grade and slip forms) remain in place until the employer has determined that the concrete has reached sufficient strength to support its weight and superimposed loads. The employer must make this determination after having complied with one of two alternatives. As a result of the evidence and information received in response to Issues #3 and #4, the final rule has been revised to indicate that one of these alternatives is that the plans or specifications actually stipulate conditions for formwork removal, and the employer has followed those conditions.

An alternative proposed in paragraph (d)(1) of the NPRM, but deleted in the final rule would have allowed the employer to determine when to remove formwork by simply following the times listed in Table Q-1 of the NPRM. OSHA received several comments and several organizations testified at the hearing on the acceptability of Table Q-1 in lieu of an actual test.

The BCTD (Ex. 14-40) objected to the reliance on Table Q-1 to determine the time before removing formwork. They based their objection on, among other

things, the belief that employers would ignore the formwork removal variables. They felt that concrete should be tested for proper strength.

Dun-Par (Tr. II, 6) testified, "This Table Q-1 * * * is an antique." Ingvar Schousboe (Ex. 19) commented that concrete elements such as walls, columns, piers, and pile caps may be stripped of forms on the basis of elapsed time and temperature because the risk is low or nonexistent. However, he did not recommend the use of time for removal of forms from under floors. Mr. Schousboe based his recommendation on the need to know, by testing, the quality of the concrete that was delivered to the site.

The UBCJA (Tr. II, 40) testified as follows:

Of critical importance is the timing of form and shoring removal. OSHA has proposed a timetable Q-1 to be used for form removal. We want to reiterate our objections to the sole reliance on this time, since it does not take into account all of the many variables that can affect concrete strength and curing time.

They again stated their objection to the use of Table Q-1 in post hearing comments (Ex. 30).

The PCA (Ex. 14-5) recommended that the note regarding the minimum curing temperature precede Table Q-1 to provide greater emphasis on the effect of temperature on concrete curing. They also recommended that OSHA prohibit the use of Table Q-1 to remove forms and shores from under concrete containing fly ash or ground granulated iron blast furnace slag. They based their objection on the fact that concrete containing these materials has different strength gain characteristics than standard portland cement concrete. However, the commenter did not provide any information comparing the strength gain characteristics of fly ash concrete with standard portland concrete. OSHA requested comment in the hearing notice on the use of Table Q-1 for removing forms and shores from concrete containing fly ash or ground iron blast furnace slag. In the notice, OSHA stated that one commenter had recommended that such concrete should be tested before removal of forms. OSHA sought to determine whether the use of Table Q-1 should be prohibited for concrete containing these materials.

One person and one company testified at the hearing on this issue. The testimony disagreed with the comment made by the PCA.

John Hanson (Tr. I, 91) testified as follows:

It is well recognized that the strength-gain characteristics of pozzolan concretes are less

at early ages when compared to portland cement without pozzolans. However, Table Q-1, in my view, should be considered to represent the judgment of qualified people in the profession as to circumstances when, if the concrete has [not] been tested, the forms may be removed.

A representative from Blue Circle Holdings Inc. (Blue Circle) (Tr. I, 205) testified:

* * * Table Q-1 has been used quite successfully over many, many years and has done so at times where the finest and the activity of portland cements was much slower than we have in today's modern cements. This system worked very well for those years, and all of the changes in the construction procedures and the rate of strength gains for conventional portland cements and concrete have increased to the point that we still feel the Table Q-1 is quite relative and does provide an assurance of safety for the worker.

OSHA also requested comment in the hearing notice on the effect of lowering the temperature used in Table Q-1, explaining that Scott Bridge Company (Ex. 14-21) recommended that the temperature used in Table Q-1 be lowered to 40°F because the lower temperature is used in highway specifications for form removal.

One comment was received and two persons testified at the hearing on this issue. The comment and testimony did not support lowering the temperature in Table Q-1 from 50°F to 40°F. John Hanson (Ex. 18) commented as follows:

* * * it would be my view that it is important to stay very close to the ACI [American Concrete Institute] standard from which this table was taken on this matter, since the times represent a judgment of responsible professionals and their judgment was that this temperature should be 50 degrees fahrenheit.

Ingvar Schousboe (Tr. I, 141) testified, "The selected cutoff point for ambient temperature, 50°F or 40°F, if applied to the same time table can hardly be expected to give equally safe results."

Finally, Blue Circle's representative (Tr. I, 206) said the following:

With regard to reducing the temperature to below 50 degrees as noted in Table Q-1 to 40 degrees, we do not feel that this would be a prudent change in those structures that may be elevated and possibly present a problem when forms are removed. The hydration of portland cement is slowed down significantly at 40 degrees. In fact, some may state that the hydration hardly exists at 40-degree temperature * * *

However, after careful consideration of the comments and testimony on the use of Table Q-1, OSHA has determined that although following Table Q-1 is sometimes acceptable for determining when to remove certain formwork, sole reliance on the table is not sufficient for

determining if the concrete has indeed reached the strength needed to support its weight and all superimposed loads. Thus, if an employer relied exclusively on Table Q-1 to determine when to remove formwork, an appropriate level of safety may not be afforded to workers. OSHA does recognize that there are situations where simply waiting for time to pass may be acceptable, but such situations must be determined by a competent person such as the building engineer or the architect of record or by the formwork designer. In addition, evidence in the record, and discussed here, indicates there is widespread opposition to use of the table as proposed for a number of other reasons which cannot be substantiated or rejected by OSHA due to the lack of specific rationale provided with commenter objections. For example, many said too many variables affect the use of the table, but did not list the variables or discuss the basis for their statement. Also, a review of the most recent ANSI A10.9 standard, the 1983 version, shows that the nationally recognized standard for formwork removal is to determine that the concrete has sufficient strength to support its weight and total loads involved by conducting the type and number of tests as specified by the designer of the formwork. (ANSI allows the engineer/architect to determine what the strength should be if this is not indicated on the formwork drawings.) Consequently, OSHA has removed Table Q-1 as an alternative to following engineering specifications.

Paragraph (e)(2) of the final rule prohibits the removal of reshoring until the concrete has attained adequate strength to support its weight and all loads in place upon it. This provision is similar to proposed § 1926.705(e)(2) which was based on a provision in section 6 of the ANSI A10.9-1983 standard.

Three comments were received on the proposed provision concerning loads placed on the concrete. The PCA (Ex. 14-9) recommended that the words "normally expected" be added between the words "all" and "loads." The BCTD (Ex. 14-40) commented that the concrete should be supported until it has achieved the strength to support all loads which may foreseeably be imposed on it. WMACSA (Ex. 14-29) recommended that reshoring remain in place until the structure can support the loads imposed on it.

The comments indicated that the PCA, BCTD, and WMACSA misconstrued the intent of this provision. Each commenter recommended language to address loads to be imposed at a time after the

reshoring had been removed. However, OSHA's intent was to address loads that were actually being supported by the reshoring. In other words, if reshoring had been erected to support loads that the concrete was unable to support, then the reshoring could not be removed until the concrete has attained adequate strength to support its own weight and those loads—loads that were on the structure at the exact time that the reshoring was to be removed. The proposed provision did not address loads that would be imposed subsequent to the removal of reshoring. That is, it was not OSHA's intent that this provision conflict with § 1926.701(a) which prohibits placing any construction load on a concrete structure or portion of a concrete structure unless the employer determines, based on information received from a person who is qualified in structural design, that the structure or portion of the structure is capable of supporting the loads.

Because the commenters' concerns have been addressed via § 1926.701(a), no revision of the proposed paragraph is necessary except to revise the language to make it clear that the reshoring is to support the weight of the concrete and loads in place upon it. Therefore, OSHA promulgates paragraph (e)(2) as revised.

Section 1926.704 Requirements for precast concrete.

Section 1926.704 of the final rule contains the requirements for precast concrete. The requirements in this section were relocated from proposed § 1926.706 to promote a more logically organized standard.

Paragraph (a) of the final rule requires that precast concrete wall units, structural framing, and tilt-up wall panels be adequately supported to prevent overturning and to prevent collapse until permanent connections are completed. The intent of this provision is to prevent accidents such as the one that occurred on March 31, 1978, when one employee was killed. The employee was erecting a precast concrete wall panel and the panel fell and crushed the worker. The panel was not braced to prevent collapse (Ex. 6). The existing construction regulations do not contain a specific requirement addressing bracing of precast concrete panels, only the referenced ANSI A10.9-1970 does. However, the final rule requirements of this paragraph clearly set forth requirements for bracing precast members. Observance of these requirements will prevent accidents such as the one described here.

This paragraph has been relocated from § 1926.706(a)(1) of the proposal and

was based on section 9.4 of the ANSI A10.9-1983 standard which contains a similar provision. OSHA proposed that precast concrete wall units, structural framing, or tilt-up wall panels be laterally supported to resist overturning forces until permanent connections are completed. The final rule is the same as the proposed rule except the word "laterally" was replaced with "adequately," the word "or" was replaced with "and" and the phrase "to resist overturning forces" was revised to read "to prevent overturning and to prevent collapse."

OSHA received two comments and one person testified at the hearing on this provision of the proposed rule. The NEA (Ex. 14-22) agreed with the proposed rule. However, they commented, " * * * the completion of permanent connections should not be required in instances where precast panels are provided adequate temporary support prior to unhooking by temporary shoring, a temporary erection connection or part of a permanent connection." OSHA agrees with the commenter. OSHA does not intend for the final rule to require that precast concrete members be permanently secured prior to unhooking from the crane. The other commenter, WMACSA (Ex. 14-29), commented, "redefine to mean only precast concrete structural framing." However, the WMACSA did not explain the reasons for their recommendation. OSHA believes that employee injury could occur as a result of the collapse of any type of precast unit, including wall units and tilt-up wall panels, and that the proposed requirement to support such units has a direct bearing on employee safety. Therefore, it has not redefined the provision to apply only to precast structural members.

In addition to the written comments, OSHA's expert witness, John Hanson (Tr. I, 92), testified that the coverage of the proposed rule would be expanded by using the phrase "to resist overturning forces or collapse." OSHA agrees with the suggested change, acknowledging that its intent was to address the collapse of precast members.

After consideration of the above comments, OSHA determined that the proposed rule should be revised by replacing the word "laterally" with "adequately," the word "or" with "and," and revising the phrase "to resist overturning forces" to read "to prevent overturning and to prevent collapse." The word "laterally" was deleted because the record demonstrates that precast concrete members can be

supported from directions other than from their sides. Instead, OSHA has substituted the word "adequately" to allow the employer some flexibility to determine what type of support will prevent overturning and collapse of the precast members. The word "or" was changed to "and" because it may not be clear that any and all precast concrete wall units, structural framing members and tilt-up wall panels must be supported. The use of the word "or" may mistakenly lead employers to believe that if they are erecting one or more of the above types of precast members that they need only brace one "or" the other. OSHA intends that all precast members be adequately supported and so stated this intention when it discussed the proposed requirement at (50 FR 37549) where it used the word "and." Finally, OSHA clarified the purpose of this requirement by stating the reason for this provision—to prevent overturning and to prevent collapse. Therefore, OSHA promulgates paragraph (a) as revised.

Paragraph (b) specifies that lifting inserts which are embedded or otherwise attached to tilt-up wall panels must be capable of supporting twice the maximum intended load applied or transmitted to them. Paragraph (c) specifies that lifting inserts which are embedded or otherwise attached to precast concrete members, other than tilt-up members, must be capable of supporting at least four times the maximum intended load applied or transmitted to them. Paragraph (d) specifies that lifting hardware must be capable of supporting at least 5 times the maximum intended load applied or transmitted to the hardware.

Paragraphs (b) and (c) were relocated from proposed § 1926.706(a)(4)(i) and (ii) which are essentially the same as the final rule. Paragraph (d) was not listed in the proposed rule but is essentially the same as the existing requirement found in the ANSI A10.9-1970 standard which OSHA references. In fact, all of safety factors prescribed for precast operations are based on existing requirements in the OSHA references ANSI A10.9-1970 standard. OSHA observes that all these requirements are essentially the same as the requirements specified in Section 9 of the most recent ANSI standard, A10.9-1983.

OSHA received only one comment on the proposed provisions in paragraphs (b) and (c). The BCTD (Ex. 14-40) commented that OSHA was not completely clear that the proposal provided the same degree of protection as the ANSI standard on which OSHA based its proposed requirements. They

also indicated that their concern was with making certain that the support system as installed—and not the hardware in isolation—be required to meet the criteria established in ANSI's 1983 revisions. OSHA agrees with the BCTD and has added the phrase "which are embedded or otherwise attached to" in the final provisions to clarify the Agency's regulatory intent.

Additionally, the BCTD recommended that OSHA include ANSI's A10.9-1983 requirement that lifting hardware have a factor of safety of five. OSHA agrees that the lifting hardware should have a factor of safety greater than the lifting inserts and acknowledges that a failure to maintain a factor of safety of at least five could have a negative impact on worker safety. In fact, this is an existing requirement which OSHA inadvertently failed to include in the notice of proposed rulemaking. Therefore, OSHA promulgates paragraphs (b), (c), and (d) as revised.

Paragraph (e) of the final rule prohibits employees from being under precast concrete members being lifted or tilted into position except those employees required for the erection of those members. The intent of this provision is to limit employee exposure and prevent injury caused by being struck by falling precast members. This paragraph was relocated from § 1926.706(a)(3) of the proposal which prohibited employees from being under precast concrete members being lifted or tilted into position. The proposed rule was based on existing rules located in Sections 10.4 and 11.5 of the ANSI A10.9-1970 (Ex. 9) which applied to tilt-up and lift-slab operations, respectively. Since both these rules were similar, OSHA hoped to combine the provisions rather than have the same provision specified for each method of erection. OSHA observes that the most current ANSI standard for Concrete and Masonry Work, ANSI A10.9-1983, in Sections 9 and 10, also contains essentially similar provisions.

The final rule is essentially the same as the proposed rule, except that an exception for employees who are required for the erection of precast members has been made. OSHA observes that although this general requirement was originally intended to apply whenever a precast member was positioned—either by lifting, tilting or jacking (which would have included lift-slab operations)—the recent decision by OSHA to reopen the record on the lift-slab operations section, precludes the application of this provision to lift-slab operations. Instead, lift-slab employers will follow the existing requirements

which have been reprinted in the Appendix to § 1926.705 of this Final Rule.

OSHA received two comments on the proposed rule. The NEA (Ex. 14-22) stated that employees must spend some time under precast panels to align them with the existing structure. NIOSH (Ex. 14-39) comments supported the proposed rule; however, NIOSH wanted to know whether the proposed rule would apply to a worker on or underneath a precast member who was aligning the member with connector inserts. OSHA recognizes that some workers, those who are actively engaged in the erection of the member, must be allowed to work under the members which are being lifted or tilted into position. The final rule clearly reflects this allowance. All other employees, however, are prohibited at all times from being under those precast members. Therefore, OSHA promulgates paragraph (e) as revised.

Section 1926.705 Lift-slab operations.

Section 1926.705 of the final rule has been reserved for the unique requirements of lift-slab construction. Even though OSHA proposed specific requirements for lift-slab operations in § 1926.706(b) of the proposed rule, this section of the standard is not being finalized in this document. Instead, is the subject of a separate rulemaking effort. OSHA has determined that it is necessary to reopen the record to consider revision of the proposed rule on the standard addressing lift-slab construction. This would be done in order to address more adequately the information and evidence that will be introduced into the public record as a result of OSHA's investigation of the collapse in Bridgeport, Connecticut. Pending completion of the above action, the existing OSHA requirement to follow Section 11 of the American National Standard Safety Requirements for Concrete Construction and Masonry Work, ANSI A10.9-1970, remains in full force and effect for lift-slab construction. To aid employers in their compliance efforts, OSHA is reprinting these ANSI lift-slab requirements in the Appendix to § 1926.705. In addition, OSHA reminds employers that existing § 1926.305(a) and (b) also contain requirements relating to jacks used in the lift-slab operations.

Section 1926.706 Masonry construction.

Section 1926.706 of the final rule contains requirements for masonry construction. The intent of these provisions is to prevent accidents such as the one that occurred on May 19,

1976, in which two employees were killed. The two employees were tacking metal decking using an electric welder at a high school under construction (Ex. 4). A nearby masonry wall collapsed, struck the two employees, killing them. The existing construction regulations do not contain a specific requirement addressing bracing of masonry walls or limiting access to the collapse zone. However, the final rule requirements of this section clearly set forth requirements for protecting employees from masonry wall collapses. Observance of these requirements will prevent accidents such as the one described here.

Paragraph (a) of the final rule requires that the employer establish a limited access zone whenever a masonry wall is being constructed. Paragraph (a)(1) requires that the zone be established prior to the start of construction. Paragraph (a)(2) requires that the zone run a distance equal to the length of the wall and extend outward a distance equal to the height of the wall to be constructed, plus four feet. Paragraph (a)(3) requires the zone to be established on the side of the wall which will be unscaffolded. Paragraph (a)(4) requires that the employer limit access to the zone to only those employees who are actively engaged in constructing the wall. Paragraph (a)(5) requires the employer to keep the limited access zone in place until the wall is adequately supported to prevent overturning and to prevent collapse *unless* the height of the wall is over eight feet, then the limited access zone must remain in place until the requirements of paragraph (b) below have been met.

Paragraph (b) requires the employer to brace all masonry walls over eight feet in height to prevent overturning and to prevent collapse *unless* the wall is adequately supported so that it will not overturn or collapse. The bracing shall remain in place until permanent supporting elements of the structure are in place.

The requirements of the final rule differ substantially from the requirements of the proposed rule. The proposed rule, § 1926.707(a)(1), would have required all masonry walls to be laterally supported to resist horizontal forces where such walls were not capable of withstanding the forces that will be applied to them during construction. OSHA further proposed in § 1926.707(a)(2) that the lateral supports for masonry walls be capable of withstanding a load of 15 pounds per square foot applied to the wall. Section 1926.707(a)(2) has been deleted (see the

discussion under *Requirements Proposed but not Finalized below*). OSHA based its proposed requirements on the ANSI A10.9-1983 requirements for masonry construction.

In connection with the proposed requirements, OSHA raised a specific issue (Issue No. 10) in the NPRM to gather information to determine if lateral support were only needed at certain heights. OSHA asked, among other questions, if pilasters, partition walls, end walls, and masonry walls with reinforcement were adequate lateral supports, at what height should bracing be required, and the reasons why a particular height was recommended by the commenters.

Several comments were received on the proposed provisions and the specific issue, including the following:

CAL/OSHA (Ex. 14-2) commented:

After the first-story height, the walls should have lateral supports. Beyond 20 feet in height, the unsupported walls would probably collapse. They are usually supported by braces or tie-backs.

The NCCSHAC (Ex. 14-16) commented:

By the very nature of the circular cross-sections of masonry chimneys and liners, these units are "self-bracing." Further, chimney liners are not exposed to wind load. We therefore recommend that this paragraph be revised to read: Masonry walls (except for industrial chimneys and liners), exposed to wind or other forces, shall be temporarily braced until the design lateral strength of the wall is reached or supporting members are in place to resist such forces as may be applied to them during construction.

Associated General Contractors of Dallas (Ex. 14-8) commented:

The engineer's design (load bearing, non-load bearing) is complex and therefore the height of masonry walls requiring lateral support cannot be arbitrarily stated.

Safety Consultants (Ex. 14-25) commented:

Masonry walls while under construction should be shored to withstand a wind load of at least 80 mph and that shoring system should be approved and inspected by the structural design engineers.

Gilbane Building Company (Ex. 14-28) commented:

With regard to masonry walls, the recommendations in the masonry institute should be followed. There are too many conditions which must be considered by a competent engineer to give a firm answer at what height the walls should be laterally supported. This can vary from five feet to ten feet to twenty feet depending upon conditions and design. The major reason for determining the height of support is the amount of lateral load, i.e., wind that must be resisted.

The question of whether pilasters, partition walls, end walls, and masonry walls with reinforcement are adequate lateral support is one that must be answered by a competent engineer. It is dependent upon the lateral load that is placed on the wall that is being supported. If it is to act as a beam, it must be reinforced as a beam. If you expect it to act as a supported column, then it must be reinforced as one. These are decisions which must be made by a competent engineer, not by a regulatory agency such as OSHA.

The current industry practice is to provide lateral support for walls on both sides of the walls. As is known from the many failures and collapses that occur with the type of construction, this is not uniformly practiced.

The WMACSA (Ex. 14-29) suggested the provision be revised as follows:

Shoring and bracing. Masonry walls shall be temporarily shored and braced until designed lateral strength is reached to prevent collapse due to wind or other forces.

Technical Safety Associates (Ex. 14-34) commented that masonry walls over six (6) feet high should be temporarily shored and braced.

The National Constructors Association (Ex. 14-36) commented that OSHA should not specify the height of masonry walls requiring temporary lateral support, further stating that the proposed provision requires lateral support if and when it is needed, which is appropriate. The commenter identified seven variables which must be considered to determine the need for bracing.

General Shale Products Corp. (Ex. 14-43) questioned the reasonableness of OSHA's proposed bracing requirements and suggested that other approaches be considered such as limited access zones, posting of signs and barricading of potential hazards.

And finally, the Mason Contractors Association of America (MCAA) (Ex. 14-30) submitted a suggestion endorsed by employer groups, unions, and manufacturers, including the Mason Contractors Association of America, the National Concrete Masonry Association, the Portland Cement Association, the Brick Institute of America, the Bricklayers & Allied Craftmen International Union, the Laborers International Union of North America, and the International Masonry Institute. OSHA believes these groups constitute a balanced cross-section of all interests involved in masonry construction. They suggested establishing a limited access zone, which would be restricted to workers actively engaged in constructing the walls, and requiring the bracing of unsupported walls over 8 feet in height which are not capable of withstanding forces to be applied during construction. The MCAA also discussed the injury data available from OSHA's

Fatality and Catastrophe Abstracts involving masonry wall collapses and how they arrived at this consensus suggestion. According to the MCAA, the injury data they discussed included 20 incidents involving injuries and deaths. In 11 of the cases, the walls were not braced at all. In four of the cases, the walls had been braced, but the bracing had been removed prematurely. In another 4 cases, bracing was used, but the condition of the bracing rendered it ineffective.

These comments prompted OSHA to seek additional information in its hearing notice. In that notice, OSHA discussed the comment that had been received from the MCAA and which was supported by employer groups, unions, and manufacturers. OSHA also asked for accident data on wall collapses.

In response, OSHA heard from both its expert witnesses and several others who attended the hearing. OSHA's expert witness, John Hanson (Ex. 18) testified, "I do not believe that all walls with a nonsupported height of eight feet or less can be excluded from the requirement for bracing. It becomes a function of the width of that wall as well as the height of the wall." Mr. Hanson's statement led to questioning by others at the hearing. Specifically, the Safety Chairman of the Mason Contractors of Missouri, asked Mr. Hanson didn't he think that walls less than eight feet should be excluded from the bracing requirements (Tr. I, 99). After some discussion to clarify the question, Mr. Hanson responded by citing various factors that would have to be considered before deciding whether or not a wall under eight feet needed bracing. He also said, "There are many eight-foot walls that I would be willing to accept as not needing bracing, but there are many other eight-foot high walls in my mind would require bracing . . . therefore I do not believe a requirement based just on a matter of height alone is sufficient."

OSHA's other expert witness, Ingvar Schousboe also testified on the provision for masonry construction. He said, "For part (c) of that, I think it would be reasonable to consider the thickness limitation for an eight-foot high unbraced wall." (Tr. I, 142).

A representative from the International Masonry Institute, testifying on behalf of the Masonry Industry Committee (Tr. I, 148), restated the position put forth by MCAA (as discussed above, Ex. 14-30), in their written comment—creation of a limited access zone, exclusion of all walls under 8 feet from any bracing requirements, and requiring bracing for walls over 8

feet which were not capable of withstanding forces during construction. The representative commented that the revisions represented an informed consensus recommendation of groups familiar with the hazards of masonry construction, and urged OSHA to adopt their suggested revisions.

Upon completion of the MCAA's testimony, the representative was questioned on his thoughts on the statement made by OSHA's expert witness—that walls under 8 feet should not be excluded from bracing simply because of height. The MCAA representative commented, "The eight feet is certainly not a magic number. But it is a number that has been used as a kind of rule of thumb. In masonry construction, there are other items that are rules of thumb from past experience and common sense. Eight feet happens to be one of those numbers." He further commented that the eight feet was used by Factory Mutual in their prevention loss data and that he thought Factory Mutual considered masonry walls below eight feet not to pose a hazard.

It is evident from the comments received that there is a wide variety of opinions regarding the height at which a masonry wall should be braced. As discussed, the record shows recommendations ranging from 5 to 20 feet as the appropriate height. Few, if any, of the recommendations were accompanied by the evidence or support necessary for OSHA's use in promulgating a final rule. Nor was there adequate discussion or comment of the benefits of establishing a limited access zone in lieu of bracing walls with an unsupported height of eight feet or less.

Nonetheless, OSHA feels the record has adequately established that masonry walls do collapse and worker protection is needed (see discussion above and the NPRM at 37543). OSHA has decided, therefore, after carefully reviewing all the comments and testimony, the literature on average wind speed, and the accident data on wall collapses as previously discussed, that the suggestion put forth by the MCAA has merit, as reflected in the final rule. OSHA believes that creation of a limited access zone for all walls and the bracing of all unsupported walls over 8 feet in height, provides an appropriate level of protection to employees. The limited access zone will limit the number of employees exposed to the hazard to those employees who are actively engaged in constructing the wall and who most likely, would be on the side of the wall away from the collapse area. If the wall is 8 feet or under in height, the limited access zone

must remain in place until the wall is adequately supported to prevent overturning and collapse. Such support can be obtained as a result of the wall having reached sufficient strength to prevent overturning and collapse, having been permanently supported, or having been braced. However, if the wall is over eight feet in height and unsupported, the wall must be braced before the limited access zone can be removed and the bracing must remain in place until the permanent supporting elements of the structure are in place. OSHA believes that these provisions provide a level of safety equivalent to that which would have been afforded by the proposed requirement.

OSHA notes, however, that a part of the recommendation of the MCAA does not appear to be necessary for inclusion in the final rule. Specifically, OSHA has not included the language of the MCAA recommendation which seems to imply that masonry walls supported during construction by intersecting walls, piers, and pilasters will have adequate support to prevent overturning and collapse. While OSHA recognizes that intersecting walls, piers, and pilasters which are constructed as the wall is being constructed may indeed provide such support, OSHA also recognizes that it would be necessary to specify the number of intersecting walls, piers, and pilasters that would be needed based on the length of the wall being constructed if OSHA were to incorporate in the final rule, the entire recommendation of the MCAA. For example, OSHA does not believe that a wall 200 feet long would be sufficiently supported because it had one intersecting wall, located 10 feet from one end of the wall. In any event, such elaboration is unnecessary in the final rule since the provision has been written in performance language, requiring the employer to adequately brace all walls over 8 feet in height to prevent overturning and collapse. This provision, of course, as discussed above, does not apply where walls are sufficiently supported such that they are capable of withstanding the forces applied during construction that could cause overturning and collapse. Intersecting walls, piers, pilasters, and end walls as well as having reached their designed strength (self-support) are examples of support that may be used to withstand forces that could cause overturning and collapse. Thus, employers should consider many factors that are appropriate for determining which walls to brace and how to brace the walls. In light of the above, OSHA promulgates § 1926.706 as revised.

Requirements Proposed But Not Finalized

OSHA observes that there are several requirements in the proposed rule that it has decided not to finalize. First, OSHA proposed in § 1926.705(a)(3) that formwork be strengthened whenever reinforcing steel, materials, or equipment are stored on top of the formwork. There were several comments received on the proposed rule. Commenters (Exs. 14-9, 14-10, 14-11, and 18) pointed out that formwork may not require strengthening in all cases. They suggested that words like "if necessary" or "adequate" be placed in the rule for clarity. Two commenters (Exs. 19 and 14-29) suggested that this rule could be deleted since the rule in § 1926.703(a)(1) of the proposal already addressed the strength of formwork. After carefully considering all the comments received, OSHA agrees that § 1926.703(a)(1) adequately addresses the hazard which would have been regulated by § 1926.705(a)(3). OSHA, therefore, has decided not to finalize proposed § 1926.705(a)(3).

Two similar provisions proposed, but not promulgated, are found in §§ 1926.706(a)(2) and 1926.707(a)(2) of the proposal. Both of the proposed provisions required lateral supports to be capable of supporting a load of 15 pounds per square foot (PSF) applied to the precast units (§ 1926.706(a)) or to the masonry walls (§ 1926.707(a)). These two provisions are being discussed together because most commenters indicated that their comment applied to both provisions and both provisions have not been finalized for the same reason.

The proposed provision in § 1926.706(a)(1) was based on paragraph 10.3 of ANSI A10.9-1970 (Ex. 9) which is incorporated into OSHA's existing rule by reference. The proposed rule, however, did not specify the 10 psf limit of the A10.9-1970 standard, but instead, specified the 15 psf limit set forth in the updated A10.9-1983 ANSI concrete standard. The proposed provision in § 1926.707(a)(1) was also based on the ANSI A10.9-1983 standard.

OSHA received several comments on the proposed provisions. Three commenters (Exs. 14-9, 14-13, and 14-31) objected to increasing the support requirement from 10 pounds per square foot to 15 pounds per square foot. They objected to the proposed requirements because they contended that employees would not be working in 70 mile per hour winds and yet OSHA was requiring bracing equivalent to a wind load of 70 mph. For example, the AGC (Ex. 14-31) commented:

Excessive bracing, would cause additional employee exposure when requiring that lateral supports be capable of withstanding a load of 15 pounds per square foot (PSF). At 15 PSF walls could withstand winds in excess of 70 mph. Since OSHA's responsibility is employee safety, it would be realistic to believe that employees would not be exposed to a hazard as they would not be working in such weather conditions. Consequently this proposed requirement is not within the scope of OSHA's responsibilities.

Milwaukee Construction Industry Safety Council (Ex. 14-19) commented:

Requiring walls be braced to withstand a lateral force of 15 lbs is excessive. It requires a wind in excess of 70 mph to produce that amount of force * * * we suggest a requirement for a braced wall to withstand a force of 5 lbs psf is sufficient to protect employees without creating hazards associated with excessive bracing.

Another commenter, WMACSA (Ex. 14-29), requested that OSHA clarify whether the requirements for the temporary supports were for the total load, including bracing design, or just the wind load. The SSFI (Tr. I, 178) stated that OSHA should not specify in §§ 1926.706 and 1926.707 requirements for lateral support. The SSFI testified as follows:

These forces should not be specified in the OSHA standards. The reason is that one specified support force may not be appropriate for the varying circumstances on all job sites. The standard should affirmatively require that consideration for wall bracing should take into account such matters as the prevailing wind pressure load, mean wind speed gradients at various heights, wind directionality, terrain roughness and building geometry, wall location and time of the year. For example, there may be cases in which ground floor walls may require minimal support force, and subsequent levels require substantially greater bracing force requirements above 15 PSF. Because of these numerous variables, the Contractor and Engineer/Architect of record must be given the responsibility but, still, flexibility in providing adequate wind bracing support throughout the entire construction process.

After careful consideration of the comments and testimony received, OSHA has determined that the proposed rules discussed above are unnecessarily specific and redundant. OSHA observes that § 1926.704 (a) adequately addresses supporting precast members and § 1926.706 adequately addresses supporting masonry walls. OSHA feels worker safety would not be reduced if the proposed provisions in question were not promulgated since the hazards are adequately addressed in other provisions. Therefore, OSHA has not promulgated proposed §§ 1926.706(a)(2) or 1926.707(a)(2).

Additionally, OSHA proposed to delete a number of requirements which were specific to shoring operations. OSHA felt that these were redundant since the hazards addressed by the specific requirements were adequately addressed by the existing general requirements for shoring. OSHA received no comment on its proposal to delete these specific requirements for shoring and therefore, deletes these paragraphs as proposed. The following table lists the deleted specific requirement, the corresponding proposed general requirement, and the location of the general requirement in the final rule.

Existing	Proposed	Final
1926.700(e)(2)(i)	1926.705(a)(1)	1926.703(a)(1)
1926.700(e)(2)(ii)	1926.705(a)(1)	1926.703(a)(1)
1926.700(e)(2)(iii)	1926.705(a)(1)	1926.703(a)(1)
1926.700(e)(2)(iv)	1926.705(a)(1)	1926.703(a)(1)
1926.701(c)(1)	1926.705(c)(2)(ii)	1926.703(b)(3)
1926.701(c)(2)	1926.705(a)(1)	1926.703(a)(1)
1926.701(c)(3)	1926.705(a)(1)	1926.703(a)(1)
1926.701(d)(1)	1926.705(a)(1)	1926.703(a)(1)
1926.701(d)(4)	1926.705(a)(1)	1926.703(a)(1)
1926.701(d)(6)	1926.705(c)(2)(ii)	1926.703(b)(2)
1926.701(d)(7)	1926.705(c)(2)(ii)	1926.703(b)(2)
1926.701(d)(8)	1926.705(c)(2)(ii)	1926.703(b)(2)
1926.701(d)(9)	1926.705(c)(2)(ii)	1926.703(b)(2)
1926.701(d)(10)	1926.705(a)(1)	1926.703(a)(1)

Finally, OSHA Notes that it raised one issue in the NPRM and one issue in the hearing notice that have not resulted in a final requirement nor has OSHA discussed them in the final rule in relation to any of the proposed or finalized provisions.

The issue raised in the NPRM was Issue #11 in which OSHA stated that the proposed rule was generally written in performance language to provide flexibility for compliance and asked if any of the requirements in the proposal should be made more specific?

In response, the WMACSA (Ex. 14-29) commented, "It is essential that the new standard for concrete construction contain both specific and performance levels of compliance requirements." They went on the comment that, "It is almost irresponsible to promulgate standards with the great latitude offered in a 'Performance' concept."

Speaking for the need for specific standards, OSHA's expert witness, John Hanson (Ex. 18), testified, "I agree very strongly with the comment that it is almost irresponsible to promulgate standards with the great latitude offered in a performance concept." He also said, "Where the issue with respect to safety is clear or can be clearly defined, I believe that it is appropriate and preferable to establish a specific requirement. The danger with a specific requirements is that there may be special circumstances where it is

impractical to perform the construction without violating the requirement." To address these special circumstances, Mr. Hanson recommended that a statement be added in § 1926.700 to the effect that, "The requirements in this Subpart do not need to be met if circumstances are encountered which make the construction impractical. However, before any requirement is not met, alternative requirements shall be established that eliminate or control the hazard."

However, OSHA received a number of comments (Exs. 14-10, 14-16, 14-28, 14-31) which indicated agreement with performance standards, opposition to specification standards, and the need for flexibility. The AGC (Ex. 14-31) comment summarizes the vast majority of the comments received on this issue. The AGC wrote, "AGC believes that performance standards provide the most flexibility when applied to the construction industry. The general consensus is that specific standards preclude contractors from compliance because practicality has not been considered. Specific standards are not necessarily the safest method available."

CAL/OSHA (Ex. 14-2) commented that performance standards are probably more desirable throughout the industry.

OSHA observes that none of the commenters answered the specific question in the NPRM; i.e., "What if any of the requirements in the proposal should OSHA make more specific?" There being no comment on the need to revise any performance standards to specification standards, OSHA has not taken any action on this issue. OSHA appreciates the comments and opinions expressed on the issue of performance versus specification.

In the hearing notice, OSHA indicated that it had received several comments that recommended new regulations be established for the following tasks:

- (a) Flying Forms;
- (b) Natural Drafting Cooling Tower Construction;
- (c) Cleaning Concrete Pumping Systems;
- (d) Concrete Buggies;
- (e) Concrete Construction Housekeeping;
- (f) Storage and Handling of Concrete Blocks and Bricks;
- (g) Pretensioning and Post-tensioning Concrete; and
- (h) Handling and Storage of Precast Concrete Members.

OSHA asked for data, evidence, and documentation to demonstrate risks associated with the above listed tasks and asked for suggested ways to control these risks.

OSHA received little additional information in response to this issue. OSHA did hear testimony from its expert witness, John Hanson (Ex. 18), who said that he agreed with the comments that additional regulation were needed in a number of areas. The data, evidence and documentation to support the recommendations, however, were not forthcoming.

The data, evidence, and documentation received in response to this issue was so limited that it was insufficient to enable OSHA to determine if additional regulation is needed. Therefore, no action has been taken at this time in response to the issue raised in the hearing notice with the exception of issue (g) which has been discussed above in connection with § 1926.701(c)(1) and (2). Additionally, OSHA observes that some of the items listed are already covered in some detail by existing Part 1926 regulations. For example, Subpart C addressed housekeeping for all construction sites. The hazards associated with storage and handling of materials are addressed in Subpart H. Thus, the concerns of commenters regarding items (e), (f), (g), and (h) above have been addressed. OSHA will continue its efforts to determine if additional regulation in any of the areas listed is needed.

IV. Summary of the Regulatory Impact and Regulatory Flexibility Assessment

Introduction

Executive Order 12291 (46 FR 13197, February 19, 1981) requires that a regulatory analysis be conducted for any rule having major economic consequences on the national economy, geographical regions, individual industries, or levels of government. In addition, the Regulatory Flexibility Act of 1980 (Pub. L. 96-353, 94 Stat. 1164 (5 U.S.C. 601 *et seq.*)) requires the Occupational Safety and Health Administration (OSHA) to determine whether the proposed regulation will have a significant economic impact on a substantial number of small entities.

Consistent with these requirements, OSHA has prepared a Final Regulatory Impact and Regulatory Flexibility Assessment for the current and revised standards governing Concrete and Masonry Construction. This analysis includes a profile of affected firms and industries, a description of the regulatory and nonregulatory alternatives, estimates of the benefits and the costs of full compliance for both the existing and revised standards, and the potential economic and

environmental impacts. The complete analysis, as summarized in this section, is based on data and information provided by JACA Management Consultants in *An Economic Impact Statement/Technological Feasibility Study of the Proposed Revisions to Subpart Q Part 1926.700 Through 1926.702*, which is available in the rulemaking record and on additional information submitted to the record.

The Secretary has determined that this action would not be a "major rule" as defined by section 3(b) of Executive Order 12291 as it will not have an annual effect on the economy of \$100 million or more, cause major increases in costs or prices for individual industries, or have any other significant adverse effects. The Secretary also certifies that this action will not have a significant impact on a substantial number of small entities as defined by the Regulatory Flexibility Act. The Final Regulatory Impact and Regulatory Flexibility Assessment is available for inspection and copying in the rulemaking docket.

Statement of the Problem and Summary of Industry Profile

The existing standards governing safety hazards associated with concrete and masonry construction in Subpart Q of 29 CFR Part 1926 were adopted in 1971 with only minor revisions since that time. A number of factors have led OSHA to propose revisions to Subpart Q at this time. First, the requirements of the standard are complicated and confusing as a result of the incorporation by reference of the American National Standards Institute (ANSI) standard for concrete, formwork, and shoring (ANSI A10.9-1970). The ANSI standard, in turn, references that of the American Concrete Institute (ACI No. 347). Thus, the contractor who wishes to comply with OSHA regulations would need to refer to up to three overlapping, and possibly conflicting, sets of rules. To further complicate matters, Subpart Q only requires that any equipment and materials that are used meet ANSI standards, not that the equipment itself be used. Moreover, both ANSI and ACI have updated their standards but the existing Subpart Q still refers to the old ANSI standard.

In addition to these difficulties, Subpart Q is becoming increasingly out of date, creating gaps in coverage. Hazards associated with the collapse of masonry walls have never been adequately covered. Newer technologies, such as the use of precast concrete, are not addressed by the standard, and techniques for in-place

testing of concrete are inadequately considered.

A final difficulty has been that Subpart Q's requirements for formwork design and removal have been very narrowly interpreted by Administrative Law Judges. The standard requires that they be adequate during the placement of concrete. This has been interpreted to mean that formwork that collapsed immediately before or after placement was not in violation of the standard.

For all of these reasons, OSHA is revising Subpart Q at this time. The three major purposes of the revisions are to clarify and simplify the standard, to cover inadequately addressed hazards, and to incorporate recent advances in concrete construction technology.

Concrete and masonry work occurs across a broad range of four-digit Standard Industrial Classification (SICs) codes within the construction industry. OSHA has determined that the proposal would affect all of SIC 15 (Building Construction), and all but SIC 1611, (Street and Highway Construction) in SIC 16. In SIC 17, SICs 1741 (Masonry), 1751 (Carpentering), 1771 (Concrete Work), 1794 (Excavation and Foundation Work), and 1799 (Special Trade Contractors Not Elsewhere Classified) would also be affected. OSHA has assumed that virtually all firms with paid employees within these affected SICs would be affected by the standard, although this is doubtlessly an overestimate, particularly for special trade contractors. There were 246,975 firms in these SICs in 1984.

OSHA has also estimated the amount of construction that would be affected by the revised standard. It is estimated to affect about 12.6 percent of total new construction, or about \$48.8 billion in 1987. OSHA has also estimated the affected population in several ways. The best estimate of the population potentially at risk is about 503,369 full-time equivalent workers in 1987.

Costs, Benefits and Feasibility

OSHA has estimated the actual compliance costs required by the existing standard and the incremental costs for the revised standard. Annualized costs of compliance with the current standard would be approximately \$5.6 million. Full compliance with the revised standard would cost approximately an additional \$38.2 million. These costs do not include estimates for any changes in the lift-slab provisions as these will be addressed in a separate Federal Register notice.

Based solely on the fatalities avoided, this would translate into a cost per fatality avoided of about \$119,000 for

coming into full compliance with the existing standard and about \$516,000 per fatality avoided for the incremental costs of the revised standard. These costs and thus the cost per fatality avoided would of course also be offset by the lost workday and nonlost workday injuries avoided and the cost savings related to property losses.

OSHA has also estimated the potential cost savings resulting from concrete and masonry accidents that would more than offset the increased costs of compliance. These cost savings resulted from the indirect costs of accidents such as property damage, scheduling delays, increased insurance premiums, and lost worktime. Based on the number of fatalities and injuries that will be avoided under full compliance it is estimated that these cost savings would be about \$348 million annually.

OSHA has calculated the maximum impact on profits of the revised standard, assuming a worst case where contractors would bear all of the costs. Due to the incremental costs, the largest potential impact of the proposed standard would be on Masonry and Stonework which could experience a 55 percent decline in return on assets, from 6.5 percent to 2.9 percent. OSHA has also estimated the potential impact on output and employment. The impacts are expected to be quite small for all industries except Masonry and Stonework where there is potential for output and employment declines of about 2.65 percent.

The revised standard would be more protective than is the current standard. Full compliance with the present Subpart Q would prevent an estimated 47 fatalities, 2,259 lost workday injuries, and 1,689 nonlost workday injuries annually. Full compliance with the revised standard would prevent an additional 74 fatalities, 1,556 lost workday injuries and 1,469 nonlost workday injuries annually.

Regulatory Flexibility Assessment

OSHA has evaluated the expected cost of compliance for small entities. For the purpose of this analysis, a small entity has been defined as a firm having nine or fewer employees. Approximately 82 percent of the affected firms would fall within this size category. OSHA has estimated that even in Masonry and Stonework, where the impact is potentially the greatest, the cost per firm would be approximately \$339 for the smallest size class. In addition, the standard would not require large capital expenditures or any sort that would put small firms, with limited access to funds, at a relative disadvantage. Nor is

special technical expertise required for compliance that would be beyond the resources of small firms.

For the above reasons, and pursuant to the Regulatory Flexibility Act, OSHA certifies that, while the revised standard may affect a substantial number of small entities, it is not expected to have a significant economic impact for these small entities.

Environmental Impact Assessment— Finding of No Significant Impact

This standard has been reviewed in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4231 *et seq.*), the guidelines of the Council on Environmental Quality (CEQ) (40 CFR Part 1500), and OSHA's DOL NEPA Procedures (29 CFR Part 11). As a result of this review, the Assistant Secretary for OSHA has determined that the revised rule would have no significant environmental impact.

The revisions consist primarily of work practices and procedures, including requirements for reinforcing steel, concrete placement, equipment, formwork, precast concrete, and masonry construction. In addition the revisions include a clarification of the language of the subpart to eliminate ambiguities, uninformative provisions, and redundancies found in the existing standards. To the extent that these safety procedures are in place and are integrated into daily construction operations, the potential for occupational accidents and injuries will be reduced and the safety of the workplace will be enhanced. These changes will not affect the environment outside the workplace and are generally excluded under Subpart B, § 11.10 of the DOL NEPA Regulations (29 CFR Part 11) because they are unlikely to influence air, water or soil quality, plant or animal life, the use of land or other aspects of the environment.

Although activities in the vicinity of construction work as well as the disposal of materials removed from construction sites may tend to impact on the local environment, there is no reason to believe that there will be any adverse impact on air, water or soil quality beyond what will ordinarily occur from such construction operations. That is, the revisions will not alter the nature of these operations, nor further affect the makeup or disposal of the material generated or removed during concrete and masonry construction work.

V. OMBV Approval Under the Paperwork Reduction Act

This subpart contains a collection of information in § 1926.703(a)(3). This

provision requires employers to maintain a copy of their formwork plans at the job site. OMB has reviewed this collection and approved it through June 1991. The approval number is 1218-0095.

VI. State Plan Requirements

The 25 States with their own OSHA-approved occupational safety and health plans must review their existing standard within six months of the publication date of the final standard or show OSHA why there is no need for action, e.g., because an existing State standard covering this area is already "at least as effective" as the revised Federal standard. These States are: Alaska, Arizona, California, Connecticut (State and local government workers only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York (State and local government workers only), North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington and Wyoming.

List of Subjects in 29 CFR Part 1926

Concrete placement, Construction safety, Formwork, Masonry Construction, Occupational safety and health, Precast concrete.

VII. Authority

This document was prepared under the direction of John A. Pendergrass, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, Third and Constitution Avenue, NW., Washington, DC 20210.

Accordingly, pursuant to sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (84 Stat. 1593, 29 U.S.C. 653, 655, and 657); section 107 of the Contract Work Hours and Safety Standards Act (38 Stat. 96, 40 U.S.C. 333); Secretary of Labor's Order No. 9-83 (48 FR 35736); and 29 CFR Part 1911, Subpart Q of Part 1926 of Title 29 of the Code of Federal Regulations is amended as set forth below.

Signed at Washington, DC, this 10th day of June 1988.

John A. Pendergrass,
Assistant Secretary of Labor.

Part 1926 of Title 29 of the Code of Federal Regulations is amended as follows:

PART 1926—[AMENDED]

1. By revising Subpart Q of 29 CFR Part 1926 to read as follows:

Subpart Q—Concrete and Masonry Construction

- Sec.
- 1926.700 Scope, application, and definitions, applicable to this subpart.
 - 1926.701 General requirements.
 - 1926.702 Requirements for equipment and tools.
 - 1926.703 Requirements for cast-in-place concrete.
 - 1926.704 Requirements for precast concrete.
 - 1926.705 Requirements for lift-slab operations.
 - 1926.706 Requirements for masonry construction.

Appendix A to Subpart Q—References to Subparts of Part 1926

Subpart Q—Concrete and Masonry Construction

Authority: Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, and 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, and 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 3536), as applicable; and 29 CFR Part 1911.

§ 1926.700 Scope, application, and definitions applicable to this subpart.

(a) *Scope and application.* This subpart sets forth requirements to protect all construction employees from the hazards associated with concrete and masonry construction operations performed in workplaces covered under 29 CFR Part 1926. In addition to the requirements in Subpart Q, other relevant provisions in Parts 1910 and 1926 apply to concrete and masonry construction operations.

(b) *Definitions applicable to this subpart.* In addition to the definitions set forth in § 1926.32, the following definitions apply to this subpart.

(1) "Bull float" means a tool used to spread out and smooth concrete.

(2) "Formwork" means the total system of support for freshly placed or partially cured concrete, including the mold or sheeting (form) that is in contact with the concrete as well as all supporting members including shores, reshores, hardware, braces, and related hardware.

(3) "Lift slab" means a method of concrete construction in which floor, and roof slabs are cast on or at ground level and, using jacks, lifted into position.

(4) "Limited access zone" means an area alongside a masonry wall, which is under construction, and which is clearly demarcated to limit access by employees.

(5) "Precast concrete" means concrete members (such as walls, panels, slabs, columns, and beams) which have been

formed, cast, and cured prior to final placement in a structure.

(6) "Reshoring" means the construction operation in which shoring equipment (also called reshores or reshoring equipment) is placed, as the original forms and shores are removed, in order to support partially cured concrete and construction loads.

(7) "Shore" means a supporting member that resists a compressive force imposed by a load.

(8) "Vertical slip forms" means forms which are jacked vertically during the placement of concrete.

§ 1926.701 General requirements

(a) *Construction loads.* No construction loads shall be placed on a concrete structure or portion of a concrete structure unless the employer determines, based on information received from a person who is qualified in structural design, that the structure or portion of the structure is capable of supporting the loads.

(b) *Reinforcing steel.* All protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement.

(c) *Post-tensioning operations.* (1) No employee (except those essential to the post-tensioning operations) shall be permitted to be behind the jack during tensioning operations.

(2) Signs and barriers shall be erected to limit employee access to the post-tensioning area during tensioning operations.

(d) *Riding concrete buckets.* No employee shall be permitted to ride concrete buckets.

(e) *Working under loads.* (1) No employee shall be permitted to work under concrete buckets while buckets are being elevated or lowered into position.

(2) To the extent practical, elevated concrete buckets shall be routed so that no employee, or the fewest number of employees, are exposed to the hazards associated with falling concrete buckets.

(f) *Personal protective equipment.* (1) No employee shall be permitted to apply a cement, sand, and water mixture through a pneumatic hose unless the employee is wearing protective head and face equipment.

(2) No employee shall be permitted to place or tie reinforcing steel more than six feet (1.8 m) above any adjacent working surface unless the employee is protected by the use of a safety belt or equivalent fall protection meeting the criteria of Subpart E of this part.

§ 1926.702 Requirements for equipment and tools.

(a) *Bulk cement storage.* (1) Bulk storage bins, containers, and silos shall be equipped with the following:

- (i) Conical or tapered bottoms; and
- (ii) Mechanical or pneumatic means of starting the flow of material.

(2) No employee shall be permitted to enter storage facilities unless the ejection system has been shut down, locked out, and tagged to indicate that the ejection system is not to be operated.

(b) *Concrete mixers.* Concrete mixers with one cubic yard (.8 m³) or larger loading skips shall be equipped with the following:

- (1) A mechanical device to clear the skip of materials; and

- (2) Guardrails installed on each side of the skip.

(c) *Power concrete trowels.* Powered and rotating type concrete troweling machines that are manually guided shall be equipped with a control switch that will automatically shut off the power whenever the hands of the operator are removed from the equipment handles.

(d) *Concrete buggies.* Concrete buggy handles shall not extend beyond the wheels on either side of the buggy.

(e) *Concrete pumping systems.* (1) Concrete pumping systems using discharge pipes shall be provided with pipe supports designed for 100 percent overload.

(2) Compressed air hoses used on concrete pumping system shall be provided with positive fail-safe joint connectors to prevent separation of sections when pressurized.

(f) *Concrete buckets.* (1) Concrete buckets equipped with hydraulic or pneumatic gates shall have positive safety latches or similar safety devices installed to prevent premature or accidental dumping.

(2) Concrete buckets shall be designed to prevent concrete from hanging up on top and the sides.

(g) *Tremies.* Sections of tremies and similar concrete conveyances shall be secured with wire rope (or equivalent materials in addition to the regular couplings or connections).

(h) *Bull floats.* Bull float handles, used where they might contact energized electrical conductors, shall be constructed of nonconductive material or insulated with a nonconductive sheath whose electrical and mechanical characteristics provide the equivalent protection of a handle constructed of nonconductive material.

(i) *Masonry saws.* (1) Masonry saws shall be guarded with a semicircular enclosure over the blade.

(2) A method for retaining blade fragments shall be incorporated in the design of the semicircular enclosure.

(j) *Lockout/Tagout Procedures.* (1) No employee shall be permitted to perform maintenance or repair activity on equipment (such as compressors, mixers, screens or pumps used for concrete and masonry construction activities) where the inadvertent operation of the equipment could occur and cause injury, unless all potentially hazardous energy sources have been locked out and tagged.

(2) Tags shall read *Do Not Start* or similar language to indicate that the equipment is not to be operated.

§ 1926.703 Requirements for cast-in-place concrete.

(a) *General requirements for formwork.* (1) Formwork shall be designed, fabricated, erected, supported, braced and maintained so that it will be capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork. Formwork which is designed, fabricated, erected, supported, braced and maintained in conformance with the Appendix to this section will be deemed to meet the requirements of this paragraph.

(2) Drawings or plans, including all revisions, for the jack layout, formwork (including shoring equipment), working decks, and scaffolds, shall be available at the jobsite.

(b) *Shoring and reshoring.* (1) All shoring equipment (including equipment used in reshoring operations) shall be inspected prior to erection to determine that the equipment meets the requirements specified in the formwork drawings.

(2) Shoring equipment found to be damaged such that its strength is reduced to less than that required by § 1926.703(a)(1) shall not be used for shoring.

(3) Erected shoring equipment shall be inspected immediately prior to, during, and immediately after concrete placement.

(4) Shoring equipment that is found to be damaged or weakened after erection, such that its strength is reduced to less than that required by § 1926.703(a)(1), shall be immediately reinforced.

(5) The sills for shoring shall be sound, rigid, and capable of carrying the maximum intended load.

(6) All base plates, shore heads, extension devices, and adjustment screws shall be in firm contact, and

secured when necessary, with the foundation and the form.

(7) Eccentric loads on shore heads and similar members shall be prohibited unless these members have been designed for such loading.

(8) Whenever single post shores are used one on top of another (tiered), the employer shall comply with the following specific requirements in addition to the general requirements for formwork:

(i) The design of the shoring shall be prepared by a qualified designer and the erected shoring shall be inspected by an engineer qualified in structural design.

(ii) The single post shores shall be vertically aligned.

(iii) The single post shores shall be spliced to prevent misalignment.

(iv) The single post shores shall be adequately braced in two mutually perpendicular directions at the splice level. Each tier shall also be diagonally braced in the same two directions.

(9) Adjustment of single post shores to raise formwork shall not be made after the placement of concrete.

(10) Reshoring shall be erected, as the original forms and shores are removed, whenever the concrete is required to support loads in excess of its capacity.

(c) *Vertical slip forms.* (1) The steel rods or pipes on which jacks climb or by which the forms are lifted shall be—

(i) Specifically designed for that purpose; and

(ii) Adequately braced where not encased in concrete.

(2) Forms shall be designed to prevent excessive distortion of the structure during the jacking operation.

(3) All vertical slip forms shall be provided with scaffolds or work platforms where employees are required to work or pass.

(4) Jacks and vertical supports shall be positioned in such a manner that the loads do not exceed the rated capacity of the jacks.

(5) The jacks or other lifting devices shall be provided with mechanical dogs or other automatic holding devices to support the slip forms whenever failure of the power supply or lifting mechanism occurs.

(6) The form structure shall be maintained within all design tolerances specified for plumbness during the jacking operation.

(7) The predetermined safe rate of lift shall not be exceeded.

(d) *Reinforcing steel.* (1) Reinforcing steel for walls, piers, columns, and similar vertical structures shall be adequately supported to prevent overturning and to prevent collapse.

(2) Employers shall take measures to prevent unrolled wire mesh from

recoiling. Such measures may include, but are not limited to, securing each end of the roll or turning over the roll.

(e) *Removal of formwork.* (1) Forms and shores (except those used for slabs on grade and slip forms) shall not be removed until the employer determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Such determination shall be based on compliance with one of the following:

(i) The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

(ii) The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

(2) Reshoring shall not be removed until the concrete being supported has attained adequate strength to support its weight and all loads in place upon it.

Appendix to § 1926.703(a)(1)

General Requirements for Formwork

(This Appendix is non-mandatory.)

This appendix serves as a non-mandatory guideline to assist employers in complying with the formwork requirements in § 1926.703(a)(1). Formwork which has been designed, fabricated, erected, braced, supported and maintained in accordance with Sections 6 and 7 of the American National Standard for Construction and Demolition Operations—Concrete and Masonry Work, ANSI A10.9-1983, shall be deemed to be in compliance with the provision of § 1926.703(a)(1).

(Information collection requirements contained in paragraph (a)(2) were approved by the Office of Management and Budget under control number 1218-0095)

§ 1926.704 Requirements for precast concrete.

(a) Precast concrete wall units, structural framing, and tilt-up wall panels shall be adequately supported to prevent overturning and to prevent collapse until permanent connections are completed.

(b) Lifting inserts which are embedded or otherwise attached to tilt-up precast concrete members should be capable of supporting at least two times the maximum intended load applied or transmitted to them.

(c) Lifting inserts which are embedded or otherwise attached to precast concrete members, other than the tilt-up members, shall be capable of supporting at least four times the maximum intended load applied or transmitted to them.

(d) Lifting hardware shall be capable of supporting at least five times the maximum intended load applied or transmitted to the lifting hardware.

(e) No employee shall be permitted under precast concrete members being lifted or tilted into position except those employees required for the erection of those members.

§ 1926.705 Requirements for lift-slab operations.

In addition to the general requirements of this Subpart, employers engaged in lift-slab operations shall comply with the existing specific requirements for lift-slab operations which are prescribed in ANSI A10.9-1970. These requirements, found in Section 11 of the American National Standard Safety Requirements for Concrete Construction and Masonry Work, ANSI, A10.9-1970, are reprinted in the Appendix to this section. In addition, there are applicable requirements in § 1926.305 (a) and (b) of the Construction Safety and Health Standards which apply to jacks in general, and jacks used specifically in lift-slab construction.

Appendix to § 1926.705—Lift-Slab Operations

(Reprinted from ANSI A10.9-1970)

(This Appendix is Mandatory.)

Section 11. Lift-Slab Operations

11.1 General. The safety requirements and recommendations in Section 11 apply specifically to lift-slab construction operations.

11.2 Design and Planning. Lift-slab operations shall be designed and planned by a qualified professional engineer or architect. Such plans and designs shall include detailed instructions and sketches indicating the prescribed method of erection.

11.3 Jacking Equipment.

11.3.1 Jacking equipment shall not be loaded beyond its safe working capacity, and then threaded rods and other members that transmit loads to the jacks shall have a minimum safety factor of 2.5. Jacking equipment used in lift-slab operations shall meet the criteria in 11.3.1 through 11.3.4. (Note: ANSI has interpreted this provision to mean that the safety factor of 2.5 must be met for all jacking components such as jacks, threaded rods, lifting nuts, lifting angles, as well as shearheads, columns and footings).

11.3.2 Jacks shall be so designed and installed so that they will not continue to lift when overloaded.

11.3.3 Jacks shall be installed with a safety device which will enable them to continue to support the load in any position should the jack malfunction and lose its lifting ability.

11.3.4 The maximum number of manually-controlled jacks on one slab shall be limited to 14, and in no event should the number be

too great to permit the operator to maintain the slab level within specified tolerances.

11.4 Uniform Lifting. Jacking operations shall be synchronized in such a manner as to insure even and uniform lifting of the slab. During lifting, all points of the slab support shall be kept within one-half inch of that needed to maintain the slab in a level position. If leveling is automatically controlled, a device shall be installed which will stop the operation when the one-half-inch tolerance is exceeded or when there is a malfunction in the jacking system. If level is maintained by manual controls, such controls shall be located in a central location and attended by a trained operator while lifting is in progress.

11.5 Falling Hazard. No one shall be permitted under the slab during jacking operations. (Note: ANSI has interpreted this provision as follows: "No one is permitted in the building during jacking operations except those employees required for the jacking operation and to secure slabs.

§ 1926.706 Requirements for masonry construction.

(a) A limited access zone shall be established whenever a masonry wall is being constructed. The limited access zone shall conform to the following.

(1) The limited access zone shall be established prior to the start of construction of the wall.

(2) The limited access zone shall be equal to the height of the wall to be constructed plus four feet, and shall run the entire length of the wall.

(3) The limited access zone shall be established on the side of the wall which will be unscaffolded.

(4) The limited access zone shall be restricted to entry by employees actively engaged in constructing the wall. No other employees shall be permitted to enter the zone.

(5) The limited access zone shall remain in place until the wall is adequately supported to prevent overturning and to prevent collapse unless the height of wall is over eight feet, in which case, the limited access zone shall remain in place until the requirements of paragraph (b) of this section have been met.

(b) All masonry walls over eight feet in height shall be adequately braced to prevent overturning and to prevent collapse unless the wall is adequately supported so that it will not overturn or collapse. The bracing shall remain in place until permanent supporting elements of the structure are in place.

Appendix A to Subpart Q—References to Subpart Q of Part 1926

(This Appendix is non-mandatory.)

The following non-mandatory references provide information which can be helpful in understanding and complying with the requirements contained in Subpart Q.

- Accident Prevention Manual for Industrial Operations; Eighth Edition; National Safety Council.
- Building Code Requirements for Reinforced Concrete (ACI 318-83).
- Formwork for Concrete (ACI SP-4).
- Recommended Practice for Concrete Formwork (ACI 347-78).

- Safety Requirements for Concrete and Masonry Work (ANSI A10.9-1983).

- Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens (ASTM C39-86).

- Standard Test Method for Making and Curing Concrete Test Specimens in the Field (ASTM C31-85).

- Standard Test Method for Penetration Resistance of Hardened Concrete (ASTM C803-82).

- Standard Test Method for Compressive Strength of Concrete Cylinders Cast In-Place in Cylindrical Molds (ASTM C873-85).

- Standard Method for Developing Early Age Compressive Test Values and Projecting Later Age Strengths (ASTM C918-80).

- Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction (ASTM E329-77).

- Method of Making and Curing Concrete Test Specimens in the Laboratory (ASTM C192-88).

- Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete (ASTM C42-87).

- Methods of Securing, Preparing and Testing Specimens from Hardened Lightweight Insulating Concrete for Compressive Strength (ASTM C513-86).

- Test Method for Comprehensive Strength of Lightweight Insulating Concrete (ASTM C495-86).

- Method of Making, Accelerating Curing, and Testing of Concrete Compression Test Specimens (ASTM C684-81).

- Test Method for Compressive Strength of Concrete Using Portions of Beams Broken in Flexure (ASTM C116-68 (1980)).

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