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Thursday  
August 13, 1998

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**Part II**

**Department of Labor**

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**Occupational Safety and Health  
Administration**

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**29 CFR Part 1926  
Safety Standards for Steel Erection;  
Proposed Rule**

**DEPARTMENT OF LABOR****Occupational Safety and Health Administration****29 CFR Part 1926**

[Docket No. S-775]

RIN No. 1218-AA65

**Safety Standards for Steel Erection**

**AGENCY:** Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.

**ACTION:** Proposed rule; Notice of hearing.

**SUMMARY:** The Occupational Safety and Health Administration (OSHA) proposes to revise the construction industry safety standards addressing steel erection. The intent of this revision is to enhance the protections provided to workers engaged in steel erection and to update and strengthen the general provisions that address steel erection. This proposal contains requirements for hoisting and rigging, structural steel assembly, beam and column connections, joist erection, pre-engineered metal building erection, fall protection and training. The proposed requirements address significant hazards in the steel erection industry. The principal hazards addressed by this proposal are those associated with working under loads; hoisting, landing and placing decking; column stability; double connections; hoisting, landing and placing steel joists; and falls to lower levels. Notice is also given of an informal public hearing.

**DATES:** Written comments on the proposed rule and notices of intention to appear at the informal public hearing on the proposed rule must be postmarked by November 12, 1998. Parties who request more than 10 minutes for their presentations at the informal public hearing and parties who will submit documentary evidence at the hearing must submit the full text of their testimony and all documentary evidence postmarked no later than November 17, 1998. The hearing will take place in Washington, DC and is scheduled to begin on December 1, 1998.

**ADDRESSES:** Comments on the proposal are to be submitted in quadruplicate or 1 original (hardcopy) and 1 disk (5¼ or 3½) in WP 5.0, 5.1, 6.0, 6.1, 8.0 or ASCII to: the Docket Officer, Docket S-775, U.S. Department of Labor, Occupational Safety and Health Administration, Room N2625, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 219-7894. Written comments of 10

pages or less may be transmitted by facsimile (fax) to the Docket Office at (202) 219-5046, provided an original and three (3) copies are sent to the Docket Office thereafter. Comments may be submitted electronically by e-mail to [steelerection@osha-no.osha.gov](mailto:steelerection@osha-no.osha.gov). If the e-mail contains attached electronic files, the files must be in WordPerfect 5.0, 5.1, 6.0, 6.1, 8.0 or ASCII. When submitting a comment by e-mail, please include your name and address.

Any information not contained on the disk or in the e-mail (e.g., studies, articles) must be submitted in quadruplicate. Specific comments on the collection of information requirements may also be submitted to: The Office of Information and Regulatory Affairs, Attn: OMB Desk Officer for OSHA, Office of Management and Budget, Room 10235, Washington, DC 20503, (202) 395-7316.

Notices of intention to appear at the hearing, and testimony and documentary evidence which will be introduced into the hearing record, must be submitted in quadruplicate to: the Docket Officer, Docket S-775, U.S. Department of Labor, Occupational Safety and Health Administration, Room N2625, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 219-7894. The hearing will be held in Washington, D.C., beginning December 1, 1998 at 10:00 a.m. in the Auditorium of the Frances Perkins Building, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210.

**FOR FURTHER INFORMATION CONTACT:** Office of Information and Consumer Affairs, OSHA, U.S. Department of Labor, Room N3647, 200 Constitution Avenue, N.W., Washington D.C. 20210, (202) 219-8151.

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**SUPPLEMENTARY INFORMATION:****I. Background**

Congress amended the Contract Work Hours and Safety Standards Act (CWHSA) (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 (CSA) [P.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 (the Act) (84 Stat. 1590; 29 U.S.C. 651 *et seq.*), was enacted by Congress in 1970 and authorized the Secretary of Labor to adopt established Federal standards issued under other statutes, including the CSA, as occupational safety and health standards.

Accordingly, the Secretary of Labor adopted the construction standards which had been issued under the CSA, in accordance with Section 6(a) of the Act (36 FR 10466, May 29, 1971). The Safety and Health Regulations for Construction were redesignated as Part 1926 of 29 CFR later in 1971 (36 FR 25232, December 30, 1971). Subpart R of Part 1926, currently entitled "Steel Erection," incorporating §§ 1926.750 through 1926.752, was adopted as an OSHA standard during this process. The requirements in the existing standard cover flooring, steel assembly, bolting, plumbing-up and related operations. In 1974 a revision in the temporary flooring requirement was made pursuant to a rulemaking conducted under section 6(b) of the Act (39 FR 24361).

Since that time, OSHA has received several requests for clarification of various provisions, including those pertaining to fall protection. The Agency began drafting a proposed rule to revise several provisions of its steel erection standard in 1984 and on several occasions discussed its intention with its Advisory Committee on Construction Safety and Health (ACCSH). During these discussions, the fall protection requirements of the standard often aroused controversy. The discussions with ACCSH led to the development of several draft notices requesting information or proposing changes to the rule. None of these draft notices was published, nor was public comment sought, except through the proceedings of the Advisory Committee.

In 1986, the Agency issued a Notice of Proposed Rulemaking for subpart M (Fall Protection) and announced that it

intended the proposed rule to apply to all walking/working surfaces found in construction, alteration, repair (including painting and decorating), and demolition work, except for five specific areas. Although none of the specific areas pertained to steel erection, the Agency noted that "Additional requirements to have fall protection for connectors and for workers on derrick and erection floors during steel erection would remain in subpart R—Steel Erection."

This statement led to confusion. Many of the commenters to the subpart M rulemaking noted that they were not sure whether subpart M or subpart R would govern their activities. In one case, two sets of comments were provided, one to be used if subpart M applied and the other if subpart R applied. In the face of this uncertainty, the Agency decided that it would regulate the fall hazards associated with steel erection in its planned revision of subpart R.

OSHA announced its intention to regulate the hazards associated with steel erection, and in particular the fall hazards associated with steel erection, in a notice published in the **Federal Register** on January 26, 1988 (53 FR 2048). In that notice OSHA stated the following:

The rulemaking record developed to date indicates that the Agency needs more information in order to develop a revised standard covering fall protection for employees engaged in steel erection activities. The comments received to date have convinced the Agency to develop a separate proposed rule which will provide comprehensive coverage for fall protection in steel erection. OSHA intends, therefore, that the consolidation and revision of fall protection provisions in subpart M do not apply to steel erection and that the current fall protection requirements of Part 1926 continue to cover steel erection until the steel erection rulemaking is completed. Accordingly, in order to maintain coverage under existing fall protection standards pending completion of the separate steel erection fall protection rulemaking, OSHA plans to redesignate existing §§ 1926.104, 1926.105, 1926.107(b), 1926.107(c), 1926.107(f), 1926.500 (with Appendix A), 1926.501, and 1926.502 into subpart R when the Agency issues the final rule for the subpart M rulemaking.

Since that time, the Agency drafted several documents which it presented to ACCSH for comment. The Agency was also petitioned by affected parties to institute negotiated rulemaking. The first request for negotiated rulemaking was submitted to the Agency in 1990. At that time, it appeared the Agency would soon publish a Notice of Proposed Rulemaking in the **Federal Register** and,

therefore, the request was denied. However, affected parties once again made their concerns known, and the Agency delayed publication of the NPRM while it made a further, more comprehensive study of the concerns raised.

OSHA retained an independent consultant to review the fall protection issues raised by the draft revisions to subpart R, to render an independent opinion on how to resolve the issues, and to recommend a course of action. In 1991, the consultant recommended that OSHA address the issue of fall protection as well as other potential revisions to subpart R by using the negotiated rulemaking process (Ex. 4–18A).

Based on this recommendation and continued requests for negotiated rulemaking by affected stakeholders, on December 29, 1992, OSHA published a **Federal Register** notice of intent to establish a negotiated rulemaking committee (57 FR 61860). The notice requested nominations for membership on the Committee and comments on the appropriateness of using negotiated rulemaking to develop a steel erection proposed rule. In addition, the notice described the negotiated rulemaking process and identified some key issues for negotiation.

In response to the notice of intent, OSHA received more than 225 submissions, including more than 60 nominations for membership on the Committee and several sets of comments. After an evaluation of the submissions, it was apparent that an overwhelming majority of commenters supported this action, and OSHA decided to go forward with the negotiated rulemaking process. The Agency selected the members of the Committee from among the nominations.

On May 11, 1994, OSHA announced that it had established the Steel Erection Negotiated Rulemaking Advisory Committee (SENRAAC) (59 FR 24389) in accordance with the Federal Advisory Committee Act (FACA) (5 U.S.C. App. I), the Negotiated Rulemaking Act of 1990 (NRA) (5 U.S.C. 561 *et seq.*) and section 7(b) of the Occupational Safety and Health Act (OSH Act) (29 U.S.C. 656 (b)) to resolve issues associated with the development of a Notice of Proposed Rulemaking on Steel Erection. Appointees to the Committee included representatives from labor, industry, public interests and government agencies. OSHA was a member of the committee, representing the Agency's interests.

## II. Establishing the Steel Erection Negotiated Rulemaking Advisory Committee (SENRAAC)

Negotiated rulemaking is a process by which a proposed rule is developed through negotiation of differing viewpoints by a committee that is intended to be composed of representatives of all the interests that will be significantly affected by the rule. The negotiated rulemaking process is thus fundamentally different from OSHA's usual development process for proposed rules. Negotiation allows interested parties to discuss possible approaches to various issues rather than the Agency asking them to respond to the details of an OSHA draft proposal. The negotiation process involves a mutual education of the parties on the reasons for different positions on the issues as well as on the concerns about the practical impact of various approaches.

Each committee member participates in resolving the interests and concerns of other members instead of leaving it up to OSHA to bridge different points of view.

A key principle of negotiated rulemaking is that agreement is reached by consensus of all the interests. The NRA defines consensus as unanimous concurrence among the interests represented on a negotiated rulemaking committee, unless the committee itself unanimously agrees to use a different definition of consensus.

SENRAAC was formed with particular attention to obtaining full and adequate representation of those interests that may be significantly affected by the proposed rule. Section 562 of the NRA defines the term "interest" as follows:

"interest" means, with respect to an issue or matter, multiple parties which have a similar point of view or which are likely to be affected in a similar manner.

Particular care was taken to identify any unique interests which were determined to be significantly affected by the proposed rule and ensure that they were fully represented on the Committee.

The members of the Committee are: Richard Adams—Army Corps of Engineers, who was later replaced by Donald Pittinger; William W. Brown—Ben Hur Construction Company; Bart Chadwick—Regional Administrator, Region VIII, Occupational Safety and Health Administration (since retired); James E. Cole—International Association of Bridge, Structural & Ornamental Iron Workers; Stephen D. Cooper—International Association of Bridge, Structural & Ornamental Iron Workers; Phillip H. Cordova—El Paso

Crane & Rigging, Inc.; Perry A. Day—International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers & Helpers; James R. Hinson—J. Hinson Network, Inc.; Jim Lapping—Building and Construction Trades Department (AFL-CIO), replaced by Brad Sant and later replaced by Sandy Tillett; Richard King—Black & Veatch; John R. Molovich—United Steelworkers of America; Carol Murkland—Gilbane Building Company; John J. Murphy—Williams Enterprises of Georgia, Inc.; Steven L. Rank—Holton & Associates, Ltd.; Ray Rooth—CAL/OSHA; Alan Simmons—International Association of Bridge, Structural & Ornamental Iron Workers; William J. Smith—International Union of Operating Engineers; Ronald Stanevich—National Institute for Occupational Safety and Health (NIOSH) later replaced by Tim Pizatella, Division of Safety Research; C. Rockwell Turner—L.P.R. Construction Co.; and Eric Waterman—National Erectors Association.

SENTRAC was chaired by Philip J. Harter, Esq., a trained facilitator. The role of the facilitator was to apply proven consensus building techniques to the OSHA advisory committee setting. This individual was not involved with the substantive development of the standard. Rather, the facilitator's role generally included:

- (1) Chairing the meetings of the committee in an impartial manner;
- (2) Impartially assisting the members of the committee in conducting discussions and negotiations;
- (3) Acting as disclosure officer for committee records under the Freedom of Information Act (FOIA); and
- (4) In accordance with FACA's requirements, keeping minutes of all committee meetings.

SENTRAC consists of 20 members. Although these members represent particular interests, natural coalitions formed around particular issues, and certain members were identified as spokespersons for these coalitions.

Interested parties who were not selected to membership on the Committee were provided an opportunity to contribute to the negotiated rulemaking effort in the following ways:

- (1) by being placed on the Committee mailing list and submitting written comments to the Committee as appropriate;
- (2) by attending the Committee meetings, which were open to the public, caucusing with the SENTRAC member representing his or her interest on the Committee, and addressing the Committee (usually allowed at the end

of the discussion of an issue or the end of a session, as time permitted); and/or (3) by participating in a workgroup established by the Committee.

Informal workgroups were established by SENTRAC to assist the Committee in "staffing" various technical matters (e.g., researching or preparing summaries of the technical literature or commenting on particular matters before the Committee) to facilitate Committee deliberations. They also assisted in drafting regulatory text. The workgroups were made up of SENTRAC members and other parties who had expertise or a particular interest in the technical matter(s) being studied.

SENTRAC began negotiations in mid-June, 1994, and has met 11 times. Initial meetings dealt with procedural matters, including schedules, agendas and the establishment of workgroups. Workgroups addressed major issues, such as Scope, Fall Protection, Joists, Slippery Surfaces, Pre-Engineered Metal Buildings, and Cranes. During subsequent meetings, the foundations for negotiations were established and preliminary resolutions of issues were reached. Through negotiations at full Committee meetings and options developed by Committee workgroups, the Committee reached consensus on a proposed revision to the regulatory text for subpart R. This preamble addresses that text, which is the basis for OSHA's proposed rule.

During SENTRAC negotiations, the Committee addressed some difficult issues. Particularly controversial was the relationship between the fall protection requirements of subpart M (OSHA's standard for Fall Protection in construction) and such requirements in the steel erection context. Subpart M was published in the **Federal Register** on August 9, 1994 (59 FR 40672), and became effective on February 6, 1995. Initially, that standard applied to steel erection in non-building structures such as tanks, towers and bridges but not to steel erection in buildings. On October 7, 1994, five steel erection companies petitioned OSHA for an administrative stay of final subpart M to the extent that the standard applied to steel erection activities. The companies alleged that they had not received fair notice that the requirements of subpart M would apply to steel erection in non-building structures such as bridges, tanks and towers and that, in consequence, they had not had the opportunity to comment on the issue. Subsequently, OSHA agreed to stay subpart M as it applied to such activities and announced this decision to SENTRAC on December 8, 1994. The Committee was informed that the Agency had decided

to consider fall protection standards for all steel erection activities in the subpart R rulemaking as part of the SENTRAC process. OSHA also indicated that it intends to address any aspects of steel erection fall protection not ultimately addressed by SENTRAC by proposing to include them under subpart M or in a separate regulation, after notice and comment.

On January 26, 1995, OSHA issued a notice in the **Federal Register** (60 FR 5131) delaying the application of subpart M to non-building steel erection activities until August 6, 1995. On August 2, 1995, OSHA published a follow-up notice in the **Federal Register** (60 FR 39254) amending subpart M to indicate that its provisions did not cover steel erection, and that requirements relating to fall protection for employees performing steel erection work are included in § 1926.105 and in subpart R. The notice also stated that, until such time as subparts M and R have been revised, the Agency's enforcement policy on fall protection during steel erection would be the policy outlined in Deputy Assistant Secretary James R. Stanley's July 10, 1995, memorandum to the Office of Field Programs, "Fall Protection in Steel Erection" (Ex. 9-13F) (see full discussion of this memo in the fall protection section below). The notice also noted the Agency's intention to conduct a supplemental rulemaking in the near future, to provide an opportunity for public comment on the extension of subpart M coverage to any steel erection activity that subpart R does not address.

OSHA believes that the proposed subpart R will help to reduce the significant risk of death and serious injury that has continued to confront workers engaged in steel erection activities. In addition, the clarified and revised language of the proposal will help employers and employees understand the requirements of the steel erection standard and will improve worker safety by clarifying and consolidating current requirements into a single set of provisions that will be easier for employers to understand. OSHA is also proposing changes and additions to the current rules to provide more protective requirements and to close gaps in the current rule's coverage of steel erection hazards. These proposed revisions have been achieved through the SENTRAC negotiations, with active participation from workgroup members such as the Steel Joist Institute (SJI), American Institute for Steel Construction (AISC), Steel Erectors Association of America (SEAA), American Iron and Steel Institute (AISI), Metal Building Manufacturers

Association (MBMA), Steel Deck Institute (SDI), National Association of Miscellaneous, Ornamental and Architectural Products Contractors (NAMOA), the Institute of the Ironworking Industry (III), the Ironworkers Employers Associations of Washington, D.C. and Western Pennsylvania (IWEA), and the Allied Building Metal Industries. These organizations, although not members of the Committee, were able to contribute significantly to the negotiations through recommendations they made at various full Committee and workgroup meetings. This proposal has also been reviewed by OSHA's Advisory Committee on Construction Safety and Health (ACCSH). ACCSH was kept informed of SENRAC's progress throughout the negotiated rulemaking process and was given copies of the draft consensus regulatory text (Exs. 9-147, 9-148).

In summary, the SENRAC Committee was established by OSHA to negotiate a draft revision of the steel erection standard to serve as the basis for a proposed rule. The Committee and its workgroups met over an 18-month period and recommended a consensus document to OSHA. OSHA believes that the consensus document reflects the concerted effort of the entire steel erection community—steel erectors (both union and non-union); employee representatives; steel fabricators; major producers of domestic steel; manufacturers of steel joists, steel deck, steel coatings, pre-engineered metal buildings and safety equipment; insurance interests; safety consultants; and construction safety associations—to develop a comprehensive, workable and enforceable proposed standard for the safe erection of steel. In accordance with the Negotiated Rulemaking Act of 1990 and the Department of Labor's Negotiated Rulemaking Policy (57 FR 61925), the draft regulatory text and accompanying rationale presented to OSHA by the SENRAC Committee constitute the basis for this proposed rule.

In this Notice of Proposed Rulemaking (NPRM), OSHA provides notice to all affected employers and employees of these proposed revisions to subpart R, which the Agency believes are necessary to protect employees. OSHA believes the clarified language of the proposal will help employers to protect their employees more effectively and to comply more readily.

### III. Pertinent Legal Authority

The purpose of the Occupational Safety and Health Act, 29 U.S.C. §§ 651 *et seq.* ("the Act"), is "to assure so far

as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources." 29 U.S.C. § 651(b). To achieve this goal, Congress authorized the Secretary of Labor to promulgate and enforce occupational safety and health standards (see 29 U.S.C. §§ 655(a) (authorizing summary adoption of existing consensus and federal standards within two years of Act's enactment), 655(b) (authorizing promulgation of standards pursuant to notice and comment), 654(b) (requiring employers to comply with OSHA standards)).

A safety or health standard is a standard "which requires conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to provide safe or healthful employment" (29 U.S.C. § 652(8)).

A standard is reasonably necessary or appropriate within the meaning of Section 652(8) if it substantially reduces or eliminates significant risk, and is economically feasible, technologically feasible, and cost effective, and is consistent with prior Agency action or is a justified departure, is supported by substantial evidence, and is better able to effectuate the Act's purposes than any national consensus standard it supersedes. See 58 FR 16612-16616 (March 30, 1993).

OSHA has generally considered, at minimum, a fatality risk of 1/1000 over a 45-year working lifetime to be a significant health risk. See the Benzene decision *Industrial Union Dep't v. American Petroleum Institute*, 448 U.S. 607, 646 (1980); the Asbestos decision *Building and Constr. Trades Dep't, AFL-CIO v. Brock*, 838 F.2d 1258, 1265 (D.C. Cir. 1988); the Formaldehyde decision *International Union, UAW v. Pendergrass*, 878 F.2d 389, 392 (D.C. Cir. 1989).

A standard is technologically feasible if the protective measures it requires already exist, can be brought into existence with available technology, or can be created with technology that can reasonably be expected to be developed. *American Textile Mfrs. Institute v. OSHA*, 452 U.S. 490, 513 (1981) ("ATMI"); *AISI v. OSHA*, 939 F.2d 975, 980 (D.C. Cir. 1991) ("AISI").

A standard is economically feasible if industry can absorb or pass on the costs of compliance without threatening its long term profitability or competitive structure. See *ATMI*, 452 U.S. at 530 n. 55; *AISI*, 939 F.2d at 980. A standard is cost effective if the protective measures it requires are the least costly of the available alternatives that achieve the same level of protection. *ATMI*, 453 U.S.

at 514 n. 32; *International Union, UAW v. OSHA*, 37 F.3d 665, 668 (D.C. Cir. 1994) ("LOTO III").

Section 6(b)(7) authorizes OSHA to include among a standard's requirements labeling, monitoring, medical testing and other information gathering and transmittal provisions. 29 U.S.C. § 655(b)(7).

All standards must be highly protective. See 58 FR at 16614-16615; *LOTO III*, 37 F.3d at 669. Finally, whenever practical, standards shall "be expressed in terms of objective criteria and of the performance desired." *Id.*

### IV. Hazards in Steel Erection

Accidents during steel erection continue to cause injuries and fatalities at construction sites. Based on a review of compliance problems and public comments over the past several years, OSHA believes that the current standard, which has been in place with little change for 25 years, needs a complete revision to provide greater protection and eliminate ambiguity and confusion. OSHA believes that reorganizing the standard's requirements into a more logical sequence and providing more effective protection will help employers to understand better how to protect their employees from the hazards associated with steel erection and will thus reduce the incidence of injuries and fatalities in this workforce.

OSHA tracks fatalities through its Integrated Management Information System (IMIS), which captures a large percentage of the fatalities in the steel erection industry; however, detailed information on the conditions that give rise to steel erection accidents is less readily available. The best available data are derived from NIOSH and industry studies and from the Bureau of Labor Statistics (BLS) (Ex. 9-39). During SENRAC negotiations, OSHA staff and a Committee statistical workgroup analyzed accident information derived from OSHA's IMIS system (Exs. 9-14A and 9-42). Of the data reviewed, the IMIS fatality/catastrophe reports provided the richest source of accident descriptions. However, it was frequently difficult for OSHA and the Committee to determine several critical elements, such as the precise activity being undertaken at the time of the accident, whether the victim was a trained ironworker, or the type of structure under construction or repair.

Nevertheless, OSHA believes that the IMIS reports, combined with the collective experience of the members of the SENRAC workgroup, provide a solid basis for identifying the types of hazards that result in accidents during steel

erection. An analysis of OSHA fatality/catastrophe data was performed by the SENRAC Statistical Workgroup which analyzed an eleven-year period (January 1984 through November 1994) and determined that 323 fatal accidents involved factors that are addressed both by OSHA's current and proposed steel erection standards [Ex. 9-42, Attachment C]. After categorizing the accidents according to primary contributing factors, the SENRAC workgroup concluded that the leading initial cause of accidents was slips (23.8 percent). The next highest categories were unknown (17.3 percent) and collapse (15.8 percent). Categorizing the accidents in the IMIS database by the immediate (final) cause of death, the SENRAC analysis reveals that 284 of the 323 fatalities (87.9 percent) involved falls from various heights where fall protection was either not provided or not used. Categorized by activity, decking was associated with the most fatalities (22.9 percent), followed by connecting (17.0 percent) and bolting (11.5 percent). An OSHA staff evaluation of these reports for an eight year period (January 1984 through December 1990) revealed that fatalities associated with various types of accidents were caused by the following factors:

- *Collapses while landing or placing a load*—most were the result of placing loads on unsecured or unbridged joists.
- *Collapses while connecting joists or trusses*—most were the result of prematurely disconnecting the crane before the piece was secure.
- *Workers struck by objects during miscellaneous activities*—most were the result of walking or working under a load.
- *Workers struck by objects and then falling*—most were the result of being struck while landing a load or making a connection, by a tool slipping, or by a piece of decking being blown off a pile when fall protection was not provided or used.
- *Improper use or failure of fall protection*—most were the result of employee failure to use available fall protection systems even though the worker was wearing a belt (and in some cases lifelines were rigged).
- *Unsecured or unstable decking*—most were the result of stepping onto or working on unsecured decking that slipped out of place when fall protection was not provided or used.
- *Other falls during decking activities*—most were the result of stepping off the metal decking onto insulation (and then falling to the ground) during roofing operations

where fall protection was not provided or used.

- *Plumbing, bolting, welding and cutting*—most were the result of the worker not being tied off while at the work station (whether or not fall protection was provided).
- *Walking/standing on the beam/joist (i.e., moving point-to-point)*—most were slips or falls where fall protection was not provided or used.

Based upon these analyses, OSHA has preliminarily determined that the SENRAC recommendations would, taken together, generally address those situations that have caused a significant number of ironworker catastrophes and fatalities in the past.

For the time period examined, the fatality/catastrophe reports described accidents that involved at least one fatality or 5 hospitalizations. (In April, 1994, the reporting criterion was changed to 1 fatality or 3 hospitalizations (59 FR 15594).) These reports do not cover the entire universe of steel erection accidents; for example, an individual accident that did not result in a fatality would not be reported in the IMIS reports. Nonetheless, the IMIS data enabled OSHA to broadly characterize the fatality data in a way that permitted the estimation of baseline risk for specific types of steel erection hazards.

For its assessment of baseline risk in steel erection, OSHA used fatality data from the Bureau of Labor Statistics' (BLS) Census of Fatal Occupational Injuries and distributed the data according to the committee's categorization of the OSHA IMIS accident data. BLS reports that over the period 1982-1993, structural metal workers experienced an average of 40 fatalities per year. OSHA determined that, of these fatalities, approximately 28 deaths per year were caused by factors that are addressed by the proposed standard (see the preliminary economic analysis, Chapter III, summarized below in Section VII). Furthermore, results from the 1992 BLS injury survey identify 1,836 lost-workday injuries (1,164 "struck-by" injuries and 672 "falls to lower levels") whose circumstances would be addressed by provisions in the proposed standard. With an estimated workforce of 38,980 iron workers in construction ([BLS, Occupational Employment Statistics Survey, 1993]; see the preliminary economic analysis), OSHA concludes that these baseline fatality and injury levels are high and clearly pose a significant risk to these workers that justifies Agency action. Therefore, OSHA has undertaken this negotiated rulemaking to reduce these significant

risk levels. OSHA preliminarily concludes that the proposed standard will substantially reduce this significant risk.

Even though detailed data targeted exclusively at steel erection accidents are not available, steel erection is known to have a high rate of serious accidents. Available sources of information on steel erection injuries and fatalities include a draft report on fatal work-related falls in structural steel erection (Ex. 9-13E); a draft National Institute for Occupational Safety and Health (NIOSH) document entitled "Structural Steel Erection: Falls" (Ex. 9-15); the report of the SENRAC Statistical Workgroup (Exs. 9-42 and 9-49); a comparison of non-union and union contractor construction fatalities (Ex. 9-85); and a report on fatalities in the construction industry in the United States, 1992 and 1993, by the Center to Protect Workers' Rights (Ex. 9-119). The Committee urged OSHA to use improved technology to collect more detailed steel erection fatality inspection data. OSHA agrees with SENRAC on this issue, because an improved fatality data base will permit a more in-depth analysis of construction fatalities and provide information not available at the time of the negotiations on the most hazardous types of construction and construction activities by occupation. In response, OSHA has developed and implemented an enhanced coding system which must be used by OSHA compliance officers when recording construction fatality investigations for entry into the Agency's IMIS. This system was implemented nationally on January 1, 1997. The data OSHA is now recording when making fatality investigations will provide a rich source of detailed information indicating how and where construction fatalities occur.

Three years after the rule becomes final, OSHA will use the improved fatality data to evaluate the rule's effectiveness. Based upon this evaluation, a determination will be made as to whether modifications to the standard are necessary (see Ex. 9-130).

The following examples from OSHA's IMIS reports of accident investigations illustrate the types of accidents that occur in steel erection (Ex. 9-157):

1. April 25, 1990: 1 Fatality and 3 injuries. Four employees were sitting on steel roof beams. Two employees were bolting beams to columns and the other two employees were sitting on the beams connecting roof purlins. A gust of wind caused the columns to topple in a domino fashion. One of the employees connecting roof purlins fell 25 feet to his death and the other three employees

fell and were hospitalized. OSHA believes that compliance with the anchor bolt requirements of proposed § 1926.755(a) could have prevented this accident by requiring that all columns be anchored by a minimum of four anchor bolts and that unstable columns be guyed or braced where deemed necessary by a competent person.

2. July 23, 1984: Fatality. An employee was welding roof decking adjacent to an unguarded staircase opening. The employee fell through the opening 57 feet to the sub-level and died of multiple injuries. OSHA believes that compliance with proposed § 1926.754(e)(2) could have prevented this accident by requiring proper procedures for cutting and covering floor and roof openings.

3. October 5, 1988: Fatality. While walking atop structural steel checking joints and bolts, an employee slipped or misjudged his footing and fell approximately 20 feet to the concrete floor below, resulting in his death. OSHA believes that compliance with the fall protection requirements of proposed § 1926.760(a)(1) could have prevented the accident by ensuring that the employee was properly protected from fall hazards.

4. July 24, 1987: Fatality. While bolting-up, an employee's foot slipped, causing him to fall nearly 24 feet head first to the concrete below. OSHA believes that compliance with the fall protection requirements of proposed § 1926.760(a)(1) could have prevented the accident by ensuring that the employee was properly protected from fall hazards.

OSHA believes that in this case and the case before, compliance with the proposed fall protection requirements in § 1926.760(a)(1) could have prevented these fatalities by requiring that employees on a walking/working surface with an unprotected side or edge more than 15 feet above a lower level be protected from fall hazards.

5. November 12, 1987: Fatality. An employee was connecting X-bracing at the end of a bar joist. The joist was 40 feet long and welded at one end. The employee was sitting on the joist connecting the X-bracing when the joist slipped. The employee rode the joist down 25 feet and died of massive head injuries. OSHA believes that compliance with existing § 1926.751(c)(3) or the clarified and more comprehensive provisions of proposed § 1926.757, the open web steel joist section, and more specifically with paragraph (d)(1), could have prevented the accident by ensuring that specific erection bridging requirements were met before the hoisting cable was released from a joist.

6. April 2, 1987: 1 Fatality, 1 hospitalized injury. Two employees had unloaded 2 bundles of metal decking, 2 bundles of bridging and 2 bundles of roof frames onto 6 open web steel joists 25 feet above ground level. The joists were at 5½ foot centers and welded on the end to the "T" beam. The employees had just unhooked the second bundle of frames when the joist rolled, causing the employees to fall. All six joists broke from the welds and collapsed, landing on the employee. OSHA believes that this accident also could have been prevented by compliance with the proposed open web steel joist section of the proposed standard. Specifically, the proposed provisions of § 1926.757(e) provide criteria to be met before landing loads on joists. The requirements of current subpart R are not as complete or comprehensive in this regard.

OSHA believes that the proposed provisions will enhance employee protections by adding new requirements to close gaps in current coverage, strengthening many of the existing requirements, and promoting compliance by clarifying and consolidating current requirements. For further discussion of accident rates and significant risk, see Section VII, *Preliminary Economic Analysis*.

Based on the available information referenced in OSHA's preliminary economic analysis and other record evidence, OSHA finds that structural metal workers are faced with a significant risk of serious injury or death that can be reduced substantially by the revisions contained in this proposal. The Agency has estimated that, each year, approximately 38,980 workers in the United States suffer 1,836 serious (i.e., lost-workday) steel erection injuries. In addition, an estimated 28 steel erection workers die every year because of preventable hazardous workplace conditions. OSHA's analysis has estimated that, of the 28 annual steel erection fatalities, 26 (93 percent) will be averted by compliance with the proposed standard. Additionally, of the 1,836 lost-workday steel erection injuries occurring annually, OSHA's analysis estimates that 1,151 (63 percent) will be averted by compliance with the proposed standard. Therefore, OSHA preliminarily finds it both necessary and appropriate to proceed with rulemaking for steel erection activities.

## V. Summary and Explanation of the Proposed Standard

The following discussion summarizes and explains each provision in the proposal and the substantive changes proposed to be made to the provisions

of OSHA's existing steel erection standard.

### *Section 1926.750 Scope and application*

The existing standard does not contain a scope and application section. OSHA is proposing to add this new section to clarify that the standard would apply to employers engaged in the erection, alteration and/or repair of steel in single and multi-story buildings, bridges and other structures where steel erection occurs as well as to identify some of the specific activities that may be included in steel erection.

*Paragraph (a) Scope.* This proposed paragraph states the purpose of the subpart, which is to protect employees from the hazards associated with steel erection in the construction, alteration and/or repair of single and multi-story buildings, bridges, and other structures where steel erection occurs. The fact that the existing standard does not clearly address scope has caused much debate in the past over what structures are covered by subpart R. This paragraph would also clarify that subpart R does not apply to electrical transmission towers, communication and broadcast towers, or tanks. These structures are covered by provisions in other subparts of Part 1926.

*Paragraph (b) Application.* In this paragraph, OSHA lists the steel erection activities that may be covered by subpart R.

When SENRAC began negotiations on subpart R, the scope and application of subpart R was anticipated to be a major issue for deliberation. At the first meeting, the Committee formed a workgroup to determine what the proposed scope of subpart R should be. The Committee wanted to state clearly that this proposed steel erection standard would apply to more than multi-story buildings. The workgroup recommended, and the Committee agreed, that steel erection activities should include hoisting, connecting, welding, bolting, and rigging structural steel, steel joists and metal buildings. The Committee also decided that steel erection activities should include the installation of metal deck, siding systems, miscellaneous metals, ornamental iron and similar materials as well as moving point-to-point while performing these activities. OSHA is proposing to include these activities among those considered to be steel erection activities, as recommended by the Committee.

In an attempt to clarify what structures and activities could be considered steel erection, the scope and application paragraph includes an



extensive list of structures and activities as developed by SENRAC (see notes to paragraphs (a) and (b) of proposed § 1926.750). The notes are an attempt to ensure that employers performing the listed activities will be aware that they could potentially be covered by the proposed steel erection standard.

SENRAC intended the notes to enhance compliance by listing structures where steel erection *could* occur since many of the structures listed do not always involve steel erection. Likewise, the steel erection activities listed include examples of construction activities that are sometimes involved in steel erection but may not always be conducted by the steel erector. Simply because an employee is working on a listed structure or is performing a listed activity does not necessarily mean that the employee is engaged in steel erection. Thus, there is no presumption that every listed item constitutes a steel erection activity or operation. To determine whether a given activity on a particular structure does indeed constitute steel erection, the employer first must determine that steel erection is actually being performed and that the activities being performed are covered by this subpart. This determination would be based on the following criteria: (1) Whether the work falls within the definition of steel erection found in proposed § 1926.751; and (2) Whether the structure being erected and the activities being performed fall within the scope and application paragraphs found in proposed § 1926.750. In other words, in order to be covered by subpart R, as proposed, work would have to fit within the definition of steel erection, the scope of the proposed standard, and the application of the proposed standard.

The Committee discussed at length the differences between construction and maintenance because the construction industry performs millions of manhours per year of "industrial maintenance" work. The definition of construction contained in the Davis-Bacon Act is:

Construction work means work for construction, alteration, and/or repair, including painting and decorating.

OSHA has interpreted this definition to include alteration, repair, renovation, rehabilitation and remodeling of existing facilities or structure.

After clarifying that work is defined based on the nature of the work being performed rather than on the job title of the worker performing it, SENRAC agreed that the scope of proposed subpart R should be governed by the definition of construction work

contained in § 1910.12(b), § 1926.13 and § 1926.32(g).

SENRAC debated extensively the detailed lists of structures and activities. The Committee decided that these lists should be placed in the standard itself in paragraphs (a) and (b), respectively, because they stated the broad range of structures and activities that might be covered by subpart R. The lists are intended to enhance compliance by listing structures where steel erection could occur. OSHA is proposing these lists for comment from interested parties. Specifically, are these lists necessary? Do they clarify the extent of steel erection activities? Will they introduce confusion by suggesting that all steel erection activities and structures are included in these lists or, alternatively, that any listed activity performed on a listed structure necessarily constitutes steel erection? Because of their size, would they be more effective as an appendix to the rule or in compliance materials?

OSHA is proposing that the scope of subpart R exclude electrical transmission towers, communication and broadcast towers, and tanks from coverage. The Committee concluded that tower erection is a specialized form of steel erection and that electrical transmission towers are regulated under subpart V of 29 CFR Part 1926. In discussing potential exclusions from the scope of the proposed standard, the Committee as a whole expressed uncertainty about the extent to which these towers were currently covered by OSHA standards. OSHA provided a memo to the Committee (Ex. 9-53) describing the current coverage of towers in OSHA standards. Based on that information and the tower erection industry's reasons for exclusion from coverage by subpart R (Ex. 9-127), the Committee agreed that it would be appropriate to exclude electrical transmission, communication, and broadcast towers from the proposed scope. The Committee also believes that tanks should not be included in the scope of subpart R since tank construction is also, based on its use of cylindrical construction techniques, a specialized industry. In addition, the tank industry has clearly stated its reasons for not being covered by subpart R (Ex. 9-32F). Since tanks have never been covered by subpart R, OSHA is proposing to exclude them from the scope of revised subpart R, as well, and the Committee is in agreement with this approach. In the case of water towers, OSHA intends subpart R to cover the steel structure upon which the water tank is supported but not the water tank itself, as recommended by the

Committee. OSHA specifically solicits comments on the appropriateness of these exclusions from the scope of the proposed standard.

#### Section 1926.751 Definitions

The current standard does not contain a definitions section. Since the proposal is more comprehensive than the existing standard and refers to many technical concepts, terms and materials, a definition section is being proposed. The proposed definition section lists and defines all major terms used in the proposed standard to assist employers in understanding the proposed provisions and thus facilitate compliance.

*Anchored bridging.* This term would be defined by OSHA to mean that the steel joist bridging is connected to a bridging terminus point. This definition was recommended by the Steel Joist Institute (SJI), accepted by the Committee and is being proposed by OSHA.

*Bolted diagonal bridging.* OSHA is proposing to define this term to mean diagonal bridging which is bolted to a steel joist or joists. This definition was developed by a SENRAC workgroup, was accepted by the Committee, and is being proposed by OSHA.

*Bridging clip.* OSHA is proposing that this term be defined as a device that is attached to the steel joist to allow the bolting of the bridging to the steel joist. This definition was recommended by SJI and accepted by the Committee.

*Bridging terminus point.* This term would be defined to mean a wall, beam, tandem joists (with all bridging installed and a horizontal truss in the plane of the top chord) or other element at an end or intermediate point(s) of a line of bridging that provides an anchor point for the steel joist bridging. This definition was recommended by SJI, accepted by the Committee, and is being proposed by OSHA.

*Choker.* OSHA would define this term to mean a wire rope or synthetic fiber rigging assembly that is used to attach a load to a hoisting device. This definition was developed by a SENRAC workgroup and accepted by the Committee.

*Clipped connection.* This term would be defined by OSHA to mean the connection material on the end of a structural member intended for use in a double connection which has a notch at the bottom and/or top to allow the bolt(s) of the first member placed on the opposite side of the central member to remain in place. The notch(es) fits around the nut or bolt head of the opposing member to allow the second member to be bolted up without



removing the bolt(s) holding the first member. This definition was developed by a workgroup of the Committee and accepted by SENRAC.

**Cold formed joist.** OSHA defines this term as an open web joist fabricated with cold formed steel components. This definition was recommended by SJI, was accepted by the Committee, and is being proposed by OSHA.

**Cold forming.** This term would be defined by OSHA to mean the process of using press brakes, rolls, or other methods to shape steel into desired cross sections at room temperature. This definition was recommended by the Steel Deck Institute, was accepted by the Committee, and is being proposed by the Agency.

**Competent person.** This term is defined in § 1926.32(f) as one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. Because of the frequent use of the term in this proposal, the Committee urged OSHA to repeat this definition in subpart R even though the definition appears in § 1926.32 and applies to all of the standards contained in 29 CFR Part 1926, and OSHA agrees with the Committee's recommendation. The Committee reasoned that an employer performing steel erection should be able to locate the competent person definition in subpart R instead of having to search for it elsewhere in Part 1926.

**Composite joists.** OSHA defines this term to mean steel joists designed to act in composite action with concrete floor and (or) concrete roof slabs. Typically, a portion of the top chord of the joist (or a lug or similar device attached to the top chord of the joist) is embedded in the concrete slab. This definition was developed by a SENRAC workgroup and accepted by the Committee.

**Connector.** OSHA would define this term to mean an employee who, working with hoisting equipment, is placing and connecting structural members and/or components. After lengthy discussion on how to define what a connector is and what tasks a connector performs, the Committee decided to define as narrowly as possible the activities that a connector performs in light of the connector-specific proposed fall protection provisions in § 1926.760, which will be discussed later in the preamble. OSHA requests comment on this definition.

**Construction load for joist erection.** This term would be defined to mean any load other than the weight of the

employee(s), the joists and the bridging bundle. This definition was recommended by SJI, accepted by the Committee, and is being proposed by OSHA.

**Controlled Decking Zone (CDZ).** This term would be defined by OSHA to mean an area in which certain work (e.g., initial installation and placement of metal deck) may take place without the use of guardrail systems, personal fall arrest systems or safety net systems provided that alternative procedures (e.g., controlled access, worker training, use of control lines or equivalent) are implemented. Controlled decking zones are discussed in proposed § 1926.760(c). OSHA requests comment on the necessity of defining a CDZ since all of the requirements for a CDZ are in proposed § 1926.760(c). If it is necessary to define a CDZ, is this an appropriate definition?

**Controlled load lowering.** OSHA would define this term to mean lowering a load by means of a mechanical hoist drum device that allows a hoisted load to be lowered with maximum control using the gear train or hydraulic components of the hoist mechanism. Controlled load lowering requires the use of the hoist drive motor to lower the load. This definition was developed by a SENRAC workgroup and accepted by the Committee. Controlled load lowering is an essential component of the multiple lift rigging procedure and the hoisting of personnel platforms addressed in proposed § 1926.753.

**Controlling contractor.** OSHA would define this term to mean a prime contractor, general contractor, construction manager or any other legal entity at the site who has, by contract with other parties, the overall responsibility for the project, its planning, quality and completion and is intended to describe an entity in addition to the steel erector who is responsible for hazards that result from poor performance, pre-planning, or communication. Based on its analysis of actual steel erection fatalities, catastrophes and collapses, the Committee agreed that many hazardous situations could have been avoided if, for example, concrete foundations had been properly cured, anchor bolts that were replaced had been properly repaired, or cranes had been appropriately placed to avoid overhead exposure. All of these primarily fall within the responsibility of the controlling contractor. In several of the proposed revisions, therefore, OSHA is proposing, based on the Committee's recommendation, that the controlling contractor be held responsible for communicating with the steel erector to

prevent accidents from happening during certain activities; see, for example, § 1926.752(a), (b) and (c) (Approval to begin steel erection, site layout and overhead protection, respectively); § 1926.755(b)(3) (Repair, replacement or field modification of anchor bolts); § 1926.759(b) (Falling object protection); and § 1926.760(e) (Fall protection). OSHA solicits comments from interested parties on the appropriateness of this approach to ensuring accountability for adequate planning and coordination.

**Critical lift.** OSHA proposes to define this term to mean a lift that (1) exceeds 75% of the rated capacity of the crane or derrick, or (2) requires the use of more than one crane or derrick. This definition was developed by a SENRAC workgroup and accepted by the Committee.

**Decking hole.** OSHA would define this term to mean a gap or void more than 2 inches (5.1 cm) in its least dimension and less than 12 inches (30.5 cm) in its greatest dimension in a floor, roof or other walking/working surface. Pre-engineered holes in cellular decking are not included in this definition. This definition was developed by a SENRAC workgroup to be industry specific and was accepted by the Committee. The workgroup borrowed part of this definition from the subpart M definition of "hole." The subpart M definition was modified, however, to limit the size of a hole to more than 2 inches in its least dimension and less than 12 inches in its greatest dimension to be compatible with the definition of an opening (defined later). The proposed definition of decking hole and the proposed definition of opening differ from the subpart M definitions in that subpart M uses the term "hole" to describe all holes and openings in floors, roofs and other walking/working surfaces and uses the term "opening" to apply only to holes and openings in walls. By custom and practice, the common usage of these same terms in steel erection refers to different situations and hazards. In steel erection, a hole is a commonly used term that means a small gap or void that presents a tripping hazard or a falling object hazard and an opening is a larger gap or void in a walking/working surface that presents a fall hazard to the employee. Therefore, to be more industry specific, OSHA is proposing to define "decking hole" and "opening" based on the size of the gap or void in a floor, roof or other walking/working surface only. This proposal contains requirements that treat "decking holes" and "openings" differently, which necessitates having

two separate definitions based on the size of the gap or void.

*Derrick floor.* This term, which was developed by a SENRAC workgroup and accepted by the Committee, would be defined by OSHA to mean that elevated floor of a building or structure that has been designated to receive hoisted pieces of steel prior to their final placement.

*Double connection.* OSHA proposes to define this term to mean an attachment method where the connection point is intended for two pieces of steel which share common bolts on either side of a central piece. This definition was developed by the Committee to address the serious collapse hazard involved in making this complex connection. Double connections are discussed in proposed § 1926.756(c).

*Erection bridging.* OSHA would define this term to mean the bolted diagonal bridging that must be installed prior to releasing the hoisting cables from the steel joists. This definition was recommended by SII and accepted by the Committee and the term is found in proposed § 1926.757, Open Web Steel Joists.

*Fall restraint (Positioning device) system.* This term would be defined by OSHA to mean a body belt or body harness used to prevent an employee from free falling more than 24 inches (61 cm) and where self rescue can be assured. Such a system consists of an anchorage, connectors, a body belt or harness and may include a lanyard, deceleration device, lifeline, or suitable combination of these. This definition was developed by the Committee, and the term is used in proposed § 1926.760, Fall Protection. The criteria for "positioning device systems" found in § 1926.502(e) would apply to these types of fall restraint systems used in steel erection.

*Girt (in pre-engineered metal buildings).* This term would be defined by OSHA to mean a "Z" or "C" shaped member formed from sheet steel spanning between primary framing and supporting wall material. This definition was developed by a SENRAC workgroup, accepted by the Committee, and the term is used in proposed § 1926.758, Pre-engineered Metal Buildings.

*Headache ball.* OSHA proposes to define this term to mean a weighted hook that is used to attach loads to the hoist load line of the crane. This definition was developed by a SENRAC workgroup, accepted by the Committee, and is used in proposed § 1926.753, Hoisting and Rigging.

*Hoisting equipment.* This term would be defined to mean commercially

manufactured lifting equipment designed to lift and position a load of known weight to an erection location at some known elevation and horizontal distance from the equipment's center of rotation. "Hoisting equipment" includes but is not limited to cranes, derricks, tower cranes, barge-mounted derricks or cranes, gin poles and gantry hoist systems. The Committee developed a definition for hoisting equipment that would include all equipment that is used in steel erection to lift loads to a specified location. The intent was to ensure that this equipment is not strictly limited to cranes. The definition was also crafted to avoid a situation where a steel erector might elect to characterize employees who are not true connectors, e.g., detailers, as connectors by providing them with a "come-a-long" to meet the definition of connector. Thus, a "come-a-long" would not be included in the definition of hoisting equipment because a "come-a-long" is a mechanical device, usually consisting of a chain or cable attached at each end, that is used to facilitate movement of materials through leverage rather than true hoisting equipment.

*Leading edge.* OSHA proposes to define this term to mean the unprotected side and edge of a floor, roof, or formwork for a floor or other walking/working surface (such as deck) which changes location as additional floor, roof, decking or formwork sections are placed, formed or constructed. This definition is based on the subpart M definition of "leading edge" but was enhanced by the Committee which added "unprotected side and" before "edge" to clarify that all unprotected sides and edges would be defined in subpart R as leading edges.

*Metal deck.* This term would be defined by OSHA to mean a commercially manufactured, structural grade, cold rolled metal panel formed into a series of parallel ribs; for this subpart, this would include metal floor and roof decks, standing seam metal roofs, other metal roof systems and other products such as bar gratings, checker plate, expanded metal panels, and similar products. After installation and proper fastening, these decking materials serve a combination of functions including, but not limited to: a structural element designed in combination with the structure to resist, distribute and transfer loads, stiffen the structure and provide a diaphragm action; a walking/working surface; a form for concrete slabs; a support for roofing systems; and a finished floor or roof. This definition was developed by a SENRAC workgroup and accepted by

the Committee. This workgroup believes that, for the purposes of steel erection, rather than referring to several similar building materials associated with a particular hazard, a generic term should be defined and then be used consistently in the standard. Since the materials listed in this definition are all similarly installed and eventually become walking/working surfaces, the workgroup believes that a single term would provide both greater clarity and facilitate compliance. In developing this definition, the workgroup relied on the Steel Deck Institute (SDI) "Manual of Construction with Steel Deck," in addition to its own collective expertise.

*Multiple lift rigging.* OSHA would define this term to mean a rigging assembly manufactured by wire rope rigging suppliers that facilitates the attachment of up to five independent loads to the hoist rigging of a crane. This definition was developed by a SENRAC workgroup and accepted by the Committee.

*Opening.* OSHA would define this term to mean a gap or void 12 inches (30.5 cm) or more in its least dimension in a floor, roof or other walking/working surface. For the purposes of this subpart, skylights and smoke domes that do not meet the strength requirements for covered openings in § 1926.760(d)(1) would be regarded as openings. This definition was developed by a SENRAC workgroup to prevent workers from sitting or walking on covers that are insufficient to support their weight. The last sentence of the definition was added to ensure that skylights and smoke domes would not be considered covered if they do not meet the strength requirements for covered openings in § 1926.760(d)(1) and therefore must be protected by other means. This definition differs from the definition in subpart M of this part as discussed earlier in the definition of "decking hole."

*Permanent floor.* This term would be defined by OSHA to mean a structurally completed floor at any level or elevation (including slab on grade). A floor would be considered a permanent floor when all the work contained on the structural contract documents has been completed for that floor. Concrete poured on metal deck and grating or floor plate applied to structural members would be considered permanent floors. This definition was developed by the Committee to promote clarity.

*Personal fall arrest system.* OSHA would define this term to mean a system used to arrest an employee in a fall from a working level; a personal fall arrest system consists of an anchorage, connectors, and a body harness and may

include a lanyard, deceleration device, lifeline, or suitable combination of these. The Committee recommended that this definition be identical to the definition used in subpart M of this part.

**Pre-engineered metal building.** This term would be defined by OSHA to mean a field-assembled building system consisting of framing, roof and wall coverings, and generally made of steel. Typically, in a pre-engineered metal building, many of these components are cold-formed shapes. These individual parts are fabricated in one or more manufacturing facilities and shipped to the job site for assembly into the final structure. Engineering design of the system is normally the responsibility of the pre-engineered metal building manufacturer. This definition was developed by a SENRAC workgroup and accepted by the Committee.

**Project structural engineer of record.** This term, which was developed by the Committee and is used throughout the proposed standard, would be defined by OSHA to mean the registered, licensed professional responsible for the design of structural steel framing and whose seal appears on the structural contract documents.

**Purlin (in pre-engineered metal buildings).** OSHA proposes to define this term to mean a "Z" or "C" shaped member formed from sheet steel spanning between primary framing and supporting roof material. This definition was developed by a SENRAC workgroup and accepted by the Committee.

**Qualified person.** This term, which is also defined in § 1926.32(m), would be defined in the proposed standard to mean one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project. As with the definition of competent person, because of the frequent use of the term in this proposal, the Committee urged OSHA to repeat this definition in subpart R even though the definition already exists in § 1926.32 and applies to all of the standards contained in 29 CFR Part 1926 because repeating it would enable an employer performing steel erection to locate the qualified person definition in subpart R instead of having to search for it somewhere else in Part 1926.

**Safety deck attachment.** OSHA is proposing to define this term to mean an initial attachment that is used to secure an initially placed sheet of decking to keep proper alignment and bearing with

structural support members. The term originally used in the controlled decking zone (CDZ) working draft was "safety deck welding" and "tack welds." Committee members pointed out that there were ways to attach the decking other than welding, e.g., mechanical fastening. Since the intent is to safely "attach" the newly placed decking panels, the proposed rule uses the broader language recommended by the Committee.

**Seat.** This term would be defined by OSHA to mean a structural attachment mounted to a structural member beneath a connection point, designed to support an incoming member that is to be connected to the first member. This term, which was developed by a SENRAC workgroup and accepted by the Committee, is used in the double connection section, § 1926.756(c).

**Shear connector.** OSHA is proposing to define this term to include headed steel studs, steel bars, steel lugs, and similar devices which are attached to a structural member for the purpose of achieving composite action with concrete, i.e., strengthening the top flange of the beam by interacting with the concrete to achieve a higher strength. This definition was developed by the Committee.

**Steel erection.** This term would be defined by OSHA to mean the erection of steel buildings, bridges and other structures, including the installation of steel flooring and roofing members and all planking and decking used during the process of erection. This definition was developed by the Committee, and OSHA requests comments on the appropriateness of this definition.

**Steel joist.** OSHA proposes to define this term to mean an open web, secondary load-carrying member of 144 feet (43.9 m) or less suitable for the support of floors and roofs. This term does not include structural steel trusses or cold-formed joists. This definition was recommended by SJI and accepted by the Committee.

**Steel joist girder.** OSHA would define this term to mean an open web, primary load-carrying member, designed by the manufacturer, suitable for the support of floors and roofs. This does not include structural steel trusses. This definition was recommended by SJI and accepted by the Committee.

**Steel truss.** This term would be defined by OSHA to mean an open web member designed of structural steel components by the project structural engineer of record. For the purposes of this subpart, a steel truss would be considered equivalent to a solid web structural member. This definition was

recommended by SJI and accepted by the Committee.

**Unprotected sides and edges.** OSHA proposes to define this term to mean any side or edge (except at entrances to points of access) of a walking/working surface, e.g., floor, roof, ramp or runway, where there is no wall or guardrail system at least 39 inches (1.0 m) high. This definition is identical to the corresponding definition in subpart M of this part.

#### **Section 1926.752 Site Layout, Site-specific Erection Plan and Construction Sequence**

After a review of accident reports involving collapses, the Committee reached the conclusion that many of these accidents could have been averted had adequate pre-erection communication and planning occurred. This section of the proposed rule sets forth OSHA's requirements for proper communication between the controlling contractor and the steel erector prior to the beginning of the steel erection operation and proper pre-planning by the steel erector to minimize overhead exposure during hoisting operations; Appendix A, which is referred to in this section, would also provide guidelines for employers who elect to develop a site-specific erection plan. OSHA's current standard does not contain provisions similar to those being proposed in this section.

#### **Paragraph (a) Approval to begin steel erection.**

The Committee recognized that under current practices in the industry, erection decisions are often made in the field when the steel arrives. The Committee believes that pre-planning and coordination are currently not occurring to the extent they should be.

OSHA agrees that lack of adequate planning and coordination contributes to accidents and is proposing, in paragraph (a)(1), that the controlling contractor ensure that the concrete in footings, piers, or walls, or the mortar in masonry piers and walls has achieved a minimum of 75% of its design compressive strength prior to the imposition of any structural steel load or has achieved a strength that is sufficient to support the loads imposed. This proposed requirement agrees with a recommendation by the American Institute of Steel Construction (AISC) and is similar to the OSHA requirement for concrete construction found in § 1926.703(e)(ii), which requires that formwork not be removed from cast-in-place concrete " \* \* \* until the concrete has been properly tested with an appropriate American Society for Testing and Materials (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." Since the footings, piers and walls intended to be covered by this proposed section will be supporting the steel structure being erected, OSHA, as well as the Committee, wishes to ensure that this information is provided to the steel erector before the steel is placed on the concrete.

Paragraph (a)(2) cross-references § 1926.755(b) and would require that any repairs, replacements, and field modifications be performed in accordance with the anchor bolt requirements contained in § 1926.755(b). As in the case of proposed paragraph (a)(1), OSHA, along with the Committee, wishes to ensure that the steel erector is informed of any repair, replacement, or modification to the anchor bolts prior to the placement of steel.

Paragraph (b) of this section sets out the site conditions that would have to be provided and maintained by the controlling contractor in order for the steel erector to move around the site and perform necessary operations in a safe manner.

Paragraph (b)(1) would require that the controlling contractor provide and maintain adequate access roads into and through the site for the safe delivery and movement of derricks, cranes, trucks, other necessary equipment, and the material to be erected as well as means and methods for pedestrian and vehicular control. Compliance with this provision could be achieved by developing access roads and clearly demonstrated pedestrian areas, and maintaining these throughout the life of the project.

Paragraph (b)(2) would require that the controlling contractor also provide and maintain a firm, properly graded, drained area, readily accessible to the work and with adequate space for the safe storage of materials and the safe operation of the erector's equipment. The provisions in paragraphs (b)(1) and (b)(2) are necessary to ensure that a site is prepared for the safe commencement of steel erection at a site. The Committee determined and OSHA agrees that the responsibility to provide and maintain site conditions lies primarily with the controlling contractor, who is responsible for the overall project and is the employer in the best position to minimize the hazards associated with improper site layout and conditions. The provisions in proposed paragraphs (b)(1) and (b)(2) were derived from the

AISC code of standard practice for steel buildings and bridges (Ex. 9-36).

Proposed paragraph (c) addresses the hazards associated with overhead loads. Specifically, these hazards include failure of the lifting device, which would create a crushing hazard, and items falling from the load, which creates a struck by hazard. Given the nature of the loads used in steel erection, either of these events could result in serious injury or death.

Paragraph (c) would require that all hoisting operations in steel erection be pre-planned to ensure that no employee is required to be exposed to overhead hazards and that this pre-planning be done in accordance with § 1926.753(b), which contains criteria for working under loads, and § 1926.759, which contains requirements for falling object protection. (Although the specific requirements of proposed § 1926.753(b) and § 1926.759 are discussed later in the preamble, OSHA believes that including a cross-reference to these overhead protection requirements along with the other requirements that deal with site preparation and pre-planning would enhance safety and promote compliance.)

As a result of site-specific considerations, paragraph (d) would permit employers to elect, due to conditions specific to the site, to provide employee protection by means other than those specified in § 1926.753(a)(5), § 1926.757(a)(3), or § 1926.757(e)(4)(i), if they develop a site-specific erection plan that specifies alternative means and methods to be used. The site-specific erection plan would have to be developed by a qualified person, and the plan must be available to the employees at the site. During initial discussions, the Committee considered a requirement that would require every steel erection employer to develop a site-specific erection plan in writing for every project but decided that such a requirement would be unnecessarily paperwork-intensive, especially for small businesses. OSHA is providing, in Appendix A, a guideline for establishing the components of a site-specific erection plan, as recommended by the Committee. This appendix will assist employers in developing a site-specific erection plan. A site-specific erection plan will be easier to complete once the erector has developed a model plan. Some site-specific conditions that might lead an employer to rely on an alternative rather than the requirements specified in paragraphs § 1926.753(a)(5), § 1926.757(a)(3), and § 1926.757(e)(4)(i), and examples of possible alternative methods, are addressed in the

discussion of these paragraphs later in this preamble.

### *Section 1926.753 Hoisting and Rigging*

An essential element of steel erection is the rigging and hoisting of structural steel members and materials. Several hazards are associated with these operations. This section proposes requirements for hoisting and rigging operations during steel erection activities.

#### *Paragraph (a) General.*

Paragraph (a)(1) would require a pre-shift visual inspection of cranes to be used for steel erection. Paragraph (a)(1)(i) would require that, in addition to meeting the requirements of § 1926.550, cranes being used in steel erection activities be visually inspected prior to each shift by a competent person; this inspection must include observation of the equipment during operation to detect any deficiencies.

The current requirements of § 1926.550 require that all crawler, truck or locomotive cranes in use meet the applicable requirements for design, inspection, construction, testing, maintenance and operation prescribed in the American National Standards Institute (ANSI) standard B30.5-1968, Safety Code for Crawler, Locomotive and Truck Cranes (Ex. 9-114). In addition to the requirements of § 1926.550, OSHA has preliminarily concluded, and the Committee agrees, that a more frequent inspection is needed for cranes being used for steel erection. An inspection prior to each shift is necessary to provide an added measure of protection because the proposed rule would permit certain specialized and potentially hazardous types of hoisting operations. These hoisting operations include the use of cranes to hoist employees on a personnel platform (§ 1926.753(a)(4)); to perform multiple lifts (§ 1926.753(c)); and to suspend loads over employees (§ 1926.753(b)). Since these operations are inherently dangerous, it is particularly critical for the hoisting equipment to be in proper working condition, which means that a complete visual inspection must be performed before each shift by a competent person, e.g., the operator or oiler of the hoisting equipment being used or, on a large project, the master mechanic who checks each crane. This pre-shift visual inspection is anticipated to take between 10 and 20 minutes. At a minimum, the inspection would include the items listed in paragraphs (a)(i)(A) through (L); namely, inspection of (A) all control mechanisms for maladjustment; (B) control and drive mechanisms for excessive wear of

components and contamination by lubricants, water or other foreign matter; (C) safety devices, including, but not limited to, boom angle indicators, boom stops, boom kick-out devices, anti-two block devices, and load moment indicators where required; (D) air, hydraulic, and other pressurized lines for deterioration or leakage, particularly those which flex in normal operation; (E) hooks and latches for deformation, chemical damage, cracks, or wear; (F) wire rope reeving for compliance with hoisting equipment manufacturer's specifications; (G) electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, or moisture accumulation; (H) hydraulic system for proper fluid level; (I) tires for proper inflation and condition; (J) ground conditions around the hoisting equipment for proper support, including ground settling under and around outriggers, ground water accumulation or other similar conditions; (K) the hoisting equipment for level position; and (L) the hoisting equipment for level position after each move and setup.

These are the inspection criteria listed in the ANSI B30.5-1968 standard; this standard is referenced in the current OSHA crane requirements of § 1926.550. These criteria are also included in the updated ANSI B30.5-1994, *Mobile and Locomotive Cranes* standard (Ex. 9-113), as a guideline for items which should be included in a pre-shift visual inspection. Items (A) through (I) are essentially the same as the requirements contained in the ANSI B30.5-1994 standard. The Committee recommended using the B30.5-1994 standard as the basis of reference since it reflects the most up-to-date industry practices; OSHA agrees with this recommendation. In the B30.5-1994 standard, items (a)(1)(i)(A) through (I) must be inspected during frequent inspections which, according to that standard, are assumed to take place at daily to monthly intervals, although items (A) and (D) are specifically recommended for daily inspection by that standard. The Committee considered whether the items in (A) through (L) should be inspected daily rather than pre-shift. However, the Committee noted that if a crane or other piece of hoisting equipment is not used for several days, it is only necessary to inspect that equipment before the shift on which it is to be used. As recommended by the Committee, OSHA is proposing that equipment need not be inspected if it is not to be used that day. Items (J), (K) and (L) were added by the Committee to provide additional safety during the critical period when the

hoisting equipment is being set up. Item (J) is important when hoisting equipment is set up to ensure that all ground conditions in the area of the hoisting equipment are adequate to provide proper support for the hoisting equipment. Item (K) would simply require that the operator check a site glass, carpenter's level or the leveling mechanism contained on the hoisting equipment. Item (L) would ensure that, if the hoisting equipment is moved during a shift, it would be checked for level after setup. OSHA requests comment on whether, since items (A) through (K) are pre-shift inspections and item (L) is actually an inspection that takes place during the shift, item (L) should be placed elsewhere in paragraph (a).

As indicated above, the Committee intended these pre-shift inspections to reflect the current safe practices of the industry while at the same time imposing as little additional burden on the employer as possible. OSHA agrees with SENRAC's determination that a visual inspection is sufficient to accomplish these intentions, together with such movement of the crane as may be necessary to conduct the visual inspection. For example, to visually inspect the boom angle indicators the crane must be moved to determine that the indicators are functioning properly. Also, the anti-two blocking device can be visually inspected only by raising the headache ball to the crown block to ensure that the device automatically cuts off the power to the hoisting equipment. The ANSI B30.5 language, "[Inspect] tires for recommended inflation pressure," was interpreted by the Committee to mean that a tire pressure gauge should be used to determine inflation pressure. However, the SENRAC Committee believes that the tires need only to be visually inspected for proper inflation as well as for overall condition and that no tire pressure gauge is needed. The proposal, therefore, calls for a "visual inspection of tires for proper inflation and condition."

Paragraph (a)(1)(ii) would require that, after the pre-shift inspection has been completed and a deficiency has been identified, the competent person is to determine immediately whether the deficiency constitutes a hazard. This paragraph is essentially the same as the requirement in ANSI B30.5-1994. Paragraph (a)(1)(iii) proposes to require that, if the competent person determines that the deficiency constitutes a hazard, the hoisting equipment be removed from service until the deficiency has been corrected. The Committee felt and OSHA concurs that it is necessary not

only to determine that there is a deficiency but to ensure that the hoisting equipment is taken out of service until corrective actions are taken.

Paragraph (a)(1)(iv) would require that the employer keep a record of the inspection, including the date of the inspection; the signature of the person who inspected the hoisting equipment; and a serial number or other identifier for the hoisting equipment inspected. This certification record can be a check sheet or log book in which the operator or other inspector places a check mark next to the appropriate item on the list after visually checking it and then signs and dates the sheet or book. A crane operator's log book would be sufficient (Ex. 9-112).

Paragraph (a)(1)(v) would require that equipment operators be responsible for those operations under their direct control. Whenever there is any doubt as to the safety of the hoisting operation, the operator would have the authority to stop and to refuse to continue until safety has been assured. Since the operator is normally the most knowledgeable person about the equipment being used, OSHA agrees that the operator should have control over shutting down the equipment if it is believed to pose a safety concern. This requirement is identical to the parallel requirement in the ANSI B30.5-1968 standard for operating practices and is currently required since § 1926.550(b)(2) incorporates the ANSI B30.5-1968 standard by reference. The Committee decided that the B30.5-1968 requirement assigning responsibility for the safe operation of the hoisting equipment to the operator provides a greater degree of safety than the ANSI B30.5-1994 requirement, which places authority with the supervisor. A letter from a professional engineering firm to the secretary of the ASME B30 committee (Exhibit 9-133) addresses this issue as follows:

\* \* \* Control of a heavy-lifting operation solely under the direction of a supervisor or any other person who may be less qualified than he, is not prudent. The crane operator has instrumentation in the crane to base his action upon, and should be the ultimate person to make decisions about the capacity and safety of both the machine and lifting operation \* \* \*

A qualified crane operator can make decisions about handling a crane load. A supervisor may or may not have qualifications in safe crane operation. Safe crane operation belongs in the domain of qualified operators, not managers.

Paragraph (a)(2) would require that, prior to each shift, a qualified rigger inspect the rigging in accordance with

§ 1926.251 of this part. OSHA accepts the Committee's conclusion that it is not necessary to define the term "qualified rigger." A qualified rigger is thus simply a "qualified person" who is performing the inspection of the rigging equipment. Rigging would be inspected according to the requirements in § 1926.251 of this part, Rigging Equipment for Material Handling. To promote ease of compliance, the proposal provides a cross reference to that section.

Paragraphs (a)(3) and (a)(4) address the issue of transporting employees using hoisting equipment. Paragraph (a)(3) would prohibit the direct use of the headache ball, hook or load to transport personnel except as provided in paragraph (a)(1)(v)(4) of this section. These practices are widely recognized to be unsafe since they expose the employee to hazards of falling off the load or, in a case where the load falls, falling with the load.

Paragraph (a)(4) of the proposal would allow the use of cranes and derricks to hoist employees on a personnel platform (e.g., man basket) when work under this subpart is being conducted, even though the requirements of § 1926.550(g)(2), Crane or Derrick Suspended Personnel Platforms, prohibit the use of a crane or derrick to hoist employees on a personnel platform unless structural design or worksite conditions make conventional means more hazardous or infeasible. In steel erection, however, the work station moves progressively as pieces of structural steel are connected to each other. This means that elevators cannot be installed until much of the structure has been completed. Transporting ironworkers to a workstation elevated hundreds of feet in the air by hoisting a personnel platform with a crane eliminates the hazards associated with worker fatigue that can occur from climbing or walking up. The Committee also believes that many steel erection activities (particularly repetitive activities performed at different locations, such as bolting-up, that require a great deal of climbing up and down) can be performed much more safely and efficiently, and with greatly reduced exposure to hazards, when done from a personnel platform than from scaffolding. The time to perform the activity is only a fraction of the time to erect and dismantle the scaffolding that would be required to do the job safely. Exposures to fall hazards and other hazards associated with erection and dismantling of scaffolds for short term, repetitive activities are eliminated by the use of a personnel platform. The Committee further noted that, when cranes or lifts are used to hoist a

personnel platform, employees engaged in steel erection are still protected by the other requirements of § 1926.550(g). These include hoisting work practices, such as performing the lift in a slow, cautious and controlled manner; holding pre-lift meetings; conducting trial lifts; requiring a safety factor of ten; and the use of engineering controls, such as anti-two blocking protection and controlled lowering capability. OSHA agrees that these measures increase the safety of employees being hoisted on a personnel platform; OSHA seeks comment from interested parties on the issue of hoisting employees as a regular practice in steel erection.

Paragraph (a)(5) would prohibit safety latches on hooks from being deactivated or made inoperable except: when a qualified rigger has determined that the hoisting and placing of purlins and single joists can be performed more safely by doing so; or when equivalent protection is provided in a site-specific erection plan. Some activities in steel erection create a situation where it is actually safer to hoist members by deactivating the safety latch, e.g., when it eliminates the need for workers to climb up or onto unstable structural members, such as single columns or single bar joists, to unhook the member. The proposal would allow the employer to defeat or tie-back the safety latch in two situations: first, if a qualified rigger (during hoisting and placing of purlins and single joists) determines that deactivating the safety latch presents a lesser hazard than leaving it on, or second, if it provides equivalent protection and is incorporated as a safe practice for particular lifts in a site-specific erection plan. This would eliminate abuse of the technique and ensure that, when it is performed, the necessary precautions are taken. OSHA solicits information on the appropriateness of this approach, particularly with regard to the protection provided to the workers involved in such lifts.

*Paragraph (b) Working under loads.* The proposed requirements of paragraph (b) were patterned after requirements in § 5002 of the California Code of Regulations (Ex. 9-24D1) that regulate overhead loads for occasional unavoidable exposure.

Paragraph (b)(1) would require that routes for suspended loads be pre-planned to ensure that no employee is required to work directly below a suspended load, with exceptions for certain employees. Normally, hoisting operations can be performed from one location with a clear travel path and no overhead passes. OSHA understands, however, that overhead passes cannot

be eliminated entirely due to the complexity of modern construction, which requires that many activities take place concurrently. On many building sites, for example, existing buildings, structures, streets, overhead lines and so forth make it possible to hoist construction materials from one or two storage areas. As a result, loads must be moved over the same work areas throughout the course of the job. In addition, on some large projects, such as the construction of power plants, many hoisting operations take place simultaneously. In such situations, cranes must be located throughout the site to access every part of the project. Scheduling the work to avoid moving loads over occupied work areas is often not feasible. Although the proposed requirement allows loads to be moved overhead, it requires the employer to minimize such exposure to the extent possible.

Employees engaged in the initial connection of steel and employees necessary for hooking or unhooking the load are the only employees allowed to work directly below a suspended load, because they must do so to accomplish their jobs. This provision is intended to limit the number of employees exposed to the hazard of falling overhead loads.

OSHA has allowed employees to work under overhead loads in certain other, narrowly limited, work situations. For example, a similar provision is found in the OSHA construction standards in subpart Q of this Part, Concrete and Masonry Construction. Section 1926.704(e) of that standard provides:

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.

Similarly, the lift-slab section, § 1926.705(k)(1), allows some employees in certain operations to work under a suspended load; in this case, the operation involves lifting the slabs into place by the jacks:

No employee, except those essential to the jacking operation, shall be permitted in the building/structure while any jacking operation is taking place unless the building/structure has been reinforced sufficiently to ensure its integrity during erection.

When employees engaged in steel erection must work under a suspended load, such exposure must be governed by the criteria in paragraph (b)(2). These criteria require, first, that materials being hoisted be rigged to prevent unintentional displacement. In addition, safety hooks with self-closing latches or their equivalent must be used to prevent components from slipping out of the hook; this precaution eliminates the

chance of components disengaging from the hook and causing the load to fall. An equivalent device could be a hook with another type of closing device, *i.e.*, a hook with a spring-loaded gate or another type of safety hook that would provide the same level of safety as a safety hook with a self-closing latch. Finally, the loads must be rigged by a qualified rigger.

*Paragraph (c) Multiple lift rigging procedure.*

This section proposes specific performance and work practice requirements to be met when a steel erector chooses to lift multiple pieces of steel at one time as an alternative to single lifting of individual structural members. This procedure, also known as "christmas treeing" or "tandem loading," is not addressed in OSHA's existing steel erection standard. Although the hazards associated with the lifting of tandem loads are substantial, the Committee believes that the practice can be made safe if the means and methods set forth in this paragraph are strictly observed. In drawing this conclusion, the Committee considered the information described in the following paragraphs.

Floor beams currently in use are comparatively light and may not be strong enough to support a bundle of structural steel safely. Thus, the steel must be picked up from the ground. Picking up single beams one at a time is not always practical, and tandem loads significantly increase efficiency. Some safety benefits are associated with this procedure, including a reduction in the length of time connectors and others are exposed to the hazards posed by overhead loads because fewer swings are required, a reduction in the time connectors must spend out on the iron because tandem loading allows them to complete their tasks more quickly, and reduced stress on the crane operator because fewer mechanical operations are required.

An OSHA letter dated September 9, 1993, from the Director of the Office of Construction and Engineering to the Regional Administrator of Region 1 describes some of the benefits of christmas treeing:

Christmas treeing could indeed be productive and efficient on projects when erecting floor or roof filler beams, all of the same length and weight with similar details at each end of the beams. In large industrial projects where the location of the crane is much farther away from the bay under erection, christmas treeing could also prove to be efficient. Further, the practice reduces the total number of swings the crane makes in each project, thus reducing the risk of exposing the workers located in the vicinity

of the crane or in the path of travel of the load (Ex. 9-13G, p. 2).

Paragraph (c)(1) would provide the criteria that must be met for a multiple lift to be permitted at all under this rule. A multiple lift rigging assembly, as defined in the definition section, must be utilized. By definition, the assembly must have been manufactured by a wire rope rigging supplier. Since this is a specialized type of lift, the rigging assembly must have been designed specifically for the particular use in a multiple lift and meet the specifics of the definition. A multiple lift may not involve hoisting more than five (5) members during the lift. Limiting the number of members hoisted is essential to safety, and the Committee has determined that five members is the maximum number that can be hoisted safely, taking into account the necessity of controlling both the load and the empty rigging. In addition, this limit on the number of members recognizes that a typical bay, consisting of up to five members, could be filled with a single lift. Too many members in a lift may create a string that is too awkward to control or allow too much empty rigging to dangle loose, creating a hazard to employees.

In addition, only structural members may be lifted during a multiple lift. Other items, such as bundles of decking, do not lend themselves to the multiple lift procedure. A typical multiple lift member would be a wide flange beam section between 10 and 30 feet long, typically weighing less than 1,800 pounds. Employees engaged in a multiple lift operation must be trained in these procedures in accordance with § 1926.761(c)(1), which contains specific training requirements for employees engaged in multiple lifts. Due to the specialized nature of multiple lifts and the knowledge necessary to perform them safely, this training requirement is necessary to ensure that employees are properly trained in all aspects of multiple lift procedures.

Paragraph (c)(2) describes how the components of the multiple lift rigging assembly are to be designed and assembled. The employer must ensure that each multiple lift rigging assembly is designed and assembled with a maximum capacity for the total assembly and for each individual attachment point. This capacity, certified by the manufacturer or qualified rigger, would be based on the manufacturer's specifications and would have a 5 to 1 safety factor for all components. Since multiple lift rigging is special rigging used only for the

purpose of performing a multiple lift rigging procedure (MLRP), the rigging would be certified by the qualified rigger who assembles or the manufacturer who provides the entire assembly to ensure that the main line is capable of supporting the whole load and each hook is capable of supporting the individual members. The appropriate rigging assembly to be used is the lightest one that will support the load. Typically, one assembly is manufactured and certified for the heaviest anticipated multiple lift on the job, and this rigging is then used for all the MLRPs.

To ensure that a MLRP does not overload the hoisting equipment, the Committee recommended that OSHA propose a provision in paragraph (c)(3) that would prohibit the total load of the MLRP from exceeding either the rated capacity of the hoisting equipment as specified in the hoisting equipment load charts or the rated capacity of the rigging as specified in the rigging rating chart. Several crane manufacturers have recognized that MLRP is becoming an industry practice and have accepted the use of their cranes for this purpose provided that the crane is utilized in a manner consistent with the safe practices defined in the operator's manual and crane capacity chart (Ex.9-30). Paragraph (c)(3) proposes these provisions.

Paragraphs (c)(4) and (c)(5) address safe rigging for the multiple lift. Paragraph (c)(4) would require that the multiple lift rigging assembly be rigged with the members attached at their center of gravity and be kept reasonably level, be rigged from the top down, and have a distance of at least 7 feet (2.1 m) between the members. In practice, these procedures mean that the choker attached to the last structural member of the group to be connected would be the one attached on the rigging assembly closest to the headache ball. The next to last member to be connected would be attached to the next lower hook on the rigging assembly and so on. As each member is attached, it would be lifted approximately two feet off the ground to verify the location of the center of gravity and to allow the choker to be checked for proper connection. Adjustments to choker location would be made during this trial lift procedure. The choker length would then be selected to ensure that the vertical distance between the bottom flange of the higher beam and the top flange of the next lower beam is never less than 7 feet. Thus, when the connector has made the initial end connections of the lower beam and moves to the center of each beam to remove the choker, there



will be sufficient clearance to prevent contacting the upper suspended beam. Furthermore, although the OSHA letter referred to earlier (Ex. 9-13G) suggested that the beam spacing could be eight or nine feet, the Committee determined, and OSHA agrees, that seven feet is more appropriate since, in addition to the necessary clearance just mentioned, a typical connector could easily reach up and grab the member at seven feet but might have some trouble doing so if the spacing were greater. OSHA requests comment on whether spacing greater than 7 feet would constitute a hazard.

Once the members are ready to be set, paragraph (c)(5) would require that the members be set from the bottom up. Even though this is the only practical way that the members can be set, the inclusion of this proposed requirement promotes clarity.

Paragraph (c)(6) sets forth the proposed requirements for lowering the load. Like the hoisting of personnel platforms, multiple lifts must employ controlled load lowering when lowering loads into position for the connectors to set the members. OSHA agrees with the Committee's recommendation that such a device is essential to prevent potential accidents if the crane operator's foot should slip off the brake, the brake fails, or the load slips through the brake. When the load is over the connectors and is being lowered into place, the operator must have maximum control over the load. This proposed requirement would have prevented the July 20, 1990, fatality in Austin, Texas, referred to in Ex. 9-13G (p. 4).

Several members of the Committee stated that the use of a MLRP reduces total employee exposure to suspended load hazards as well as to the hazards associated with crane supported loads traveling horizontally. An MLRP is treated as an engineered lift and accordingly receives the full attention of the entire raising gang. The lifts are made in a more controlled fashion due to the special rigging and physical size of the assembled load. In addition, cranes used for multiple lifts must have controlled load lowering devices.

A Committee workgroup was formed to develop the MLRP section of the proposed regulatory text. This workgroup noted several additional benefits of MLRPs. For example, the increased weight of the load hoisted using an MLRP results in reduced swing, boom, and hoist speeds, which increases the amount of control the operator has over the lift. The workgroup also stated that crane operators report that the swing operation has the greatest potential for operator error and loss of load control,

and therefore that reducing the number of swings enhances safety. The workgroup thus believes that the reduced number and speed of swing operations associated with MLRPs will increase safety, and that lift precision will also be increased because MLRPs require that controlled load lowering devices be used on cranes making such lifts. When the operator is working in the blind (where the connectors cannot be seen), according to the workgroup, reducing the number of swing cycles is particularly important because it minimizes the opportunity for a communication error, which could cause an accident. Furthermore, the workgroup stated that the total suspended load time and the frequency of loads passing overhead are reduced for all non-erection personnel on the job when an MLRP is being performed. This is particularly important, according to the workgroup, because these workers normally are occupied with other tasks and often do not pay attention to suspended loads that may be passing overhead. This group of employees includes those working under canopies and partially completed floor systems who cannot see hoisted material passing overhead but could be injured if a load were dropped.

In addition, when single pieces are hoisted, the emphasis is often on speed. The lift is hoisted, swung and boomed at maximum crane speed in an effort to maximize production. Under these circumstances, the Committee felt that single piece hoisting increases the potential for problems in the hoist sequence and in the final placement of each member and additionally contributes to operator fatigue.

According to the workgroup, a great safety benefit of multiple lifting is that the manipulation of the members at the point of connection limits the movement of the hoist hook, in most cases, to an area less than 10 feet in diameter and additionally requires that such movement be done at a slow speed and with maximum control. The hazard that connectors consider the most serious, that of a high speed incoming beam, is thus minimized using the MLRP process.

#### *Section 1926.754 Structural Steel Assembly*

This section sets forth the proposed requirements for the assembly of structural steel.

Paragraph (a) would require that structural stability be maintained at all times during the erection process. This would be a general requirement for any type of steel structure. Since structural stability is essential to the successful

erection of steel structures, this proposed section is intended to prevent collapse due to lack of stability, a major cause of fatalities in this industry.

Paragraph (b) proposes additional requirements specifically for multi-story structures. Paragraph (b)(1) would require that permanent floors be installed as the erection of structural members progresses and that there be not more than eight stories between the erection floor and the upper-most permanent floor, except where the structural integrity is maintained as a result of the design. This paragraph is identical to existing § 1926.750(a)(1) in OSHA's steel erection standard.

Paragraph (b)(2) would prohibit having more than four floors or 48 feet (14.6 m), whichever is less, of unfinished bolting or welding above the foundation or uppermost permanently secured floor, except where the structural integrity is maintained as a result of the design. This paragraph is essentially the same as existing § 1926.750(a)(2), except for the addition pertaining to situations where structural integrity is maintained as a result of the design. The Committee recommended an exception similar to that in paragraph (b)(1) to allow for flexibility in design.

Paragraph (b)(3) would require that a fully planked or decked floor or nets be maintained within 2 stories or 30 feet (9.1 m), whichever is less, directly under any erection work being performed. This is essentially the same provision as existing § 1926.750(b)(2)(i), except that the proposed revision adds the option of installing nets in addition to the planked or decked floor options. Paragraph (b) thus retains many of the requirements of OSHA's existing steel erection rule.

*Paragraph (c) Walking/working surfaces.* This paragraph sets forth proposed requirements to control the slipping/tripping hazards encountered when working on steel structures. The Committee pointed out that the hazards posed by shear connectors need to be addressed in any revision of subpart R. Shear connectors are commonly found in bridges and in other types of steel erection. When attachments, like shear connectors, are shop-welded to the top flange of beams, the resulting projections can create a significant tripping hazard. Field installation of these attachments can significantly reduce exposure to this hazard. Any costs imposed by field installation of the attachments is likely to be more than offset by the increased productivity and safety for employees who walk on the top flange of the structural steel. It is much safer to walk on a beam that is not

studded with these shear connectors or otherwise covered with a temporary working surface. The installation of these shear connectors needs to be performed on a beam in a manner that allows the installer to maintain a clear walking surface.

Paragraph (c)(1)(i) would prohibit the attachment of shear connectors (such as headed steel studs, steel bars or steel lugs), reinforcing bars, deformed anchors or threaded studs to the top flanges of beams, joists or beam attachments so that they project vertically from or horizontally across the top flange of the member until after the decking, or other walking/working surface, has been installed.

Additionally, paragraph (c)(1)(ii) would require that when shear connectors are utilized in the construction of composite floors, roofs and bridge decks, employees lay out and install the shear connectors after the decking has been installed, using the deck as a working platform. This paragraph would also prohibit the installation of shear connectors from within a controlled decking zone (CDZ), as specified in § 1926.760(c)(8).

SENAC reviewed the issue of slippery surfaces caused by painted or coated steel. The Committee found that a major cause of falls in the steel erection industry is the presence of slippery walking, working and climbing surfaces in steel erection operations when fall protection is not used. The problem initially arises from the application of protective coatings on structural steel used, for example, in the construction of mills, chemical plants and other structures exposed to highly corrosive materials as well as in the construction of stadiums or other structures exposed to varying weather conditions. It is usually impractical to leave the steel uncoated and then to paint the entire structure in the field after erection. Unfortunately, steel coated with paints or protective coatings can be extremely slippery. When there is moisture, snow, or ice on coated steel, the hazard is increased. Related to this is the issue of the slipperiness of metal decking.

The problem of slipperiness created by coated steel has been discussed by industry and union safety committees for more than two decades. In the late 1970's, a study was conducted by the National Bureau of Standards. This study, according to a SENAC workgroup, reached no definite conclusions and proposed no solution (Ex. 9-10). At the urging of labor and management during the late 1980's, a NIOSH sponsored study entitled, "Correlation of Subjective Slipperiness

Judgments with Quantitative COF Measurements For Structural Steel," was conducted by the University of Oklahoma's Institute for Safety & Ergonomics Studies (Ex. 9-10). This study looked into the effects that protective coatings have on the slipperiness of structural steel. Once again, according to the SENAC workgroup, the data did not provide a sufficient basis for determining adequate means for controlling or eliminating the slippery surfaces on painted structural steel members.

Slipperiness of painted surfaces has been a problem not only in the United States but also in Canada. In the Province of Alberta the problem has been addressed by requiring the use of an anti-skid coating. Although use of this coating involves an added cost, this cost is not significant, according to those involved (Ex. 9-10).

A SENAC workgroup considered all the information available to it and recommended that SENAC adopt a performance standard that would mandate a minimum 0.5 static coefficient of friction (COF) for all working, walking and climbing surfaces when they arrive on the job site. The workgroup noted that the slippery surface issue was originally limited to slippery paint on structural members but had been expanded to include metal decking.

This recommendation of the SENAC workgroup was questioned by some members of the industry, including the Steel Deck Institute (SDI) (Ex. 9-87) and the Metal Building Manufacturers Association (MBMA) (Ex. 9-129). The main concern expressed by these groups was how an employer would know that it was in compliance, and, specifically, how surfaces would be tested to determine that this COF had been achieved and what instrument would be used to make this determination. An expert on slip prevention made a presentation to the Committee on how to measure the COF of a slippery surface.

The expert reviewed the primary methods for testing the slipperiness of surfaces. The first instrument was described as a drag meter. A major limitation of this device is that it will not work on dirty or wet surfaces. Thus, testing wet and dirty surface conditions which actually occur on job sites is impossible using this device. A second instrument was an articulated strut device. This device is currently being tested by the American Society for Testing and Materials (ASTM). A third device examined was a pendulum-like device. It is limited in that it requires a level floor for proper measurement.

Lastly, the expert described a measuring device that he has developed that measures not COF but slip resistance. He noted that this instrument has been modified and is available as a portable unit. He described two major advantages to this device: it can test wet surfaces and it can be used in the field to test surfaces as they are actually walked on.

Following this presentation and after lengthy discussions on the slippery surface issue, the Committee concluded that conclusive studies and documented information on the subject of slippery surfaces in steel erection are not available. To obtain more information, the Committee agreed that a study should be conducted by the expert to test these slippery surfaces. This study, commissioned by SENAC, was conducted in May of 1995 under the guidance of the SENAC workgroup. In a final report of the study to SENAC (Ex. 9-64), the expert summarized the methodology and findings. Seven surfaces were tested under both wet and dry conditions using two different instruments. In addition to these mechanical tests, five ironworkers ranked how slippery these surfaces felt while walking on them. The two results were compared. A minimum standard for slip resistance was set forth in the report.

The study was presented to SENAC and suggested the following tentative draft regulatory text for discussion based on the recommendation of the study: "all painted, coated or otherwise visibly treated skeletal structural steel members that are walking/working surfaces shall have a finish that has a slip index of .75 or higher as measured with an English XL Slip-Resistance tester or a slip index of .60 or higher as measured with a Brungraber, Mark II Slip Tester and would have to be tested in accordance with certain test procedures set out in an appendix." The Committee determined, based on information obtained from and presentations given by industry groups at SENAC meetings, that the draft language was not acceptable. The industry groups providing information included the Steel Deck Institute (Ex. 9-73), the Metal Building Manufacturers Association (Ex. 9-74), the Metal Construction Association (Ex. 9-75), Bethlehem Steel (Exs. 9-106 and 9-110), the National Coil Coaters Association (Ex. 9-108), American Iron and Steel Institute (Ex. 1-109), and the American Institute of Steel Construction (Ex. 9-128). The Committee thus concluded that it could not determine a minimum value for slip resistance or COF, given all the variables to be

considered, nor could it agree on an acceptable testing method.

The Committee next decided to separate the issues of slippery surfaces on metal decking and on structural steel. Furthermore, based on perceived differences in the feasibility of compliance, there was general agreement that a requirement for structural steel could be proposed while one for metal decking should not be proposed at this time.

The Committee, consequently, recommended that OSHA propose paragraph (c)(3) to prohibit workers from walking the top surface of any structural steel member which has been finish coated with paint or similar material unless documentation or certification, based on an appropriate ASTM standard test method, is provided stating that the finished coat has not decreased the COF from that of the original steel before it was finish-coated. This documentation or certification must be available at the site and to the steel erector. Rather than define a minimum requirement for the COF, the Committee decided to ensure that the product on which the workers are walking/working is no more slippery than bare, uncoated steel, which is considered by the Committee to be safe to walk/work on, even when wet. OSHA seeks comments and additional information on this point and on the availability of methods to increase the safety of workers in this situation and to measure the slipperiness of such surfaces. There are currently two ASTM standardized test methods for determining the COF of wet surfaces, thus enabling the painted or coated surface to be tested for possible certification that the COF has not decreased (see Appendix B).

With regard to the issue of the slipperiness of metal decking, OSHA is reserving paragraph (c)(2) to allow additional time to study the slippery surface aspects of metal decking and identify a solution to the problem. A coalition of steel-producing and steel-related organizations has indicated its intention to gather data and prepare comments with respect to paragraph (c)(2). The coalition intends to identify the principal factors contributing to slip and fall injuries in steel erection, and devise feasible and effective approaches to reduce those risks (Ex. 9-151). OSHA invites additional comments and information on walking/working surfaces and the slippery aspects of metal decking from other interested parties.

*Paragraph (d) Plumbing-up.* Paragraph (d)(1) would require that connections of the equipment used in

plumbing up be properly secured. This is identical to existing § 1926.752(d)(1) of OSHA's steel erection standard. Paragraph (d)(2) would require that plumbing-up equipment be removed only with the approval of a competent person. This is essentially the same as existing § 1926.752(d)(4), except that the word "guys" is changed to "equipment" and "under the supervision" is changed to "with the approval." In addition, Committee members noted that, with respect to open web steel joists, the stabilizer plate requirement of proposed § 1926.757(a)(4) will greatly facilitate the plumbing-up of structures. It should be noted that several SENRAC members have raised an issue (issue #3 in section VI, Other Issues) regarding the adequacy of this performance language.

*Paragraph (e) Decking.* This paragraph sets forth the proposed requirements to protect employees during decking operations, including the installation of metal deck (metal deck is defined in the definition section of this standard). The Committee recognized that improper installation of decking can cause accidents. Analyses of the fatality/catastrophe reports in OSHA's IMIS system by SENRAC and OSHA staff (Exs. 9-14A, 9-42 and 9-49) indicate that falls related to decking when fall protection is not used account for a large percentage of steel erection related fatalities. The proposed requirements contained in paragraph (e) attempt to address many of the hazards which cause decking accidents.

Paragraph (e)(1) deals with some of the common hazards associated with hoisting, landing and placing of deck bundles. Many of the proposed requirements of this paragraph are adapted from the *Steel Deck Institute Manual of Construction With Steel Deck* (Ex. 9-34A).

Paragraph (e)(1)(i) would prohibit the use of bundle packaging and strapping for hoisting unless specifically designed for that purpose. Bundle straps usually are applied at the factory and are intended to keep the bundle together until it is placed for erection and the sheets are ready to be spread. Decking is bundled differently; some manufacturers design the strapping to be used as a lifting device. However, hoisting a bundle by straps that are not designed for lifting is extremely dangerous. The bundle straps can break apart or loosen, creating a falling object hazard or, if a structural member is hit by the bundle or its contents, a potential collapse hazard.

Paragraph (e)(1)(ii) would require that, if loose items such as dunnage, flashing, or other materials are placed on top of deck bundles which are being

hoisted, such items must be secured to the bundles. Sometimes, to expedite unloading and hoisting, items such as dunnage or flashing are placed on the decking bundle to save time. Dunnage, for example, will be sent up with the bundle to help support it on the structure and to protect the decking which has already been installed. This proposal would prevent hoisting loose items or "piggy backing" unless the items are secured to prevent them from falling off the bundle in the event that it catches on the structure and tilts.

Paragraph (e)(1)(iii) would require that the landing of bundles of decking on joists be conducted in accordance with proposed § 1926.757(e)(4). This requirement is a cross-reference to the joist section of the proposed standard. Paragraph (e)(4) of that section sets out proposed criteria for landing decking on joists and will be discussed later in the preamble.

Paragraph (e)(1)(iv) also addresses the landing of bundles. Under this proposed requirement, bundles would be landed on framing members that provide sufficient support for unbanding the bundles. The bundles would have to be set in such a manner that the decking can be unbanded without losing the support of the structure. If the blocking should move while the bundle is being unbanded, the bundle would be required to have enough support to prevent it from tilting and falling into "the hole." The analysis of the fatality/catastrophe reports produced from OSHA's IMIS system (Exs. 9-14A, 9-42 and 9-49) identified the improper landing of bundles of decking as a significant factor in decking accidents because it may cause a collapse of the support members and/or bundle. Proposed paragraphs (e)(1)(iii) and (iv) are intended to eliminate these hazards by providing direction for properly landing decking bundles.

Paragraph (e)(1)(v) would require decking to be secured against displacement after the end of the shift or when environmental or jobsite conditions warrant. This requirement would prevent decking from being left unsecured between shifts or overnight and would prevent decking from becoming dislodged from the structure or bundle because of environmental conditions such as high wind. A gust of wind may cause individual sheets to peel off an unsecured bundle of decking and fly through the air. Wind can also move a sheet of loose decking and create a hazard where an employee inadvertently steps onto a loose piece of decking, believing it to be secured.

*Paragraph (e)(2) Roof and floor openings.* This paragraph proposes steel

erection procedures for installing metal deck at roof and floor openings to prevent, among other things, the hazard of employee falls through deck openings. The Committee found such falls to be a major cause of decking accidents.

Paragraph (e)(2)(i) would require that, where structural design and constructibility allow, framed deck openings have structural members turned down to allow continuous deck installation. Requiring framed deck openings to be turned down allows continuous decking to be performed without having to cut the deck around the opening. This procedure generally applies to small openings rather than larger openings, such as elevator or mechanical shaft openings; it may not be appropriate to cut the decking around larger openings at a later time.

Paragraph (e)(2)(ii) would require that roof and floor openings be covered during the decking process so that uncovered openings do not create potential fall hazards. If the design of the structure does not allow for covering of the roof and floor openings, they must be protected in accordance with proposed § 1926.760(a)(2). Openings for elevator shafts and stairs are typically too large to cover and would usually be protected with a guardrail. To decrease even further the possibility of an employee falling through a deck opening, proposed paragraph (e)(2)(iii) would require that decking holes and openings not be cut until necessary for the construction process. Once cut, however, openings would have to be protected immediately in accordance with § 1926.760(d), which sets forth the criteria for covering roof and floor openings, or they would have to be otherwise permanently filled (i.e., filled with the equipment or structure intended for the opening, at which time the opening would no longer be a fall hazard).

Paragraph (e)(3) would require that wire mesh, exterior plywood, or the equivalent, be installed around columns where planks or decking do not fit tightly. Gauge metal, typically cut out to the profile of the column, is commonly used for this purpose and would be considered an equivalent material. This provision is identical to existing § 1926.752(h), except that the proposed provision adds "or decking" to make clear that the requirement to cover open areas around columns applies during decking operations both to prevent falls and to prevent items from falling through these openings to lower levels.

Paragraph (e)(4) would require that decking be laid tightly and secured to prevent accidental movement or

displacement. This is essentially the same as existing § 1926.752(f) of OSHA's steel erection standard. The analysis of the fatality/catastrophe reports of data in OSHA's IMIS system (Exs. 9-14A, 9-42 and 9-49) established that stepping onto or working on unsecured decking is a factor in decking accidents.

Paragraph (e)(5)(i) would require that a derrick floor be fully decked and/or planked and the steel member connections be completed so as to support the intended floor loading. Paragraph (e)(5)(ii) would require that temporary loads on a derrick floor be distributed over the underlying support members to prevent local (spot) overloading of the deck material. These provisions contain essentially the same requirements as those in existing § 1926.750(b)(1)(i). OSHA is clarifying and updating the existing requirement, but the basic concept of the provision would be unchanged. This provision would apply mainly to multi-story structures and is intended to ensure that the derrick or erection floor has been installed with all required bolts and that final decking has been completed before the floor is loaded and the sequence of constructing subsequent levels begins. This level, which then becomes the working level for the erection of floors above, may need to support a derrick and the steel members required for the erection of those levels. Such temporary loads would have to be distributed evenly over the derrick floor to ensure stability.

#### *Section 1926.755 Anchor Bolts*

This section addresses the hazards associated with column stability and, specifically, the proper use of anchor bolts to ensure column stability. The Committee concluded that inadequate anchor bolt installation could be a factor in causing structure collapses. One participant, a connector by trade, addressed the Committee and asserted that collapses due to poor footings and anchor bolts are currently the primary cause of connector accidents (Ex. 6-3, p. 4). The Committee was in general agreement; OSHA solicits comments and additional information on the relative importance of these and other causes of structural collapse and the extent to which they result in falls during steel erection activities.

This section sets out parameters for properly installing and, when necessary, modifying anchor bolts. Paragraph (a) proposes general requirements for ensuring erection stability. Paragraph (a)(1) would require that all columns be anchored by a minimum of 4 anchor bolts. Additionally, as discussed below,

this paragraph would require that column anchor bolt assemblies, including the welding of the column to the base plate, be designed to resist a 300 pound (136.2 kg) eccentric load located 18 inches (.46 m) from the column face in each direction at the top of the column shaft. The Committee listened to some presenters who were of the opinion that there may be some types of columns that may require only two anchor bolts. Also, it was contended by some participants that space limitations or structural considerations may limit the size of the base plate or the bearing surface (particularly on a masonry wall) so that it is not wide enough to allow the placement of four anchor bolts. The Committee recommended, however, that OSHA propose to require a minimum of four anchor bolts for all columns, for the reasons discussed above. In some instances, installing two anchor bolts at the column base might create a stable structure, but this would not be the case until after all of the horizontal beams have been installed and the frame has been completed. Until the frame has been completed, using two bolts could cause a hinge effect that could tip the column. Requiring all column anchorages to have four bolts eliminates the possibility of creating this hinge effect.

Additionally, since a connector with a tool belt must climb the column, which creates an eccentric load on the column, proper anchor bolt installation is doubly necessary. Anchor bolt assemblies would have to be designed to resist a 300 pound (136.2 kg) eccentric load located 18 inches (.46 m) from the column face to prevent the column from toppling over with a worker on it. Based on a SENRAC workgroup determination, 300 pounds (136.2 kg) represents the maximum weight of an ironworker with a tool belt. Eighteen (18) inches (.46 m) off the face of the column is the center of gravity for an ironworker climbing a column.

Paragraph (a)(2) addresses the setting of columns and would require that columns be set on level finished floors, pre-grouted leveling plates, leveling nuts, or shim packs which are adequate to transfer the construction loads. This proposed requirement is intended to ensure that the column sits on a level surface. Placing a column on a surface that is not level could allow the column to pivot and pull out the anchor bolts, creating a collapse hazard.

Paragraph (a)(3) would require that unstable columns be evaluated by a competent person and be guyed or braced where deemed necessary. If it is determined, for example, that the

anchor bolts could potentially be pulled out under field conditions, the competent person can elect to guy or brace the column.

*Paragraph (b) Repair, replacement or field modification.* This paragraph addresses the situation where the steel erector may be working after another contractor who has repaired, replaced or modified an anchor bolt. The steel erector often cannot visually tell when an anchor bolt has been repaired and thus will not be aware of the repair unless notified that a repair has been made. If an anchor bolt has been improperly repaired, replaced or modified, it could lead to a collapse. The intent of this proposed paragraph is to ensure that the erector has the opportunity to make sure that any work on anchor bolts has been adequately performed.

Paragraph (b)(1) would prohibit the repair, replacement or field modification of anchor bolts without the approval of the project structural engineer of record. This would ensure that any change to the original anchor bolt is performed in a manner consistent with original specifications.

Paragraph (b)(2) would require that any such approval by the project structural engineer of record also indicate any requirements for special column guying or bracing as a result of the repair, replacement or modification. If the project structural engineer of record has approved the repair, replacement, or field modification, guying or bracing may be required as a precaution.

Paragraph (b)(3) would require that, prior to the erection of a column, the controlling contractor provide written notification to the steel erector if there has been any repair, replacement or modification of the anchor bolts for that column. This proposed requirement, working in conjunction with proposed § 1926.752(a)(2), completes the communication loop. Generally, the steel erector does not have contact with the project structural engineer of record and would rely on the controlling contractor to convey any notification from the project structural engineer of record. This form of communication between the controlling contractor and steel erector is already a common jobsite practice.

#### *Section 1926.756 Beams and Columns*

This section sets forth proposed requirements for connections of beams and columns to ensure stability of the steel structure during the erection process. Recognizing that inappropriate or inadequate connections of beams and columns is inherently hazardous and

can lead to collapse and worker fatalities, the Committee recommended, and OSHA proposes, a combination of performance and specification requirements to address these hazards.

*Paragraph (a) General.* This paragraph would require that, during the final placing of solid web structural members, the load not be released from the hoisting line until the members are secured with at least two bolts per connection, drawn up wrench-tight, or the equivalent as specified by the project structural engineer of record. This is identical to existing § 1926.751(a) of OSHA's steel erection standard, except that "or the equivalent as specified by the project structural engineer of record" has been added to allow for alternative types of connections such as welding, or, in the case of heavy members, allowance for more than two bolts.

*Paragraph (b) Diagonal bracing.* Paragraph (b) would allow solid web structural members used as diagonal bracing to be secured by a single bolt per connection, drawn up wrench-tight or the equivalent as specified by the project structural engineer of record. In many cases, solid web structural members such as channels or beams are used as diagonal bracing or wind bracing. These members technically fall under paragraph (a) above; however, since they are used in a different application, i.e., as bracing to be welded at a later time, a one-bolt connection is sufficient. These members play a different role in erection stability since they are designed to provide stability for the final completed structure and are not used as walking/working surfaces. Compliance with this provision would provide safe connections for these members.

*Paragraph (c) Double connections at columns and/or at beam webs over a column.* "Double connections" are an essential method for connecting structural steel members in some design concepts. However, these connections can pose significant hazards while erecting structural steel. When a double connection at a column is not properly executed, the resulting failure can lead to the immediate collapse of the entire structure, endangering the connector and every other worker on or around the structure. At one of the SENRAC meetings, several types of double connections were demonstrated with the use of scale model structural web members, together with a discussion of why they are hazardous and how they can be made safely. Proposed paragraph (c) would require that, when two structural members on opposite sides of a column web, or a beam web over a

column, share common connection holes, at least one bolt with its wrench-tight nut must remain connected to the first member unless a shop-attached or field-bolted seat or similar connection device is present to secure the second member and prevent the column from being displaced. When seats are provided, the connection between the seat and the structural member that it supports must be bolted together before the nuts are removed for the double connection.

A double connection, by definition, is one where more than two pieces of steel are bolted together using the same (common) bolts. This can occur where two beams are bolted to opposite sides of a column web or to the opposite sides of a beam or girder. OSHA's current steel erection standard does not address this practice. When utilizing a double connection in field erection procedures, a beam is first bolted to another beam or column. Later in the erection sequence, another beam or other member is added to the opposite side of the existing connection, using the same holes and the same bolts to "make up" the third piece in the connection. This is the situation where the practice of double connections becomes a safety concern: the nuts must be removed from the initially placed connection bolts and these bolts are then backed out to the point where they barely grip the first two pieces of steel, so that the third piece can be lined up with the existing holes. Then the same bolts are pushed back through all the holes and the nuts are tightened on the bolts to secure the three pieces of steel together. This maneuver is extremely dangerous for the connector because of the tenuous grip of the loosened bolts and the possibility that the connector's spud wrench, which is used to align the incoming piece, may slip. If at any time during the process, the carrying member (i.e., the central member to which the other two members are being attached) reacts to residual stresses developed through welding and/or misaligned connections at lower elevations, the carrying member can move suddenly, causing the bolts or the spud wrench to become dislodged. The incoming third member can also cause problems if it bumps up against the fitting or wrench end. Additionally, crane operators, wind, building movements and the connector straining to make a tough connection impose stresses that can lead to disengagement of the connection.

Several methods for performing double connections safely were discussed by the Committee. For example, a seat lug could be inserted on one side of a column, below the

connection point. When the first beam is placed, two bolts could be inserted downward into the seat lug. This would leave the other side of the column web clear so that the new beam could be positioned without disconnecting the beam on which the connector sits. In another method, an extra set of holes on one side of the connection could be added to secure the first beam installed. This would require that the connection plate on the end of the first beam be enlarged so that two additional holes could be placed just below the double connection point. Bolts could be placed in these two holes to secure the beam to the column. Even though these two bolts would go through the web of the column, they would be located below the area where the second beam would be aligned. This again would not require the connector to disconnect the first beam to allow for the second beam to be positioned. This is the configuration used for a double connection situation in Canada, called the "clipped end plate connection" (Ex. 9-27).

As mentioned earlier, double connections are essential in steel erection and cannot be eliminated; they can, however, be performed safely. The proposed requirements address hazards that exist whenever there are double connections which present a danger of structural collapse. It should be noted that double connections of filler beams in the webs of girders are not considered to be an unsafe situation and are not subject to the requirements of paragraph (c). This is because once the bay is "boxed," all filler beams are trapped between the girders. The connector sits on the girder while making the double connection and has no exposure to collapse of the individual members. In these cases there is no reason to require bolts to remain in the connection or seats or other devices to restrain the first member while the second is being erected. The seat or similar device requirement of this paragraph is also addressed in the corresponding requirement in the latest American National Standards Institute (ANSI) A10.13-1989, Steel Erection-Safety Requirements standard (Ex. 9-35), which provides that "when double connections are involved, the structural detailer and fabricator shall be consulted concerning the provisions for a seat lug or flange length extension on one of the beams, and a corresponding bolt hole in the web of the column floor or beam." The ANSI requirement does not, however, explicitly require a seat or similar device as proposed paragraph (c) would.

*Paragraph (d) Column splices.* This paragraph would require that each

column splice be designed to resist a 300 pound (136.2 kg) eccentric load located 18 inches (.46 m) from the column face in each direction at the top of the column shaft. This is similar to the proposed strength requirement for anchor bolts in § 1926.755(a)(1). In the same manner as anchor bolts, a column splice must be designed to allow for a worker to climb the column to perform work. These splices are joints that are temporarily fastened until the final welding or bolting is performed, and they must be sufficient to support the worker without folding over.

*Paragraph (e) Perimeter columns.* This paragraph would require that perimeter columns extend a minimum of 48 inches (1.2 m) above the finished floor to permit installation of perimeter cables, prior to erection of the next tier except where structural design and constructibility do not allow.

*Paragraph (f) Perimeter safety cables.* Paragraph (f)(1) would require that perimeter safety cables be installed during the structural steel assembly of multi-story structures. Paragraph (f)(2) would require that the perimeter safety cables consist of 1/2-inch wire rope or equivalent and be installed at 42-45 inches above the finished floor and at the midpoint between the finished floor and the top cable. Paragraph (f)(3) would require that where structural design and constructibility allow, holes or other devices be provided by the fabricator/supplier in, or attached to, perimeter columns at a height of 42 to 45 inches above the finished floor and at the midpoint between the finished floor and the top cable to permit installation of perimeter cables.

Proposed paragraphs (e) and (f) update and clarify the existing requirement in § 1926.750(b)(1)(iii) of OSHA's steel erection standard. They clarify that the columns need to extend far enough above the floor decking to facilitate the installation of perimeter cable. The perimeter cable must be installed at a height of 42 to 45 inches above the finished floor and at the midpoint between that cable and the finished floor level. These safety cables provide fall protection at the perimeter of the structure and are to be installed as soon as the deck has been installed to provide protection to subsequent detail crews. These perimeter safety cables are not intended to be used as lifelines or as attachment points for fall protection systems but rather as a guardrail system. The holes or other devices necessary to accommodate the safety cables would have to be provided by the fabricator of the columns prior to installation to enable the cables to be installed readily in the field after the

columns have been erected. The AISC raised concerns regarding the impact of paragraph (f) on steel fabricators. The AISC is concerned that this provision will create liability for the fabricator, confuse existing contractual relationships, and create new feasibility and materials handling problems (Ex. 9-151). However, both SENRAC and OSHA believe that the enhanced safety afforded by this provision is necessary and the Agency seeks comment on this issue.

The proposed requirements in paragraph (e) and (f) do allow for cases where the design of a structure would not allow either for the columns to extend 48 inches (1.2 m) above the finished floor or for the holes or other devices to be provided by the fabricator. Proposed Appendix F provides a guideline to assist employers in complying with these paragraphs.

#### *Section 1926.757 Open Web Steel Joists*

Some of the most serious risks facing the ironworker are encountered during the erection of open web steel joists. A limited analysis of ironworker fatalities from January 1984 to December 1990, discussed in Section IV—Hazards in Steel Erection, indicated that, of the approximately 40 fatalities caused by collapse, more than half were related to the erection of steel joists (Ex. 9-14A). Although the existing OSHA steel erection standard addresses these hazards in a limited manner, this proposed section utilizes a combination of specification and performance requirements that will provide more comprehensive protection to workers engaged in these activities. SENRAC developed these proposed requirements in cooperation with the Steel Joist Institute (SJI) and many of its member companies.

*Paragraph (a) General.* Paragraph (a) addresses the erection of steel joists in general. Paragraph (a)(1) would provide that where steel joists or steel joist girders are utilized and columns are not framed in at least two directions with solid web structural steel members, the steel joist or steel joist girder must be field-bolted at or near columns to provide lateral stability to the column during erection. This proposed paragraph refines the existing steel erection standard provision, § 1926.751(c)(1), which is otherwise identical to the proposed requirement, by adding the words "solid web" before "structural steel members" and expanding "bar joist" to "steel joists or steel joist girders." These additions are necessary clarification in light of technological advances in the industry.

Specifically, the existing language was developed at a time when the only structural steel involved in steel framing was solid web members. In the mid 1970's, the steel joist industry developed the steel joist girder to be used as a primary member in steel framing to support steel joists. Bolting these connections is considered preferable to other methods of connection because bolting provides the greatest safety while requiring the least amount of time and equipment.

Several other provisions in this proposed paragraph refer to special requirements for connections at the column. Paragraph (a)(2) would require that steel joists at or near the column that span 60 feet or less be designed with sufficient lateral stiffness that, when bolted at both ends, and with the bottom chord restrained at each end with the required column stabilizer plate (required by paragraph (a)(4) of this section), the joist does not need erection bridging to prevent it from rotating when an employee goes out onto it to release the hoisting cable. The existing rule prohibits placing any load on joists until erection bridging has been installed. However, since the joist at the column is the first joist in place, there is no place to attach erection bridging and, consequently, the joist itself must possess sufficient lateral stiffness to allow the erection process to progress safely.

The next provision, paragraph (a)(3), addresses a longer steel joist at the same position. The Committee preliminarily determined, and OSHA is proposing, that steel joists that span more than 60 feet located at columns must be set in tandem, i.e., two steel joists must be attached together, usually with bolted diagonal erection bridging, to ensure stability. These joists are commonly used in larger open structures such as warehouses, gymnasiums and arenas. This proposed provision would allow the use of alternate means of erection of such long span steel joists, provided that the alternative is designed by a qualified person to ensure equivalent stability and is included in the site-specific erection plan.

Proposed paragraphs (a)(4) and (a)(5) also refer to connections at the column. Paragraph (a)(4) is a specification for the column that would require a stabilizer plate to extend at least 3 inches (76 mm) below the bottom chord of the steel joist or steel joist girder. The plate would be required to have a  $1\frac{3}{16}$  inch (21 mm) hole placed in it to provide an attachment point for guying or plumbing cables. Paragraph (a)(5) works in conjunction with paragraph (a)(4) and would require that the bottom chords of

both the primary steel joist girders and the secondary steel joists at columns be stabilized to prevent rotation.

The foregoing provisions will result in a more stable primary structure upon which to erect steel joists. In addition, a stabilizer plate provides a ready attachment point for more efficient guying. The sequence of guying is essential to safety. These proposed requirements allow the erector more easily to guy the structure to prevent collapse as the steel is set in place. Moreover, compliance with these provisions should help to satisfy the stability requirements of paragraph (a)(6). Paragraph (a)(6) would prohibit the placement of steel joists on any support structure unless it has been stabilized. Again, this is essentially identical to the existing requirement found in § 1926.751(c)(3) of OSHA's steel erection standard.

Proposed paragraph (a)(7) addresses the hazard that arises when a steel joist or joists are placed on the structure and then left unattended and unattached. An example of a situation addressed by this paragraph involves lighter steel joists, under 40 feet in length, that would not require erection bridging under this section. A common practice in erecting these lighter joists, which can be set in place by hand, is to have a crane set the columns, steel joist girders, or solid web primary members as well as the boltable joists required by OSHA at the columns, thus boxing the bays. The crane would then place a bundle of filler joists at an end or, more likely, at the center of the bay, and then move on to the next bay. Because cranes are among the more costly pieces of equipment on a steel erection job, minimizing crane time at the site is cost effective. This provision would require that, when steel joists are landed on structures, they be secured to prevent unintentional displacement prior to installation, i.e., the bundles must remain intact until the time comes for them to be set. This proposed paragraph would also prevent those ironworkers who are shaking out the filler joists from getting too far ahead of those workers welding the joists, a practice that leaves too many joists placed but unattached (paragraph (b)(3) of this proposed section, discussed below, requires that at least one end of each steel joist be attached immediately upon placement in its final erection position and before additional joists are placed). A final example of a situation addressed by this paragraph would be when the exact dimensions of a piece of mechanical equipment to be installed in the decking is not known. A common practice, when this occurs, is to leave a joist unattached until the dimension is

known. This paragraph requires such a joist to be secured (probably to the support structure or an attached joist) pending its attachment.

The Committee spent considerable time debating the appropriateness of requiring that certain joists be fabricated with bolt holes at the ends to allow for field bolting to the structure. As recommended by SENRAC, OSHA is proposing paragraph (a)(8), which would require that, when individual steel joists are being connected to steel structures in bays of 40 feet or more, these joists be fabricated to allow for field bolting.

This provision is necessary because certain joists that are thin and flexible can be difficult to install because of their sweep. Bolting these types of joists first allows straightening of the joist, thus returning its camber and eliminating torque. Additionally, after bolting, welding can be more easily accomplished. Note that this provision would not *require* these joists to be bolted as paragraph (a)(1) would require of the joist at the column. (Attachment requirements and the exceptions to this paragraph are discussed in connection with paragraph (b) below.) Instead, proposed paragraph (a)(8) would require that the joists arrive at the jobsite with holes pre-existing, thereby providing steel erectors with the option *either* of bolting or welding the joists. In practice, not requiring the joists to be fabricated in this manner would require the steel erector to drill holes in the joists in those cases where bolting is preferable. Just as the joist at the column is a special risk situation, long steel joists that are placed in bays of 40 feet or more have a greater tendency to twist or rotate, which creates hazards for the workers installing them.

SENRAC discussed a number of hazardous situations for which bolting joists is a safer method of attachment than welding. For example, SENRAC noted that bolting is safer whenever unattached joists could be displaced by wind or construction activity, by the movement of employees, by trailing welding leads, by accidental impact against the supporting structure by a crane or other equipment, or by harmonic motion or vibration. In addition, the vision and balance of an employee working at elevation can be impaired while wearing a welding hood, which may make bolting a safer approach in this situation. Further, joists can roll and pop welds due to the movement of an erector on the joist or the stresses caused by removing the sweep; if the weld breaks, the joist fails and may cause a structural collapse. Finally, there are special hazards



associated with welding that are not associated with bolting, such as electrical and fire hazards.

Both bolting and welding provide connections of equivalent strength, and both involve some risk. The Steel Joist Institute (SJI) asserted that welding joist ends is its recommended manner of attachment and that welding eliminates the weakening that holes in the supporting member can cause. After reviewing all relevant options, the Committee concluded that steel erectors should have the option of attaching joists either by bolting or welding. When conditions for welding are adverse, however, proposed paragraph (a)(8) would allow the steel erector to bolt the joists, thus avoiding many of the hazards mentioned above.

As noted, questions were raised about this proposed requirement. SJI and others questioned whether it is possible to bolt a joist to a masonry or similar support structure. However, the proposal clearly states that the provision allowing bolting would apply only when the joist is to be attached to a steel support structure, usually a solid web beam or a steel joist girder. Additional concerns were raised about the cost and feasibility of putting holes in the steel joists and support members (see Ex. 6-8, p. 7), but SENRAC believes that the safety and other advantages of permitting bolting are clearly more important than the disadvantages of this technique.

The American Institute of Steel Construction (AISC) pointed out that, to put the holes in the supporting beams, the fabricator of the beams must know the exact location the joist will occupy before the member can be designed and fabricated. This information is frequently not available at the time the supporting beams are being fabricated, however, because of the relationship between the joist spacing and the availability of the building's mechanical equipment design. If the design information is not available to the fabricator, this could delay the fabrication of the steel and, possibly, the project.

On the other hand, the Committee believes that requiring holes for bolting to be in place will promote better pre-erection planning and communication between all parties to the design and erection process, and may even lead to standardization of HVAC specifications, thus promoting better and safer construction sequencing. As the chairman of the SENRAC steel joist workgroup stated:

Prior to sizing a structural member for supporting mechanical equipment, the

structural engineer of record or design engineer must know the exact operating weight and physical footprint of the unit that will be imposed onto the structure. This type of information is critical in the sizing of the foundations, primary and secondary structural members (Ex. 9-142).

SENRAC was convinced that, under the present system of fast-track construction, the owner, the construction manager and the general contractors are not giving sufficient attention to the selection of mechanical equipment to be installed, despite the fact that this information is available prior to construction (the lead time required for mechanical equipment is ten times greater than the time required to design and fabricate the steel for the structure) (Ex. 9-142). Therefore, the weight and size of the mechanical equipment is known long before fabrication or erection. In addition, standardizing the requirement for bolting the structure will help the industry adopt a standard "curb" sized to fit the structure, as well as promote better information exchange and forward planning. Currently the lack of importance assigned to the transmission of this critical information down the line is causing portions of the structure to be constructed out of sequence, increasing the fall hazard and risk of collapse.

Another issue was raised by workgroup members concerning the situation where joists and supporting structural members arrive at the jobsite with the holes that allow field bolting in place, but the steel erector elects to weld instead of bolt them. These workgroup members were concerned that this situation would mean that the project structural engineer of record (SER) must make a determination to fill such holes with bolts. Conversely, when the joists have been bolted, the workgroup wondered whether the SER would still require the joists to be welded to the support structure. An additional concern raised is the structural impact the holes may have on the supporting steel member, i.e., the solid web beam or the steel joist girder. In the case of beams, the issue is whether, because of the holes, the size of the steel member would have to be increased. In the case of steel joist girders, the issue is whether re-engineering would be required, perhaps even to the point of welding an additional steel plate on the top chord to accommodate the bolting of the joists. OSHA raises all of these issues and solicits comment on them. As mentioned above, the Committee determined that the benefits of providing the option of bolting

remained compelling and recommended that OSHA propose paragraph (a)(8).

Paragraph (a)(9) addresses the hazard posed by bridging joists before an adequate terminus point has been established. Bridging is not truly bridging until a terminus point is created. "Bridging," an operation integral to steel joist construction, refers to the steel elements that are attached between the joists (from joist to joist) to provide stability. "Erection bridging" is defined as " \* \* \* the bolted diagonal bridging that is required to be installed prior to releasing the hoisting cables from the steel joists." "Horizontal bridging," usually angle iron, is attached to the top and bottom chords of the steel joists by welding. There are several provisions in this section that would require bridging to be anchored. This means, by definition, that the steel joist bridging must be connected to a bridging terminus point. The term, "bridging terminus point," is also defined in the proposed rule:

Bridging terminus point means a wall, beam, tandem joists (with all bridging installed and a horizontal truss in the plane of the top chord) or other element at an end or intermediate point(s) of a line of bridging that provides an anchor point for the steel joist bridging.

Paragraph (a)(9) would simply require that a terminus point be established prior to installing the bridging in order to allow the bridging to be anchored. OSHA is aware that steel erection is a progressive process that requires one piece to be erected before the subsequent piece can be attached to it. This provision would require pre-planning to determine the particular location of the terminus point for the attachment of bridging. To assist in developing terminus points, SJI has developed several illustrative drawings that are found in non-mandatory Appendix C. In addition, paragraph (c)(3) of this section, discussed further below, deals with the problem of an erection sequence where the permanent bridging terminus points are not yet in existence at the time the joists and bridging are erected.

Paragraph (a)(10) would prohibit the use of steel joists and steel joist girders as anchorage points for a fall arrest system unless written direction allowing such use is obtained from a qualified person. Allowing those joists and girders that have specifically been approved for use as fall arrest system anchorage points by a qualified person recognizes both that performance criteria and manufacturer's specifications are not currently available regarding the adequacy of steel joists to meet the requirements of proposed

§ 1926.760(a)(2) but that some steel joists and steel joist girders are adequate to meet these load requirements. This paragraph would allow steel joists and steel joist girders to be used as anchorage points for personal fall arrest systems in those situations where a qualified person has stated, in writing, that such use is appropriate.

Paragraph (a)(11) addresses the potential for failure that can occur when a steel joist is modified from its original manufactured state. The Committee and SJI agreed that field modifications have had disastrous consequences in the past. To ensure against recurrences of this type, OSHA proposes to prohibit such modification without the prior approval of the project structural engineer of record.

*Paragraph (b) Attachments of steel joists and steel joist girders.* SJI greatly assisted the Committee in the development of this proposal by creating Tables A and B, which relate the attachment and bridging requirements of paragraphs (b) and (d) to the actual performance of particular joists. SJI arranged for Dr. Theodore Galambos, Professor of Civil Engineering at the University of Minnesota, to:

\* \* \* Mathematically develop a table of theoretical safe and stable lengths for all K Series Joists. The stable joist length was defined as the maximum span at which a laterally unsupported steel joist will safely support a 300 pound load placed on the top chord at the mid span of the joist (Ex. 9-19, p. 6).

Dr. Galambos developed joist stability spans using the following criteria: (1) the joists, which had top angles placed back to back with no space between the down standing legs of the chord angles, were free to rotate, i.e., were not attached; (2) the width of the bearing shoes of the joist was not made part of the equation; (3) there was no external lateral support; and (4) a 300-pound load was placed on the top chord of the joist at mid-span. A 300-pound load was chosen as representative of the weight of an average ironworker and his equipment, including a safety factor. Following a review of these results, SJI, through its members, field tested a representative sampling of the joists to verify the study. The joists were field tested by placing each joist on supports spaced to obtain the correct joist span plus 2½ inches of bearing length on the support member. The test load was applied in 25 pound increments by placing individual 25 pound steel plates on top of the top chord at mid-span of the joist. The load was applied until a total static load of 300 pounds was obtained. The results closely paralleled

those predicted by Dr. Galambos' mathematical model. In addition, the field testing added another criterion: that one end of the joist would be attached, which increased the stability and helped SJI with its attachment recommendations (Ex. 9-19).

Based on the results of this stability study, SJI developed two tables that were adopted in part by the Committee. Table A, Erection Bridging for Short Span Joists, includes the lighter, K-Series joists, which run up to 60 feet in length. The K-Series open web steel joists, having joist depths from 8 inches through 30 inches, are primarily used to provide structural support for floors and roofs of buildings. Although light in weight, they possess a high strength to weight ratio (Ex. 9-141). Although Table A contains all the joists in the K-Series, Table B contains only those joists in the LH-Series that are 60 feet or less, even though the series spans through 96 feet. These joists are used for the direct support of floor or roof slabs or decks between walls, beams, and main structural members, and their depths range from 18 inches to 48 inches. Although the tables do not address the "Deep Longspan," or DLH-Series, other paragraphs in this section provide specific requirements for attaching these joists. The DLH-Series joists can run up to 144 feet and have depths from 52 inches through 72 inches (Ex. 9-19). SJI limited the tables to 60 feet for two reasons: 1) the K-Series only goes to 60 feet, and 2) over 60 feet, the LH-Series are manufactured for the use of diagonal, bolted bridging only. Horizontal bridging, according to SJI specifications, can be used only with joists of 60 feet or less.

The attachment of all three series of joists is addressed in paragraph (b) of this section. The hazard addressed in that paragraph is the inadequate attachment of joists that could affect the stability of the joist and thus the safety of the employee erecting the joist. Paragraphs (b)(1) and (b)(2) would specify the minimum attachment specifications for the lighter and the heavier joists, respectively. At a minimum, the K-Series would have to be attached with either two ⅛" (3 mm) fillet welds 1 inch (25 mm) long, or with two ½" (13 mm) bolts. In addition, the Committee built in alternative performance language by adding the phrase "or the equivalent" to allow for attachment by any other means that provides at least equivalent connection strength. Similarly, at a minimum, the LH-Series and DLH-Series would have to be attached with either two ¼" (6 mm) fillet welds 2 inches (51 mm) long, or with two ¾" (19 mm) bolts. Again,

OSHA is proposing alternative performance language, "or the equivalent," for the reasons discussed above (Ex. 9-56).

Paragraph (b)(3) addresses the hazards associated with the following improper erection sequence: landing joists on the support structure; spreading them out unattached to their final position; and then attaching them. This procedure creates the potential for worker injury because joists handled in this manner may fall or the structure may collapse. To eliminate these hazards, this paragraph would require, with one exception discussed in paragraph (b)(4) below, that each steel joist be attached, at least at one end, immediately upon placement in its final erection position, before any additional joists are placed.

Paragraph (b)(4) is an exception to both the proposed (b)(3) "attachment upon final placement" requirement, and the proposed paragraph (a)(8) "all joists over 40 feet must be boltable" requirement. Paragraph (b)(4) addresses the situation where steel joists have been pre-assembled into panels prior to placement on the support structure. Pre-assembly usually involves the installation of diagonal and horizontal bridging to form a platform at ground level, which eliminates fall hazards associated with attaching bridging at elevated work stations. Placing joists on the support structure in this manner eliminates the single joist instability concerns and other hazards that led the Committee to recommend, and OSHA to propose, paragraph (a)(8) (see discussion above). Furthermore, because of the inherent stability of these pre-assembled panels, this paragraph would require only that the four corners of the panel be attached to the support structure before releasing the hoisting cables. The attachment can be either bolted or welded.

Additionally, the pre-assembled panel exception to paragraph (a)(8) allows for alternative joist erection methods such as a hybrid form of steel erection involving steel/wood-paneled roof structures, where wooden decking (dimensional wood and plywood) is attached to a single steel joist and the resulting panels are set on the support structure (Exs. 9-94, 9-95). Again, by placing joists on the support structure in this manner, the instability concerns and other hazards associated with attaching single joists, which led OSHA to propose paragraph (a)(8), are avoided (see discussion above).

*Paragraph (c) Erection of steel joists.* Paragraph (c)(1) would require that at least one end of each steel joist be attached to the support structure before

the weight of an employee is placed on the steel joist.

Paragraph (c)(2) addresses steel joists that span 40 feet (12.2 m) or less and that do not require erection bridging as required by Tables A and B. OSHA's existing steel erection requirements, § 1926.751(c)(2) and (c)(3), regarding steel joists and bridging, only address members 40 feet or longer:

(c)(2) Where longspan joists or trusses 40 feet or longer, are used, a center row of bolted bridging shall be installed to provide lateral stability during construction prior to slacking of hoisting line.

(c)(3) No load shall be placed on open web steel joists until these security requirements are met.

In the last 25 years, many new and different open web steel joists have been manufactured. In developing Tables A and B, SJI demonstrated that there are dozens of joists that span less than 40 feet that require erection bridging to maintain stability during erection. As to joists that do not require erection bridging in accordance with these tables, OSHA is proposing in paragraph (c)(2) that only one employee be allowed on the joist until all permanent (horizontal) bridging is installed and anchored.

Based on the Committee's recognition of the inherent danger of employees working on unstable joists, OSHA is proposing in paragraph (c)(3) that no employee be allowed on steel joists other than those addressed in paragraph (c)(2) unless the requirements of paragraph (d) of this section are met.

Proposed paragraph (c)(4) addresses the situation where the erection sequence calls for joists to be erected before the permanent bridging terminus points have been established. This situation commonly occurs in a single story structure that has masonry or architectural precast walls installed after the steel is partially or fully erected. Complying with proposed paragraph (c)(4) would involve pre-planning and the addition of temporary bridging terminus points to provide stability and prevent structure collapse in this situation.

*Paragraph (d) Erection bridging.* Paragraph (d) sets forth proposed erection bridging requirements for the safe erection of steel joists. Paragraphs (d)(1), (d)(2) and (d)(3) address steel joists that span 60 feet or less, over 60 feet through 100 feet and over 100 feet through 144 feet, respectively. Although, at first glance, these provisions appear similar, they reflect substantive differences that are based on engineering principles as well as the collective experience of SENRAC members. Since all of the other

provisions of paragraph (d) apply across the board to all open web steel joists, breaking out these different requirements will promote ease of compliance.

Paragraph (d)(1) refers to the joists that span less than 40 feet when the tables indicate the need for erection bridging of such joists, and to all joists in bays of 40 feet through 60 feet. Although the SJI has determined that there are certain joists with spans from 40 through 60 feet that do not require erection bridging, the Committee determined that a center row of bridging should nevertheless be required to ensure stability. OSHA is accordingly proposing paragraph (d)(1). The Agency believes, because this practice is already required by OSHA's current steel erection standard, that it is already standard industry practice. Second, the loads imposed in the SJI tests were static loads, but the load imposed by an employee would be a dynamic load. Although SJI asserted that an erector "cooning" the joist would have a stabilizing effect on the joist, the Committee nonetheless concluded that, in bays of 40 feet through 60 feet, the row of erection bridging nearest the midspan of the steel joist should be bolted diagonal bridging (paragraph (d)(1)(i)); further, the Committee believes that the hoisting cables should not be released until after the installation of this bridging (paragraph (d)(1)(ii)). Additionally, only one employee would be allowed on these spans until all other bridging is installed and anchored (paragraph (d)(1)(iii)). Anchored bridging means that the steel joist bridging is connected to a bridging terminus point. Horizontal bridging would have to be welded or attached to each joist to be considered anchored. It is unnecessary to address anchoring for bolted diagonal bridging because, by the very nature of its connection in the erection sequence, the anchorage will have already been accomplished. However, as mentioned above in the discussion of paragraph (a)(9) of this section, a terminus point is required to be established before any bridging is installed.

Paragraph (d)(2) addresses heavier joists that span over 60 through 100 feet. Here, two rows of erection bridging would be required to be placed nearest the one-third points of the steel joists (paragraph (d)(2)(i)). Again, the hoisting cables would not be released until all the bolted diagonal erection bridging is installed (paragraph (d)(2)(ii)). Since these are heavier members and since two rows of bridging must be installed in the erection sequence, only two employees would be allowed on these

joists until all other bridging is installed and anchored (paragraph (d)(2)(iii)).

Paragraph (d)(3) addresses even heavier joists that span over 100 through 144 feet. Here, all bridging is considered erection bridging and must be bolted diagonal bridging (paragraph (d)(3)(i)). Although all of the bridging addressed in paragraph (d)(2) above is bolted diagonal bridging, only the two rows nearest the third points are considered erection bridging. In the case of the largest open web steel joists, with depths up to 72 inches, all the bridging would have to be installed before the hoisting cables can be released (paragraph (d)(3)(ii)). Again, the reason for requiring bolting is that, in setting an individual steel joist, bolting is the safest and quickest way of securing the joist with the least equipment. According to proposed paragraph (d)(3)(iii), only two employees would be allowed on the spans until all the bridging is installed. In this case, since all the bridging is bolted diagonal bridging, using the term "anchored" would be superfluous because, as stated above, by the very nature of its connection in the erection sequence, anchoring will already have been accomplished. Additionally, a bolted diagonal bridging requirement would not apply to the attachment of the diagonal bridging to other than steel joists.

Proposed paragraph (d)(4) reflects the Committee's agreement that open web steel members that span over 144 feet are not considered joists but rather structural trusses. The erection methods for such members are more appropriately treated in the section on solid web structural members found in proposed § 1926.756, Beams and Columns, since they are larger, heavier members. Paragraph (d)(4) would limit what would be considered steel joists since steel trusses are heavy duty members, custom made and designed by a structural engineer, and usually made of structural shapes. The definition for "steel truss" is as follows:

*Steel truss* means an open web member designed of structural steel components by the project structural engineer of record. For the purposes of this subpart it is considered equivalent to a solid web structural member.

Although the term is not used in the body of this subpart, it is referred to in the definition of steel joists. The Committee believes that explaining what does not constitute a steel joist is important for clarity and in order to determine which erection provisions apply.

Paragraph (d)(5) addresses the situation where a joist is bottom chord bearing (i.e., attached to the primary

structure by the bottom chord of the joist) and would require erection bridging; or is forty feet or less and would not require erection bridging per Tables A and B. When a joist is top chord bearing, which is the usual application, the center of gravity of the joist is below the bearing surface of the support structure—a factor that helps to keep the joist stable. In a bottom bearing situation, however, the center of gravity is above the bearing surface of the support structure—a factor that increases the tendency of the joist to roll over. Under these circumstances, this paragraph would require an additional row of bolted diagonal bridging near each support where the bottom chord receives support. Typically this would require two rows of bridging. It is not uncommon, however, for a one story building, such as a convenience store that has a high glass front and a lower ceiling in the rear, to have steel joists which are bottom bearing in the front and top bearing in the back. Under this scenario, only one set of bolted diagonal bridging would be required. Consistent with the other requirements for erection bridging in this paragraph, this erection bridging would have to be installed prior to the release of the hoisting cables.

Paragraph (d)(6) proposes specifications and work practices for the placement and attachment of bolted diagonal erection bridging required by this proposed section. Paragraph (d)(6)(i) would require that this bridging be indicated on the erection drawing. The Committee discussed alternative indicators for the proper placement of the bridging and concluded that the erection drawing should be the exclusive placement indicator (Ex. 6–7, p. 11). Paragraph (d)(6)(ii) would require that the erection drawing be the exclusive indicator of the proper placement of this bridging.

Paragraph (d)(6)(iii) is intended to make the attachment of erection bridging less difficult and safer to accomplish. This work is performed at an elevated work station and frequently involves awkward bending and reaching. This provision would require that shop-installed bridging clips or their functional equivalents be provided with the steel joists. In addition, the proposal defines a “bridging clip” as a device that is attached to the steel joist to allow the bolting of the bridging to the steel joist. Attachments that are the functional equivalent of bridging clips would be allowed by this paragraph to provide flexibility and to allow for technological innovation should a different type of attachment be developed.

Paragraph (d)(6)(iv) addresses a hazard that is similar to that encountered with a double connection, discussed earlier. It would provide that where two pieces of bridging are attached to the steel joist by a common bolt, the nut that secures the first piece of bridging shall not be removed from the bolt for the attachment of the second. This is a work practice that is similar to a “clipped connection” (see definition section).

Paragraph (d)(6)(v) addresses a “cooning” problem rather than a tripping hazard since cooning involves straddling the top chord while walking on the bottom chord. Nonetheless, this provision works in conjunction with proposed § 1926.754(c)(1) and would require that bridging attachments not protrude above the top chord of the steel joist. This, of course, would apply both to bridging clips and their functional equivalents.

*Paragraph (e) Landing and placing loads.* Paragraph (e) addresses the hazards encountered in steel erection when landing and placing loads. Although work practice provisions found in § 1926.754(e) regarding the hoisting, landing and placing of deck bundles in general have already been discussed, this paragraph addresses these hazards specifically with regard to landing and placing loads on steel joists. SJI stressed that accidents occur “when loads are placed on unsecured/unbridged joists” (Ex. 6–8, p. 8). In addition, in the decking subgroup’s analysis of the data workgroup’s fatality and catastrophe reports, approximately 16 percent of the floor and roof deck fatalities were associated with collapses due to improper loading on steel joists (Ex. 9–49, p. 4).

Proposed paragraph (e)(1) of this section would apply to any employer who places a load on steel joists during steel erection. This paragraph would require that the load is adequately distributed so that the carrying capacity of any steel joist is not exceeded. The remainder of proposed paragraph (e) sets forth specific conditions that the employer must meet in addition to the general performance criteria in paragraph (e)(1).

Paragraph (e)(2) proposes general requirements that would have to be met before landing a construction load on steel joists, although an exception is allowed in paragraph (e)(4) for bundles of decking. Paragraph (e)(2) would prohibit placement of any construction loads on steel joists until all bridging is installed and anchored and all joist bearing ends are attached in accordance with paragraph (b) of this section (paragraph (b) contains attachment

requirements for steel joists). A “construction load for joist erection” means any load other than the weight of the employee(s), the joists and the bridging bundle. Bundles of decking constitute a construction load under this definition. Under certain conditions, however, decking can be placed safely on the steel joists before all the bridging is installed and anchored. These conditions form the basis for the exceptions in paragraph (e)(4), which is discussed below.

Although a bridging bundle is not considered a construction load, it nevertheless must be landed and placed on the steel joists in a safe manner that maintains stability. Proposed paragraph (e)(3) provides for the safe and stable placement of bridging on steel joists. Usually, this bridging will be 20 foot horizontal bridging because bolted diagonal bridging is too short to extend over 3 joists. In developing this proposed requirement, the Committee, following consultation with SJI in workgroup meetings, decided to limit the weight of the bundle to 1,000 pounds because the bridging would be placed on the joists before they have been fully stabilized. One thousand (1,000) pounds would allow the joist erector to safely place the necessary bridging on the joists. To facilitate compliance with this requirement, the SJI has agreed to establish a new industry practice of bundling bridging into 1,000 pound units. Placement of the bundle is also important. This paragraph would therefore require that the bundle of joist bridging be placed over a minimum of 3 steel joists secured on at least one end. Under these circumstances, the stability of the load would be further enhanced if the load is placed near the support member. Therefore, this provision would require that the edge of the bridging bundle be positioned within 1 foot of the secured end. A clearance of at least one foot is necessary for material handling purposes and to provide access to the steel joist’s attachment point. This last proposed requirement is practically identical to the proposed requirement for the placement of construction loads found in paragraph (e)(5) of this section.

Paragraph (e)(4) proposes special conditions to be met before a bundle of decking is placed on steel joists that do not yet have all bridging installed. Decking bundles are the most common construction loads imposed on steel joists. Although it is safe to place construction loads on steel joists when all the bearing ends have been attached and all the bridging is in place, there are certain commonly encountered situations where all the bridging in the

bay and all the bearing ends of the steel joists in the bay do not have to be fully installed and attached to land a bundle of decking safely. There are six conditions that would have to be met before an exception from paragraph (e)(2) is warranted.

Paragraph (e)(4)(i) would require the employer to determine, based on information from a qualified person, that the structure or portion of the structure is capable of safely supporting the load of decking. This determination would have to be documented in a site-specific erection plan available at the construction site (see proposed § 1926.753(d)).

Under paragraph (e)(4)(ii), the bundle of decking would have to be placed over a minimum of 3 joists to distribute the load. Since most decking comes in 20 foot lengths and the standard distance between joists is 5 feet, typically the load will be supported by 4 joists.

Paragraph (e)(4)(iii) would require that those steel joists actually supporting the bundle of decking have both ends attached to the support structure (the attachments would have to be in accordance with the requirements contained in paragraph (b) of this section).

At least one row of bridging would have to be attached and anchored, according to proposed paragraph (e)(4)(iv). The qualified person would determine the type of bridging, erection bridging or horizontal bridging, to satisfy this proposed requirement. To assist the qualified person in making this decision, paragraph (e)(4)(v) would provide a load limit of 4000 pounds (1816 kg) for the total weight of the bundle of decking. The Steel Deck Institute (SDI) has indicated that, in the future, manufacturers will deliver decking in bundles that will accommodate this load limit.

Finally, paragraph (e)(4)(vi) would require that the edge of the bundle be placed within a foot (0.30 m) of the bearing surface of the joist. This is the same requirement that applies to all loads in proposed paragraph (e)(5) of this section. Collapses could occur if any one of the six conditions in paragraph (e)(4) is not met. Therefore, to qualify for an exception, this paragraph would require that a site-specific erection plan be developed that indicates that these bundles of 4000 pounds or less will be placed over 3 or more joists that have been attached at both ends and have at least one completely installed and anchored row of bridging. Additionally, the edge of the bundle of decking must be placed within 1 foot of the bearing surface of the joist end for the exception to apply.

Paragraph (e)(5) addresses the proper placement of all construction loads (not just decking) on steel joists. As indicated above in the discussion of paragraph (e)(3), stability of the load is enhanced by placing the load near the support member. Therefore, this proposed provision would require that the edge of the construction load be positioned within 1 foot of the secured end. At least a one foot clearance is necessary for material handling purposes and for access to the steel joist's attachment point to the support structure.

#### *Section 1926.758 Pre-Engineered Metal Buildings*

During SENRAC's deliberations on the prerequisites for anchor bolts, beams, columns and open web steel joists, the Committee discussed many anomalies that appeared to be associated with pre-engineered metal buildings. The Committee was advised by the Metal Building Manufacturers Association (MBMA) that over 50 percent of the industrial buildings in steel erection are pre-engineered. This type of building frequently has lighter, cold formed members such as girts, eave struts and purlins (see definitions). Larger members in this type of construction are called rigid frames, a term not used in conventional steel erection. There are a large number of small specialized steel erectors who exclusively perform pre-engineered metal building erection. In light of these considerations and in an effort to facilitate compliance with this subpart, SENRAC developed a separate section for pre-engineered metal buildings.

This section sets forth proposed requirements to erect pre-engineered metal buildings safely. Pre-engineered metal buildings are defined in the definition section of this proposal. Pre-engineered metal buildings include structures ranging from small sheds to larger structures such as warehouses, gymnasiums, churches, airplane hangars and arenas.

Pre-engineered metal buildings use different types of steel members and a different erection process than typical steel erection. Many contractors erect pre-engineered metal buildings exclusively. An overwhelming majority of these erectors are small employers. The erection of pre-engineered metal structures presents certain unique hazards that are not addressed specifically by OSHA's existing steel erection standard. With the help and support of the MBMA and two other major manufacturers, the Committee developed and recommended to OSHA a section devoted to this industry.

Although some of the hazards are similar to general steel erection, other hazards, such as those associated with anchor bolts, construction loads and double connections, are different.

Most of the proposed requirements in this section are similar to those in other sections of this document. Where a conflict arises between a provision in the pre-engineered metal building section and that of another section of subpart R, to the extent that the work being performed is pre-engineered metal building work, the more specific pre-engineered metal building section would apply. This section, however, should not be interpreted to mean that the other provisions of subpart R do not apply to pre-engineered metal buildings where appropriate. OSHA requests comment and information on whether there are other hazards involved in the erection of pre-engineered metal buildings that are addressed elsewhere in this subpart but not in proposed § 1926.758. If so, should provisions be added to § 1926.758 to address those hazards? Additionally, should a cross-reference be made to § 1926.760 (fall protection) and § 1926.761 (training) since these sections apply to all steel erection?

Paragraph (a) states that the erection of pre-engineered metal buildings may not begin until the site layout has been completed in accordance with proposed § 1926.752(b), site layout, site-specific erection plan and construction sequence. The requirements in that section would apply to pre-engineered metal buildings as they do to other types of steel erection.

Like proposed § 1926.755(a)(1), paragraph (b) would require that all columns be anchored by a minimum of 4 anchor bolts. This requirement is necessary to ensure stability.

The proposed requirement in paragraph (c) is unique to the erection of pre-engineered metal buildings because rigid frames are found only in this type of structure. This paragraph would require that rigid frames have 50 percent of their bolts or the number of bolts specified by the manufacturer (whichever is greater) installed and tightened on both sides of the web adjacent to each flange before the hoisting equipment is released. Like proposed § 1926.756(a), this provision would require an adequate number of bolts to ensure stability before the hoist line is released. Rigid frames are fully continuous frames that provide the main structural support for a pre-engineered metal building. They provide the support that is typically provided by columns and beams in conventional steel erection. Due to

design and load requirements, connections in rigid frames occupy a greater area and require more than two bolts upon initial connection. The remaining bolts are used to attach other members to the structure and provide stability against wind loading. To require these connections to be bolted only with two bolts would not be adequate in many cases to prevent a collapse hazard.

Paragraph (d) also pertains to stability and would prohibit construction loads from being placed on any structural steel framework unless such framework has been safely bolted, welded or otherwise adequately secured. Without proper bolting or welding to provide stability, a construction load could cause a collapse of the structure.

Paragraph (e) pertains to double connections in pre-engineered metal buildings. When girts or eave struts share common connection holes, a double connection hazard exists. As with proposed § 1926.756(c), a seat or similar connection would prevent one member from becoming displaced during the double connection activity. In girt and eave strut to frame connections where girts or eave struts share common connection holes, two provisions apply. Paragraph (e)(1) would require that at least one bolt with its wrench-tight nut remain in place for the connection of the second member unless a field-attached seat or similar connection device is present to secure the first member so that the girt or eave strut is always secured against displacement. Paragraph (e)(2) maintains that the seat or similar connection device must be provided by the manufacturer of the girt or eave strut so that it is designed properly for the intended use. Because this form of double connection is unique to pre-engineered metal building construction and might not be considered a double connection under a literal reading of proposed § 1926.756(c), this provision specifically addresses girt and eave strut to frame connections.

Proposed paragraph (f) would require that both ends of all steel joists or cold-formed joists be fully bolted and/or welded to the support structure before releasing the hoisting cables, allowing the weight of an employee on the joists, or allowing any construction loads on the joists. These proposed requirements are similar to those proposed in § 1926.757 for joists. However, due to the uniqueness of pre-engineered metal building erection and the design factors of the members, the key elements of joist erection that apply to these structures are proposed to apply more stringently in paragraph (f).

Paragraph (g) would prohibit the use of purlins and girts as anchorage points for a fall arrest system unless written direction to do so is obtained from a qualified person. Generally, purlins and girts are lightweight members designed to support the final structure. They may not have been designed to resist the force of a fall arrest system. If, however, a qualified person determines that the purlin or girt is of sufficient strength to support a fall arrest system, it may be used for that purpose. The qualified person would be required to provide written documentation of this determination. This proposed requirement is identical to the one for steel joists in proposed § 1926.757(a)(10).

Proposed paragraph (h) would prohibit purlins from being used as a walking/working surface except when installing safety systems. All permanent bridging must be in place, and fall protection must be provided to the employee installing the safety system and walking or working on the surface. Purlins are "Z" or "C" shaped lightweight members, generally less than 1/8" thick, 2"-4" wide on the top and up to 40 feet long. They are not designed to be walked on and, because of their shape, are likely to roll over when used as a walking/working surface if not properly braced.

Paragraph (i) addresses the placement of construction loads on pre-engineered metal buildings to prevent collapse due to improper loading of the structure. This proposed paragraph would require that construction loads be placed within a zone that is not more than 8 feet (2.5 m) from the centerline of the primary support member. Unlike conventional decking, pre-engineered metal building decking bundles are lighter, and the sheets in the bundle are staggered. This staggering means that the bundles must be set so that the end of one bundle overlaps another bundle since the lengths of the sheets vary. The zone needs to be big enough to allow for the lapping while still having the support of the structure. An 8 foot (2.5 m) zone allows enough room to meet these objectives.

#### *Section 1926.759 Falling Object Protection*

This proposed section sets forth the requirements for providing employees with protection from falling objects. A real and everyday hazard is posed to steel erection employees by loose items that have been placed aloft and that can fall and strike employees working below.

Paragraph (a) would require that all materials, equipment, and tools that are

not in use while aloft be secured against accidental displacement. This proposed requirement would expand on the existing requirement in § 1926.752(a) which addresses bolts, drift pins and rivets. The Committee felt that the requirement should apply to any item that could become displaced, fall to a lower level and possibly injure a worker.

The intent of paragraph (b) is that, when it is necessary to have other work performed below on-going steel erection activities, proper overhead protection be provided to those workers to prevent injuries from falling objects. If this protection is not provided, work by other trades would not be permitted below steel erection work. The controlling contractor's responsibility would be to ensure that job conditions do not increase the exposure of employees to overhead hazards because of accelerated project schedules or other jobsite conditions. Additionally, this paragraph is referenced in proposed § 1926.752(c), which requires pre-planning to ensure that proper overhead protection is afforded to all employees during hoisting operations.

#### *Section 1926.760 Fall Protection*

Section 1926.760 addresses fall protection and would establish 15 feet as the fall distance triggering the proposed requirement for fall protection, with two exceptions: connectors working at heights between 15 and 30 feet and workers engaged in decking in a controlled decking zone at a height between 15 and 30 feet.

Subpart M, OSHA's fall protection standard for construction in general, was promulgated by OSHA on August 9, 1994 (59 FR 40672), and specifically excludes steel erection from its scope (see paragraph § 1926.500(a)(2)(iii)). Subpart M sets the general trigger height for fall protection in construction at 6 feet. The questions that SENRAC needed to address in determining the appropriate trigger height for fall protection in steel erection included: Should the trigger height for fall protection in steel erection be different from that in other construction operations? If so, why? Is it possible to protect workers engaged in steel erection for the entire time that they are exposed to fall hazards? If not, why not?

In answer to these questions, SENRAC pointed out that steel erection differs from general construction in several respects. Typically, in steel erection, the working surface is constantly being created as vertical columns are erected at various heights. Columns are connected with solid web beams or steel joists and joist girders to form an open

bay. In a multi-story building, the columns are usually two stories high. These structural members are set by connectors in conjunction with a hoisting unit—typically a crane. The first bay to be erected is part of the first tier or story; the bay of the second tier or story is formed. Initially the columns are attached to anchor bolts at the foundation. Usually, the next procedure is for the connector to install the header beams at the first level. Each floor is typically 12.5 to 15 feet in height. After an exterior bay is formed (“boxing the bay”), the filler beams or joists are placed in the bay. The connector then ascends the column to the next level, where the exterior members are connected to form a bay, and so on. In connecting the filler beams of a bay, the connector uses two bolts.

In making these initial connections, the connector is exposed to fall hazards as a result of several factors. One such factor involves the structure itself. Poor foundations and inadequate or ill-repaired anchor bolts (Ex. 6–3, p. 4) can fail, causing the column/structure to collapse and the connector to fall. The proposal first addresses this source of collapse to prevent failure in § 1926.755, “anchor bolts” and § 1926.757(a)(4), “stabilizer plates,” discussed earlier. Another factor is that both the connector and the structure are exposed to being struck by incoming steel. The proposal seeks to “engineer out” the risk of falling in this situation by addressing the proper hoisting and rigging of the steel members to eliminate or minimize this hazard (see discussion in § 1926.753).

The unique nature of the work itself also exposes the connector to the risk of falling. In particular, the making of double connections at columns (or at beam webs over a column) puts the connector at risk of falling due to a structural collapse. OSHA is proposing a combination of engineering controls and work practices to deal with this hazard. § 1926.756(c) would require a seat or similar device that must be secured prior to releasing the earlier connections. This prevents the column from falling away and eliminates the collapse hazard. Based on the data examined by the Committee’s statistical workgroup (Ex. 9–42), SENRAC concluded that in steel erection work, relatively few worker falls occur at heights between 6 feet and 15 feet. Connections at these heights can be performed from ladders, scaffolds or personnel work platforms. The Committee, nevertheless, fully considered the use of personal fall arrest systems for heights between 6 and 15 feet.

Several fall protection manufacturers participated in discussions of this issue. Of major concern was the relationship between the total fall distance of available personal fall arrest systems (and how they are used) and the trigger height for fall protection that needed to be established for the steel erection proposal. As was presented to the Committee by one fall protection equipment manufacturer, there are many variables that collectively need consideration in understanding fall protection. Personal fall arrest systems must first limit the force on the body and second limit the total fall distance. The best description of total fall distance offered to the Committee is that total fall distance is the sum of free fall distance, deceleration distance, harness effects and vertical elongation of parts of the personal fall arrest system. Through further definition of these terms and how they interact, the total fall distance or amount of clearance needed can be determined.

Excluding anchorage connectors, there are 4 types of personal fall arrest systems commonly used by workers in full body harnesses including: (1) shock absorbing lanyards; (2) self-retracting lifelines; (3) rope grabs with vertical lifelines; and (4) shock absorbing lanyards with rope grabs and vertical lifelines. Lanyards having different lengths and which are allowed by the user to have more or less slack can result in a wide variation of free fall distance. The three common types of anchorage connectors were described to the Committee and include: (1) horizontally mobile and vertically rigid (e.g., a trolley connected to a flange of a structural beam); (2) horizontally fixed and vertically rigid (e.g., an eyebolt, choker or clamp connected to a structural beam, column or truss); and (3) horizontally mobile and vertically flexible (e.g., a horizontal lifeline suspended between two structural columns or between stanchions, attached to a structural beam, designed to support the lifeline). Each type contains various combinations of rigidity versus flexibility, both vertically and horizontally. Depending on how one configures the personal fall arrest system, the total fall distance can range from 3–23 feet and from 4–10.5 feet depending on the combination of equipment utilized (Exs. 6–10 and 9–77).

The same fall protection equipment manufacturer indicated that the lowest point of the body of a worker performing steel erection should be at least 12.5 feet above the nearest obstacle in the potential fall path when the worker is properly using a rigidly

anchored personal fall arrest system of the shock absorbing lanyard type or self-retracting lifeline type. Another participant indicated that, in a worst case scenario and with no overhead anchorage point (which is a common situation in steel erection), 15.5 feet was the lowest height that a steel erection worker could be protected. SENRAC acknowledged, however, that workers in some cases could be protected at lower heights but only at the expense of serious constraints to mobility (especially with respect to connectors working with incoming steel), which, in turn, could increase the hazards (Ex. 6–11, p. 5).

In light of these considerations, the following requirements are proposed.

*Paragraph (a) General Requirements.* Paragraph (a) proposes the primary fall protection trigger height for steel erection activities (with certain exceptions), describes what constitutes fall protection in these circumstances, and provides specifications for alternative protection. Proposed paragraph (a)(1) would set the primary fall protection trigger height for most employees engaged in steel erection. Each employee covered by this subpart who is on a walking/working surface with an unprotected side or edge more than 15 feet above a lower level would have to be protected from fall hazards.

OSHA’s existing fall protection requirements for steel erection are found in three different provisions. Section 1926.750(b)(1)(ii) of the existing steel erection standard reads as follows:

(ii) On buildings or structures not adaptable to temporary floors, and where scaffolds are not used, safety nets shall be installed and maintained whenever the potential fall distance exceeds two stories or 25 feet. The nets shall be hung with sufficient clearance to prevent contacts with the surface of the structures below.

In addition, § 1926.750(b)(2)(i) of the existing steel erection standard addresses falls to the interior and reads as follows:

(2)(i) Where skeleton steel erection is being done, a tightly planked and substantial floor shall be maintained within two stories or 30 feet, whichever is less, below and directly under that portion of each tier of beams on which any work is being performed, except when gathering and stacking temporary floor planks on a lower floor, in preparation for transferring such planks for use on an upper floor. Where such a floor is not practicable, paragraph (b)(1)(ii) of this section applies.

With regard to non-building steel erection (e.g., bridges, conveyor systems, etc.), exterior fall hazards on tiered buildings, and both interior and exterior fall hazards on non-tiered buildings (e.g., warehouses,



gymnasiums, etc.), § 1926.105(a) of subpart E, Personal Protective and Life Saving Equipment, applies and reads as follows:

(a) Safety nets shall be provided when workplaces are more than 25 feet above the ground or water surface, or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical.

In an attempt to clarify these requirements, OSHA issued a memorandum on February 22, 1994 (Ex. 9-13F). That memo established the following enforcement policy for section 1926.750:

Citations shall not be issued to employers engaged in steel erection activities (such as, but not limited to, initial connecting, decking, welding, and bolting) during the construction of skeleton steel buildings if those employers are in compliance with the requirements of 29 CFR 1926.750(b)(2) for falls to the inside of the structure and with 29 CFR 1926.105(a) for falls to the outside of the structure. By the same token, citations shall be issued to every employer not in compliance with those standards. (For the purposes of this document, "buildings" means tiered buildings and non-tiered buildings).

With respect to fall hazards in other steel erection activities, such as in bridge and tower erection, 29 CFR 1926.105(a) shall be used where the fall hazard is 25 feet or more.

In 1995, OSHA further clarified its policy with respect to tiered, as opposed to non-tiered, buildings. In non-tiered buildings, the fall protection requirements in § 1926.105(a) apply to steel erection activities over 25 feet.

Proposed paragraph (a)(1) would require fall protection for most employees covered by this subpart at heights 10 to 15 feet lower than is required by OSHA's existing requirements. The exception for those employees covered by paragraph (a)(3), as discussed below, also provides protection at lower heights than does the existing standard.

Proposed paragraph (a)(2) would specify the fall protection systems required by this section. Such fall protection systems shall consist of perimeter safety cable systems, guardrail systems, safety net systems, or personal fall arrest or fall restraint (positioning device) systems. In addition, guardrail systems, safety net systems, and personal fall arrest or fall restraint systems must conform to the criteria set forth in § 1926.502 of this part (fall restraint systems would also be required to conform to the criteria for positioning device systems in § 1926.502). Section 1926.502 contains OSHA's general construction requirements for fall protection systems. Unlike general construction, however, steel erection

fall protection also includes perimeter safety cable systems; use of these systems has long been an industry practice and is required by § 1926.750(b)(1)(iii) of OSHA's existing steel erection standard. It is OSHA's intent that the existing requirement for the installation of a perimeter safety cable system be maintained in this proposal. As mentioned in the discussion above on proposed § 1926.756, Appendix F of this proposal provides non-mandatory guidance regarding the installation of these perimeter safety cable systems.

The exception to the proposed general requirement that fall protection be provided at heights above 15 feet (paragraph (a)(1)) is addressed in paragraph (a)(3). According to this proposed requirement, connectors and employees working in controlled decking zones would have to be protected from fall hazards in accordance with paragraphs (b) and (c) of this section, as discussed below.

*Paragraph (b) Connectors.* Proposed paragraph (b) addresses the need to protect connectors from falls, to train them in the hazards associated with connecting, and to provide them with fall protection equipment. Proposed paragraph (b)(1) would require that each connector be protected from fall hazards of more than two stories or 30 feet (9.1 m) above a lower level, whichever is less. Protection at this height is currently required by OSHA's existing steel erection standard for all employees engaged in steel erection.

In addition, proposed paragraph (b)(2) requires that each connector, as defined, complete connector training in accordance with § 1926.761. Such training must be specific to connecting and cover the recognition of hazards, and the establishment, access, safe connecting techniques and work practices required by proposed § 1926.756(c) and § 1926.760(b).

Proposed paragraph (b)(3) would require that connectors be provided with a personal fall arrest or fall restraint (positioning device) system, i.e., be wearing the equipment and be provided with the means to tie-off at heights over 15 and up to 30 feet above a lower level. In the alternative, the connector could be provided with other equally effective means of protection from fall hazards in accordance with paragraph (a)(2) of this section, which would usually mean protection by the use of nets. The definition of these systems, discussed earlier, makes it clear that a personal fall arrest or fall restraint (positioning device) system would include an anchorage.

The ability to tie-off and the provision of fall protection represent a central component of the SENRAC consensus. Paragraph (b)(3) should not, however, be interpreted to mean that the connector must be tied-off at heights in the range between 15 feet and 30 feet. The Committee's consensus agreement was only that the connectors be given the means to tie-off at any time the connector chooses to do so. In addition, an anchorage of some sort must always be available: this could be stanchions with a catenary lifeline, or simply a lifeline attached to the primary beam or joist girder; a "beamer" (a portable anchorage that rolls along the upper or lower flange of the beam) or a nylon web strap anchor; or any other form of anchor that meets the requirements of § 1926.502 of this part. The Committee believes that under certain conditions, the connector is at greater risk if he/she is tied-off. For example, in the event of structural collapse, a tied-off connector could be forced to ride the structure to the ground. The Committee believes that the connector is in the best position to determine when to tie-off, and so the connector must have the ability to choose to tie-off.

A concern was raised as to whether such a provision would affect a connector's rights under workers' compensation laws. For example, in some jurisdictions, failure to tie-off may be construed as "employee misconduct". The proposal would allow the connector the choice of when not to "tie-off" in order to avoid a potentially greater hazard. However, states determine eligibility requirements for state workers' compensation benefits.

This exception applies only to connectors actively engaged in the placement of structural members and/or components working with hoisting equipment. Regardless of job title, when an employee has finished the "connecting" phase and is performing other steel erection activities (such as detailing, bolting-up and decking), the employee would no longer be considered a "connector" for the purposes of the exception to paragraph (a)(1) of this section and would have to be protected from fall hazards in accordance with paragraph (a)(1) or paragraph (c) of this section.

*Paragraph (c) Controlled decking zone (CDZ).* Paragraph (c) addresses the other exception to providing fall protection above 15 feet permitted by this proposal. This provision would allow a controlled decking zone to be established in that area of the structure over 15 and up to 30 feet above a lower level where metal deck is initially being installed and forms the leading edge of

a work area. The Committee developed a combination of specification and work practice requirements to protect employees engaged in decking activities if an employer elects to establish a controlled decking zone rather than provide fall protection as otherwise required by this section.

Proposed paragraph (c)(1) would require that each employee working at the leading edge in a CDZ be protected from fall hazards of more than two stories or 30 feet, whichever is less. Many decking operations do not lend themselves to the establishment of CDZs. For example, single story, high bay warehouse structures and pre-engineered metal buildings require decking operations that commonly take place more than 30 feet above lower levels. The exception would not apply in these situations.

An important aspect of a CDZ is controlled access. Based on the reviews of OSHA fatality data (Exs. 9-14, 9-49), some fatalities attributed to decking operations were experienced by employees not engaged in leading edge work. Proposed paragraph (c)(2) would limit access to the CDZ exclusively to those employees who are actually engaged in and trained in the hazards involved in leading edge work.

Paragraph (c)(3) addresses the physical limits of a CDZ. The employer would be required to designate the boundaries of a CDZ and clearly mark them. Control lines would commonly be used for marking the boundaries, but the performance language of the proposed requirement also allows for the equivalent, e.g., a perimeter wall. Control lines are not defined in this proposal. OSHA requests comment on whether a definition of "control lines" is necessary or whether Appendix D provides adequate description, since it sets the criteria for control lines or, in the alternative, should Appendix D be incorporated into the provisions of § 1926.760(c)?

The intent of the proposed requirement is to limit access to the zone and to limit the overall size of the CDZ. Assuming a typical bay to be 40 feet in its greatest dimension, the Committee recommended and OSHA proposes that the CDZ not be greater than two bays plus ten feet back from the leading edge into a fully installed deck area to allow for staging. Because some bays could be larger, a specified distance criteria based on the typical bay of 40 feet or 90 feet in each direction is proposed. Additional guidelines for assistance in using control lines to demarcate CDZs are found in non-mandatory Appendix D.

Proposed paragraph (c)(4) would require that each employee working in a CDZ have completed CDZ training in accordance with the training section of this subpart. Such training would cover recognition of the hazards associated with work in a controlled decking zone and the establishment, access, safe installation techniques and work practices required by proposed § 1926.754(e) and § 1926.760(c).

Paragraph (c)(5) addresses the specific hazard that results when full support is not achieved in the placement of metal deck. For example, in steel joist construction, metal deck sheets are typically 20 feet or longer and may span more than 4 joists that are typically spaced 5 feet apart. A hazard is created if the deck is placed so that only three joists are supporting the sheet and the deck ends are unsupported. A worker not using fall protection and stepping on the unsupported end of a deck sheet so placed is exposed to a potentially fatal fall hazard. This paragraph, therefore, would require that during initial placement, deck sheets be placed so as to ensure that the structural members provide the support as designed.

Paragraph (c)(6) addresses the hazard presented to deckers when too much decking is left unsecured. The installation of metal deck requires it to be placed on the structural members, unsecured, at control marks to allow for proper alignment. As a result of the physical dynamics of the bundle during shipping, metal deck may have different widths. For example, in a typical bundle of decking, the bottom sheet can be wider than the top sheet by an inch or more. Due to these variations, field adjustment of the decking is necessary to fit the bay at the control marks. The proposal would limit the area of unsecured deck to 3000 square feet (914.4 m<sup>2</sup>) to restrict the exposure of employees engaged in the placement of these deck sheets. Given the dimensions of a typical bay (a typical bay is approximately 900 S.F.), 3000 square feet was determined to be an appropriate limit that would allow for the decking to be placed and alignment to be performed prior to tack welding. This limit would thus greatly reduce the hazards associated with large areas of decking being left unattached and unattended.

Proposed paragraph (c)(7) addresses the hazard in leading edge work that arises when an employee turns his/her back to the leading edge while attaching deck sheets. After the decking has been adjusted to fit the bay, a safety deck attachment (see definition section) must be performed with at least two

attachments per panel. When such attachments are performed on the laps (although to do so is not required), there would be four attachments per panel. Safety deck attachments are usually done by tack welding the panel but can also be achieved with a mechanical attachment, such as self-drilling screws or pneumatic fasteners. The proposed provision would require that such attachments be made from the leading edge back to the control line to protect the employee from inadvertently stepping off the leading edge.

Paragraph (c)(8) would prohibit final deck attachments and installation of shear connectors in the CDZ. These activities are not leading edge work and would not be permitted in a CDZ. Employees performing this work can be readily protected from falls by the use of conventional fall protection, e.g., guardrails.

*Paragraph (d) Covering roof and floor openings.* Paragraph (d) addresses proper covering of roof and floor openings, which is required by proposed § 1926.754(e)(2), during steel erection to prevent employees from falling through them. Paragraph (d)(1) would require that coverings of roof and floor openings be capable of supporting, without failure, the greater of either 30 pounds per square foot for roofs and 50 pounds per square foot for floors or twice the weight of employees, equipment and materials that may be imposed on the cover at any one time. The pounds per square foot specifications are based on the strength requirements for steel roof and floor decks in the SDI Manual of Construction with Steel Deck (Ex. 9-34A). The performance language is based on subpart M criteria for covers (§ 1926.502(i)). This would allow for adequate protection for employees who may walk on, or for any equipment that may be placed on, a floor or roof covering.

Paragraph (d)(2) would require that all covers be secured when installed so as to prevent accidental displacement by the wind, equipment or employees. Requiring that all covers be secured against displacement eliminates the fall hazard. Additionally, paragraph (d)(3) would require that all covers be painted with high visibility paint or be marked with the word "HOLE" or "COVER" to provide warning of the hazard so as to prevent an employee from inadvertently removing the cover.

Paragraph (d)(4) would provide that smoke domes or skylight fixtures which have been installed are not considered covers for the purposes of this section unless the strength requirements of paragraph (d)(1) above are met. A

common cause of falls is employees leaning or sitting on skylights or smoke domes which will not support their weight. These structures may not be capable of supporting the load and may give way, causing a fall. Consequently, unless they have adequate strength, these structures cannot be relied upon to protect employees from falls. OSHA invites comment on whether these skylights and smoke domes would be more appropriately treated in § 1926.754(e)(2), which addresses roof and floor openings, and in particular *permanently filling openings*, rather than in this section, § 1926.760(d), which addresses *covers* for roof and floor openings.

*Paragraph (e) Custody of fall protection.* Proposed paragraph (e) addresses fall protection, usually perimeter safety cables, initially installed and maintained by the steel erector but remaining on the site after steel erection has been completed. If no provision for the proper maintenance of such fall protection is made, the equipment could fall into disrepair and no longer function properly. Employees of contractors arriving later might rely on this potentially dangerous fall protection, creating a false sense of security in these workers. Paragraph (e) would require that fall protection provided by the steel erector not be left in an area to be used by other trades after the steel erection activity has been completed unless the controlling contractor or its authorized representative has directed the steel erector to leave the fall protection in place and has inspected and accepted control and responsibility of the fall protection prior to authorizing persons other than steel erectors to work in the area. This proposed requirement is consistent with the AISC Code of Standard Practice (Ex. 9-36, p. 15) which states:

When safety protection provided by the erector is left remaining in an area to be used by other trades after the steel erection activity is completed, the owner shall be responsible for accepting and maintaining this protection, assuring that it is adequate for the protection of all other affected trades, assuring that it complies with all applicable safety regulations when being used by other trades, indemnifying the erector from any damages incurred as a result of the safety protection's use by other trades, removing the safety equipment when no longer required and returning it to the erector in the same condition as it was received.

#### *Section 1926.761 Training.*

The OSHA steel erection proposal has many new requirements involving more widespread use of personal fall protection equipment and special

procedures for making multiple lifts, for decking activities in controlled decking zones and for connecting. Early in the development of these new requirements, the Committee recognized the need for a separate training section. The requirements proposed in § 1926.761 would supplement OSHA's general training and education requirements for construction contained in § 1926.21.

Proposed § 1926.761(a) would require that instruction on fall hazards and other specified hazards associated with steel erection activities and appropriate corrective actions be provided to employees by a qualified person.

A "qualified person," as defined in existing § 1926.32 and restated in the definition section of this proposal, means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

Proposed paragraphs (b) and (c) specify particular training that would have to be provided by the employer to employees who are exposed to the specified steel erection hazards. Paragraph (b) would require that the employer provide a training program for all employees exposed to fall hazards. The program would have to include training and instruction in the recognition and identification of fall hazards in the work area; the use and operation of perimeter safety cable systems, guardrail systems, personal fall arrest systems, fall restraint (positioning device) systems, safety net systems, controlled decking zones and other protection to be used; the correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used; the procedures to be followed to prevent falls to lower levels and through or into holes and openings in walking/working surfaces and walls; and the fall protection requirements of § 1926.760.

In addition to fall hazards, the Committee identified certain activities that would require specialized training due to the hazardous nature of the activities. Accordingly, paragraph (c) requires such training for employees engaged in multiple lift rigging procedures (MLRP), connecting activities and work in controlled decking zones.

Paragraph (c)(1) proposes additional training for employees performing MLRPs. This training would include instruction in the hazards associated with multiple lifts and the proper procedures and equipment to perform

multiple lifts safely, as proposed in § 1926.753(c).

Paragraph (c)(2) would require the employer to ensure that each connector has been provided training in the hazards associated with connecting, and in the establishment, access, proper connecting techniques and work practices proposed in § 1926.760(b) (fall protection) and § 1926.756(c) (double connections).

Paragraph (c)(3) would require additional training for controlled decking zone employees. The training must cover the hazards associated with work within a controlled decking zone, and the establishment, access, proper installation techniques and work practices required by § 1926.760(c) (fall protection) and § 1926.754(e) (decking operations).

This proposed section has been drafted to allow the employer a reasonable degree of flexibility in developing a training program and conducting training. OSHA recognizes that there are differences in the techniques that will be successful with different employees. Therefore, the proposed section does not limit the employer by specifying the manner in which the training must be conducted. Similarly, the specific content of the training course has only been generally addressed because different topics must be taught to address the variations associated with different steel erection activities and to cover hazards specific to each workplace.

The employer may choose the training provider. This could include contracting with an outside professional training company to train employees or developing and conducting the training program itself. In either case, the employer can choose the provider, method and frequency of training that are appropriate for the employees being trained. In addition, each employee must have been provided training prior to hazard exposure.

#### *Appendices to Proposed Subpart R*

The following appendices neither create additional obligations nor eliminate obligations otherwise contained in the standard. They are intended to provide useful, explanatory material and information to employers and employees who wish to use it as an aid to understanding and complying with the standard.

#### *Appendix A to Subpart R—Guidelines for Establishing the Components of a Site-Specific Erection Plan (Non-Mandatory)*

As explained in the discussion for the proposed section governing site-specific

erection plans, this appendix was developed by SENRAC as a non-mandatory set of guidelines provided to assist employers in complying with the requirements of proposed paragraph § 1926.752(d). If an employer follows these guidelines to prepare a site-specific erection plan, it will be deemed as complying with the requirements of paragraph § 1926.752(d). OSHA welcomes comment on the adequacy of these guidelines.

*Appendix B to Subpart R—Acceptable Test Methods for Testing Slip-Resistance of Walking/Working Surfaces (Non-Mandatory)*

Appendix B is provided to serve as a non-mandatory guide to assist employers in complying with the requirements of proposed paragraph § 1926.754(c)(3). The two nationally recognized test methods referred to in appendix B, ASTM F1678–96 (Standard Test Method for Using a Portable Articulated Strut Slip Tester) and ASTM F1679–96 (Standard Test Method for Using a Variable Incidence Tribometer), would provide the protocol for testing skeletal structural steel surfaces to obtain the documentation or certification required by proposed § 1926.754(c)(3). OSHA welcomes comment on the testing procedures contained in this appendix.

*Appendix C to Subpart R—Illustrations of Bridging Terminus Points (Non-Mandatory)*

Appendix C is provided to serve as a non-mandatory guide to assist employers in complying with the requirements of proposed paragraph § 1926.757(c)(3). Although the appendix does not show all possible bridging terminus points, the illustrations provide examples of common bridging terminus points. OSHA solicits information and comment on this proposed appendix.

*Appendix D to Subpart R—Illustration on the Use of Control Lines to Demarcate Controlled Decking Zones (CDZs) (Non-Mandatory)*

Appendix D is provided to serve as a non-mandatory guide to assist employers in complying with the requirements of proposed paragraph § 1926.760(c)(3). If the employer follows these guidelines to establish a control line to demarcate a CDZ, OSHA will accept the control line as meeting the requirements of paragraph § 1926.760(c)(3). This appendix neither creates additional obligations nor eliminates obligations otherwise contained in the standard. It is intended to provide useful explanatory material

and information to employers and employees who wish to use it as an aid to understanding and complying with the standard. OSHA solicits information and comment on this proposed appendix.

*Appendix E to Subpart R—Training (Non-Mandatory)*

Appendix E is provided to serve as a non-mandatory guide to assist employers in complying with the requirements of proposed paragraph § 1926.761. Even before the existence of OSHA, the Ironworkers International Union provided apprenticeship training in steel erection to its members. This training has been approved by the U. S. Department of Labor's Bureau of Apprenticeship Training for over forty years. As soon as this program is updated to reflect the requirements of this new subpart R, training under this program will be deemed as complying with the training requirements of § 1926.761. As stated in Article XI of the current approved National Apprenticeship and Training Standards for Ironworkers:

The [Ironworkers Joint Apprenticeship] Committee shall seek the cooperation of all employers to instruct the apprentices in safe and healthful work practices and shall ensure that the apprentices are trained in facilities and other environments that are in compliance with either the occupational safety and health standards promulgated by the Secretary of Labor under [the OSH Act] or state [plan] standards \* \* \* (Ex. 9–139, p. 8).

OSHA does not intend that training approved by the U.S. Department of Labor Bureau of Apprenticeship be the only training deemed to meet the requirements of § 1926.761. Employers may choose to provide their own training, provided that it fulfills the requirements of § 1926.761. The Agency invites comment on this proposed appendix.

*Appendix F to Subpart R—Installation of Perimeter Safety Cables (Non-Mandatory)*

Appendix F is provided to serve as a non-mandatory guide to assist employers in complying with the requirements of proposed paragraph § 1926.756(f), when perimeter safety cables are used to protect the unprotected side or edge of a walking/working surface. If an employer elects to follow the guidelines of this appendix, the perimeter safety cable system shall be deemed to be in compliance with the provisions of § 1926.756(f). OSHA solicits information and comment on this proposed appendix.

## VI. Other Issues

As indicated above, the Committee has reached consensus on the regulatory text. Although no negotiation sessions have been held since December 1995, Committee members have continued to provide technical assistance to OSHA staff in developing the "Summary and Explanation" section of the proposed rule. During this period, a number of additional concerns have been raised by Committee members, SENRAC workgroup members and OSHA staff. OSHA has determined that, rather than reopening the negotiations, these issues can be adequately addressed in the normal "§ 6(b) rulemaking process" that will follow the publication of this proposal. Normal rulemaking includes a comment period on the proposed rule, an informal public hearing, and, for those who have elected to participate in the hearing by filing a "Notice of intent to appear" (see Public Participation section), a post-hearing comment period. In addition, OSHA has decided that, in order to develop a complete record and to reach as many stakeholders as possible, these and other issues should be raised in this section of the proposal. The public is specifically requested to comment on all relevant issues, including the following:

1. Some hazards currently addressed by the existing requirements in § 1926.105(a) may not be adequately addressed in proposed subpart R (Ex. 9–152). Proposed § 1926.754(b)(3), for example, would require that, in multi-story structures, a fully planked or decked floor or nets be maintained within 2 stories or 30 feet, whichever is less, below and directly under any erection work which is being performed. There was a difference of opinion among the Committee members as to whether the primary purpose of this requirement is to constitute fall protection or protection from falling objects. The Committee considered this issue and concluded that the fully planked, decked or netted floor provides fall protection just as the netting on a bridge provides fall protection. Comment is requested on whether a fully planked floor provides fall protection for falls of up to 30 feet.

Existing § 1926.750(b)(1)(ii) and § 1926.105(a) provide that for buildings and other structures not adaptable to temporary floors, safety nets must be provided when workplaces are more than 25 feet above the ground or water surface, or other surface where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical. These requirements have been applied to fall hazards on

bridges, as well as fall hazards to the outside of any steel erection structure, including those adaptable to temporary floors. However, bridges would not be covered by the proposed § 1926.754(b)(3), which only applies to multi-story buildings. Therefore, public comment is requested on whether a requirement should be added to subpart R to continue to require nets for bridges over water. It is suggested that a provision could be inserted in § 1926.754(b)(2) and read as follows:

For bridges, safety nets shall be provided when workplaces are more than 30 feet above a water surface, § 1926.760(a) notwithstanding.

Comment is requested on the need for this requirement and the appropriateness of the suggested language as well as any other recommended course of action on this issue.

Additionally, the proposal would raise the height at which fall protection is required for connectors exposed to fall hazards to the outside of a building from 25 feet (existing § 1926.105) to 30 feet (proposed § 1926.760(b)(1)). Comment is also requested on the appropriateness of making this change in the standard.

2. Proposed § 1926.754(c)(3) uses the term finish-coated to describe paints or similar materials applied to steel members. It also prohibits workers from walking on a steel member that has been finish-coated without documentation that the finished coat has not decreased the COF of the steel being coated. OSHA solicits information and comments on what should or should not be considered finish-coated. Should all single coat primer paints or coatings be exempted from being considered finished coats? Are there any primer paints that should not be exempted, such as epoxy primers? Should galvanized coatings be exempted? In addition, OSHA has received information from the Structural Steel Painting Council (SSPC) that the term "finished coat" already has a common understanding in the industry and that it refers to paint applied to steel members after the steel members have been erected (Ex. 9-152). Since SENRAC is concerned with the slipperiness of painted steel before the erection of the members, should this requirement be re-worded to avoid potential confusion? Since slip resistance information is now attainable (see, for example, Appendix B), please submit data to support your views. OSHA also requests comment on whether the requirement should avoid using the term "finish-coated" at all; for

example, should it simply state: "Workers shall not be permitted to walk the top surface of any structural steel member installed after [effective date of final rule] which has a COF less than that of the original steel."

3. The plumbing-up requirements in the proposal have been questioned as to whether they are specific enough to ensure structural stability as required by proposed § 1926.754(a) (Ex. 9-152). Public comment is requested on whether additional plumbing-up requirements are necessary to protect employees. It has been suggested that the following provisions be added to § 1926.754(a):

(1) Plumbing-up equipment shall be installed in conjunction with the steel erection process to ensure the stability of the structure; and

(2) Plumbing-up equipment shall be in place and properly installed before the structure is loaded with construction material such as loads of joists, bundles of decking or bundles of bridging.

Comment is requested on the need for these requirements and the appropriateness of the suggested language as well as any other recommended course of action on this issue.

4. The preamble identifies the provisions in the standard which are new or which are changed from the provisions of the existing standard. OSHA believes that many employers are already following the procedures that would be required by many of these proposed provisions. OSHA will evaluate, on the basis of all the evidence submitted to the public record, the likely effectiveness of the proposed revised and new provisions. To assist OSHA in this area, the public is asked to provide information on the following issues:

a. Public comment is requested on the feasibility and effectiveness of the proposed changes. OSHA solicits information on the degree to which implementation of the proposed changes would reduce the occurrence or severity of accidents;

b. Public comment is requested on the amount of any costs or savings that have not been identified by OSHA (see Section VII of this preamble—Summary of the Preliminary Economic and Initial Regulatory Flexibility Analysis) which might result from the proposed changes.

5. In discussing the scope of proposed subpart R, the Committee originally developed an extensive list of structures and activities that could involve steel erection work for inclusion in an appendix that would be referenced by paragraphs (a) and (b) of § 1926.750. However, the Committee subsequently

decided that the list should be placed in the standard itself in notes to paragraphs (a) and (b), respectively. OSHA raised some concerns with this approach related primarily to how the courts might interpret a scope section with such a long and detailed list. The Agency suggested that a listed structure or activity might erroneously be viewed as being within the scope of subpart R, whether or not steel erection was taking place. Conversely, failure to include an activity or structure on the list might indicate that the activity is never to be covered by subpart R, since the list appears to be so inclusive. Moreover, the Agency stated that if the Committee's goal was to make the scope as broad as possible, it could accomplish this goal more directly by specifying instead what is *not* covered by the subpart. OSHA contended that voluminous lists of examples of covered workplaces are not appropriate in regulatory text. Nonetheless, the Committee reached consensus that the lists of structures and activities be placed in the standard as notes to paragraphs (a) and (b). OSHA requests comment on the scope and application section and specifically on whether these notes clarify the scope and application of the proposed standard; whether they restrict or expand the scope of what is considered steel erection; and whether such restriction or expansion is appropriate. In addition, OSHA notes that while the lists indicate workplaces which might be covered by subpart R, they would be covered only when steel erection work is being performed. The Agency seeks comment on whether the lists are necessary in light of that limitation.

6. Proposed § 1926.755(a) sets forth general requirements for ensuring erection stability. Paragraph (a)(1) would require that all columns be anchored by a minimum of 4 anchor bolts. Additionally, this paragraph would require that column anchor bolt assemblies, including the welding of the column to the base plate, be designed to resist a 300 pound (136.2 kg) eccentric load located 18 inches (.46 m) from the column face in each direction at the top of the column shaft.

OSHA invites comments on the following and any other relevant questions: Should these requirements include a 4:1 safety factor for the design of the column base to be consistent with other OSHA standards? Should the requirements call for the washer and nut to be placed and hand tightened at all four anchor bolts before the hoist line of the column is released to ensure that stability of the column is achieved? Should a cross-reference be provided to

§ 1926.752(a)(1) since the anchor bolts would have to be designed for the 300 lb. eccentric load when the concrete in the footings, piers and walls or the mortar in the masonry piers and walls has attained either 75 percent of the intended minimum compressive design strength or sufficient strength to support loads imposed during steel erection? Would a designer miss the provision in § 1926.752(a)(1) without a cross-reference?

7. Proposed § 1926.756 sets forth requirements for connections of beams and columns to ensure stability of the steel structure during the erection process. However, the proposal does not have any specific requirements for cantilevered beams, which exert different forces on the connection than does a typical end-connected beam. A number of accidents have occurred because of inadequate connections of cantilevered beams during erection. Is a provision needed to require that, "after proper evaluation of the span and the intended load by a competent person, cantilevered beams shall be secured with the number of bolts necessary to ensure stability."

Additionally, with regard to all connections, in some cases bolts of lesser diameter and strength than the permanent bolts specified are used on a temporary basis. If temporary bolts are used and prove to be of insufficient strength, the intent of the proposed paragraph would not be met. Is it necessary to require that the bolts used "be of the size and strength shown on the construction documents" to avert this situation? Comments addressing these concerns are requested.

8. Proposed § 1926.757(a)(8) and § 1926.757(d)(1) introduce the term "bay." Should this term be defined in the steel erection standard or is there a common understanding of the term? In addition, since the two provisions refer to specific sizes of bays, should the standard include the particulars of measuring a bay?

9. Section 1926.757 of the proposal addresses SJI specification joists. There are joists being manufactured that are not constructed to SJI specifications (for example joists in excess of 144 feet). Should the joist requirements of the steel erection standard include provisions for non-SJI specification joists?

10. In the course of SENRAC's deliberations, OSHA staff, NIOSH and Committee Workgroups made a considerable effort to study the injuries and fatalities resulting from steel erection activities (Exs. 9-13E, 9-14A, 9-15 and 9-42) so that SENRAC could determine what caused the incidents

which resulted in those injuries and fatalities and could propose appropriate protective and preventive measures.

Some of the SENRAC participants suggested that the available data were unreliable and did not accord with their experience. They believe that structural collapse is the major cause of injuries and fatalities in steel erection. The Committee therefore decided that the best way to protect a worker from a fall is to eliminate structural collapses. The Committee believes that the usefulness of fall protection in steel erection is greatly reduced in a collapse situation. However, others have evaluated the fatality data available to OSHA and determined that fall fatalities not involving collapses exceed those which involve collapses by a factor of five. Should subpart R focus, to a greater extent, on the use of fall protection to prevent fatalities? OSHA seeks comments and information regarding the characterizations of the injury and fatality data and the conclusions to be drawn from that data. Also, the Agency solicits additional information and data on the causes of injuries and fatalities experienced by employees erecting steel structures.

11. Proposed 1926.760(b) and (c) set alternative fall protection measures for employees performing the initial connection of structural steel and employees performing the installation of metal deck. Proposed subpart R does not require employers to demonstrate that the use of conventional fall protection (guardrails, safety nets or personal fall arrest systems) would be infeasible or would create a greater hazard in these cases (as do the alternative provisions to fall protection found in § 1926.501(b)(2), (12) and (13)). Currently, under § 1926.105(a), OSHA requires that employers provide fall protection to workers who are installing roof decking on non-tiered steel structures over 25 feet. Employers comply with this requirement in several ways, including the use of personal fall arrest systems. Proposed § 1926.760(b)(3) permits employers to use a CDZ in place of fall protection.

Should the Agency require employers to demonstrate that the use of fall protection is infeasible or would create a greater hazard before allowing employees to follow alternative measures for connecting or for decking operations? Should the standard specify that the connector determine that there is a greater hazard to tying-off before electing not to tie-off? OSHA seeks comments, suggestions, information and data regarding how a steel erection employer should determine what fall

protection is appropriate for its affected employees.

12. Proposed § 1926.760(b)(3) requires that connectors be provided with fall protection equipment and an available anchorage but leaves the decision to the employee as to whether to tie-off. Some steel erection companies currently require employees to use fall protection at all times above six feet. Is it appropriate to permit some work above this height to be performed without fall protection? Should the standard allow employees the option of not tying-off? Should it be the responsibility of the employer to determine whether and what conditions warrant the use of the fall protection? Should the standard provide more specific criteria to indicate when the connector is required to be tied-off? Are there particular operations for which there is evidence that tying-off either is infeasible or poses a greater hazard to connectors? The Agency requests comments and supporting data on these and related issues.

13. Proposed paragraph § 1926.760(a)(1) sets the general trigger height for fall protection in steel erection at 15 feet. Do the conditions (discussed in the preamble) justify the lack of fall protection at 6 feet, as is required by subpart M of OSHA's construction standards for most other construction activities? Are there activities or structures in the scope of proposed subpart R for which fall protection should be provided at other heights (either lower or higher)?

14. Proposed paragraphs 1926.760(b) and (c) provide exceptions to the 15 foot trigger height requirement for connectors and employees working in an established CDZ. Do the conditions discussed justify the alternative trigger height requirements for these workers? Are the alternative protective requirements in those paragraphs adequate to protect connectors and CDZ workers from falls? Is there evidence or data demonstrating that this is the case?

15. Proposed 1926.753, Hoisting and Rigging, would allow employees to work under overhead loads under certain situations (proposed paragraph (b)— Working Under Loads and proposed paragraph (c)— Multiple Lift Rigging Procedure). In addition, proposed paragraph (a)(4) would allow the use of cranes and derricks to hoist employees on a personnel platform without a showing that methods are infeasible or pose a greater hazard (see 1926.500). Does the rationale (discussed in the preamble) justify the allowance of these procedures? Are data available to determine that hoisting using a

personnel platform is safe if the specified conditions are met?

16. Proposed § 1926.761 provides the training requirements for steel erection. Included in these requirements are provisions that are specifically and uniquely found in steel erection. Re-training requirements, a common element of the training provisions in OSHA construction standards, however, were rejected by the Committee. Should all steel erection employees be required to undergo refresher training? If so, what intervals are appropriate for such training? If such training is not required in all cases, are there certain conditions or situations that do warrant additional re-training? If, for example, an employee demonstrates (by using improper procedures, not following procedures, etc.) that the employee has not retained the requisite understanding or skill or there have been significant changes in fall protection equipment or other techniques or technologies since the employee was trained, should the standard require re-training? Under what circumstances, if any, should an employee be re-trained?

An additional training requirement that is a part of many steel erectors' safety procedures is the so-called "tool box" meeting. Steel erection involves progressive sequences of erection, so that one day's shift may involve an entirely different workplace than the day before, possibly with different or unique new hazards. Would it be appropriate for OSHA to require a brief safety meeting prior to each shift or each change of activity to inform employees of identified hazards to be encountered during that shift and to make the employees aware of any particular procedures, equipment and work practices that will be used? What has been your experience with such meetings? Have you found them helpful? Protective? Cost-effective? Please provide any information or data to support your responses.

Proposed 1926.761 does not specify the details of required training programs to allow the employer flexibility in designing training programs. Do the training requirements provide adequate direction or should the frequency of training and the initial administering of training be addressed?

17. Based on the reasons stated in the preamble, is the lack of a specific requirement for slippery metal deck surfaces (reserved paragraph (c)(2) of proposed 1926.754) justified or is there adequate information to support such a requirement?

18. Proposed 1926.752(d) allows employers to elect to develop a site-specific erection plan if compelled by

site-specific considerations. Is there adequate support for not requiring a site-specific erection plan for all sites? Are there more (or fewer) situations than those identified in proposed 1926.752(d) for which the development of a site-specific erection plan would be appropriate? Does the lack of a required site-specific erection plan for every site reduce the protectiveness of the proposed standard in situations where providing such plans is feasible? OSHA solicits information on the effectiveness of erection plans and employers' and employees' experiences in developing and implementing them.

19. OSHA invites comments and information on proposed § 1926.760 (e). Specifically, to what extent do steel erection employers currently turn over fall protection systems to general contractors or follow-up contractor employers when steel erection operations have been completed? To what extent do "controlling contractors" currently assume responsibility for fall protection systems installed by steel erectors, as would be required by proposed § 1926.760 (e)(1) and (e)(2)?

20. There are six provisions in the proposal that exempt the employer from certain requirements of the standard where the design or constructibility would not allow or would eliminate the need to comply with the requirement. These are § 1926.754(b)(1), § 1926.754(b)(2), § 1926.754(e)(2)(i), § 1926.754(e)(2)(ii), § 1926.756(e), and § 1926.756(f). What criteria should be used to determine whether design or constructibility would allow the exemption? Should the employer be required to demonstrate these criteria prior to claiming an exemption to one of the provisions?

21. Proposed § 1926.760(a)(2) provides criteria for fall arrest systems and other fall protection equipment and includes strength requirements for anchorages used in fall arrest systems. Proposed § 1926.757(a)(10) prohibits the use of joists and joist girders as anchorages and proposed § 1926.758(g) prohibits the use of purlins and girts in pre-engineered metal buildings as anchorages unless "written direction to do so is obtained from a qualified person." In the discussion above, the explanation for the prohibition was explored but little was presented as to what the "written direction" should be based on. Should criteria be included in these provisions to develop the basis for the written direction and, if so, what should these criteria be?

22. OSHA welcomes small business comments in response to the following:

a. While conducting a negotiated rulemaking process, SENRAC

considered a number of alternatives to the final proposal. The alternatives are presented in the preamble and the Initial Regulatory Flexibility Analysis. Are any of these alternatives more effective while achieving the same level of safety? Are there other cost-effective alternatives to specific provisions in the rule that would produce an equally safe steel erection workplace? If so, please explain.

b. Comments are welcome from affected small businesses on all aspects of the proposal. Comments could include anticipated costs (including capital outlay), revenue and profit estimates, feasibility and anticipated levels of safety resulting from the rule. In particular, OSHA welcomes comment and any available supporting information on the cost, feasibility and safety of the following specific requirements.

(1) Section 1926.754(e)(1)(i) requirement disallowing hoisting by bundle packaging and strapping, unless the packaging and strapping are designed for hoisting.

(2) Sections 1926.755(a)(1) and 1926.758(b) requirements to anchor all columns by a minimum of 4 anchor bolts, based on specific design assembly specifications.

(3) Section 1926.756(f)(3) requirement that holes or other devices be provided by the fabricator/supplier and be attached to perimeter columns at 42–45 inches above the finished floor.

(4) Section 1926.757(a)(4) requirement that a stabilizer plate be provided on each column for steel joists and steel joist girders.

(5) Section 1926.757(a)(8) requirement for steel joists in bays of 40 feet or more to be fabricated to allow for field bolting during erection—a requirement which requires the use of building specific bolt hole construction.

(6) Section 1926.757(d)(6)(iii) requirement for shop-installed bridging clips, or functional equivalents, on all steel joists to be provided where the bridging bolts to the steel joists.

(7) Section 1926.758(e)(2) requirement for the seat or similar connection device to be provided by the manufacturer of the girt or eave strut.

c. OSHA assumes that the proposed rule will require construction and steel fabricator firms to either pass-through costs and increase prices or assume costs in some proportion and reduce profits by some amount. Small business representatives have expressed concern that, if the total cost of construction increases by greater than 5 percent, their client base will shift away from steel erection to less costly construction methods. Is this an accurate threshold



for determining the effects of the rule on the competitive position of steel erection firms? Do affected firms expect the proposed rule to increase costs of steel erection or related fabrication by more than 5 percent? Explain the bases for this calculation. Will construction and fabrication firms lose significant numbers of jobs or specific types of jobs because of a price increase? Are specific types of firms within the steel erected building industry particularly sensitive to cost increases?

d. "Leading edge" construction firms have already met many of the proposed rule's provisions. Thus, OSHA assumes that other firms will be able to meet the rule's requirements with existing equipment and production methods at reasonable economic costs. Is this an accurate assumption? Firms already in basic compliance with the proposal's provisions are welcome to comment on each of the following questions:

(1) What is the size of your firm (e.g., number of employees, annual revenue, etc.)?

(2) Which provisions of the proposed rule do you practice?

(3) How much has compliance with these practices reduced or increased your profit and why?

(4) How much has compliance with these practices increased or reduced your costs and why?

(5) How much of increased costs have you been able to pass along to the customer?

(6) When faced with the need to make a cost-competitive bid, how does your firm absorb or reduce costs associated with the additional safety practices?

e. The proposed rule places new requirements on pre-engineered metal buildings. OSHA invites this industry sector to comment and provide supplemental information on the costs and benefits of these requirements. Specifically, the agency seeks comments on the following information:

(1) The number of firms likely to be affected by this rule;

(2) The typical size of these firms (e.g., number of employees, annual revenue, etc.);

(3) The size of revenues of these firms and their profitability as a percent of revenues;

(4) The costs of the proposed requirements on these firms;

(5) The need for safety improvements associated with erection of various sized pre-engineered metal buildings; and

(6) Regulatory alternatives that may be more appropriate or cost effective for this sector.

f. OSHA has assumed that safety benefits accrue to employees in small firms at a rate equal to that in medium and large firms. OSHA's Initial Regulatory Flexibility Analysis assumed, however, that 44 percent of iron workers affected by the rule are employed by small firms and that these small firms would have to pay only 22.5 percent of the costs, leaving the majority of the cost impacts to fall on medium and larger firms. OSHA welcomes comment on whether it should assume that benefits accrue on a different basis than costs. For example, OSHA welcomes comment on whether it has properly estimated that only 22.5 percent of costs would fall on firms with fewer than 10 employees, even though 44 percent of all employees in the steel erection trade work for these very small firms? Comments are also invited on other cost and benefit assumptions.

## VII. Summary of the Preliminary Economic and Initial Regulatory Flexibility Analysis

### Introduction

The Administrator of OIRA has determined that this proposal is a significant regulatory action under E.O. 12866 and a major rule under the Congressional Review provisions of the Small Business Regulatory Enforcement Fairness Act. Accordingly, OSHA has provided OIRA with an assessment of the costs, benefits and alternatives, as required by section 6(a)(3)(C) of E.O. 12866, which is summarized below.

Executive Order (EO) 12866 requires regulatory agencies to conduct an economic analysis for rules that meet certain criteria. The most frequently used criterion under EO 12866 is that the rule will impose annual costs on the economy of \$100 million or more. OSHA's proposal to revise the steel erection standard in construction is projected to result in annual costs of less than \$100 million; nevertheless, OSHA has prepared this preliminary economic analysis, summarized below.

The Regulatory Flexibility Act of 1980, as amended in 1996, requires OSHA to determine whether the Agency's regulatory actions will have a significant impact on a substantial number of small entities. Making such a determination for this proposal required OSHA to perform a screening analysis to identify any such impacts. OSHA's screening analysis indicated that the proposed rule might have significant impacts on a substantial number of small entities. Accordingly,

OSHA has prepared an Initial Regulatory Flexibility Analysis, summarized below, of the proposed steel erection rule.

OSHA's preliminary economic analysis and initial regulatory flexibility analysis include a description of the industries potentially affected by the standard; a summary of the major changes between OSHA's existing steel erection standard and the proposed rule; an evaluation of the risks addressed; an assessment of the benefits attributable to the proposed standard; a determination of the technological feasibility of the new requirements; an estimate of the costs employers will incur to comply with the standard; a determination of the economic feasibility of compliance with the standard; and an analysis of the economic and other impacts associated with this rulemaking, including those on small businesses. OSHA's preliminary economic analysis and initial regulatory flexibility analysis of the proposed standard are based on risk and cost data collected and analyzed by OSHA's contractor, Jack Faucett Associates; these data are presented in Appendices B and C of the preliminary economic analysis.

### Affected Industries

The proposed steel erection standard affects industries and establishments within the construction industry. Table 1 presents the industry groups in construction that will be directly affected by the proposed standard. Construction employers who will be directly impacted are concentrated within SIC 1791, Structural Steel Erection, an industry with 4,463 establishments and 51,108 employees in 1996, as reported by Dun & Bradstreet [D&B, 1996a]. Within this industry, 3,724 establishments, or 83 percent of the total number of establishments, employed nineteen or fewer employees in 1996, while 3,099 establishments (69 percent) employed nine or fewer employees. SIC 1791, however, also includes employers and workers who perform construction activities other than steel erection, notably pre-cast concrete erection. Thus, any comprehensive profile of the steel erection industry must, in addition to examining affected industry groups, focus on the type of work and the trade of the workers engaged in this form of construction.

TABLE 1.—INDUSTRY GROUPS IN CONSTRUCTION POTENTIALLY AFFECTED BY THE PROPOSED STEEL ERECTION STANDARD

SIC	Industry group	Iron workers (a)	Establishments with 1–9 employees		Establishments with 1–19 employees		Establishments with 1–99 employees		Establishments with 100+ employees		All establishments	
			Establishments	Employment	Establishments	Employment	Establishments	Employment	Establishments	Employment	Establishments	Employment
15	Building Construction—General Contractors and Operative Builders.	13,760	250,639	736,753	267,669	948,795	278,225	1,310,692	3,306	185,116	281,531	1,495,808
154	General Building Contractors—Nonresidential Buildings.	13,760	35,373	130,773	42,934	225,849	49,297	452,453	1,706	148,947	51,003	601,400
1541	Industrial Buildings and Warehouses.	.....	6,055	22,269	7,422	39,733	8,884	93,823	559	60,411	9,443	154,234
1542	Nonresidential Buildings, other than in SIC 1541.	.....	29,318	108,504	35,512	186,116	40,413	358,630	1,147	88,536	41,560	447,166
16	Heavy Construction other than Building Construction.	2,490	30,861	107,284	36,389	177,080	42,484	406,738	3,663	240,183	46,147	646,921
161	Highway and Street Construction, except Elevated Highways.	220	11,465	40,482	13,476	65,703	15,767	153,454	906	109,699	16,673	263,153
162	Heavy Construction, except Highway and Street Construction.	2,270	19,396	66,802	22,913	111,377	26,717	253,284	2,757	130,484	29,474	383,768
1622	Bridge, Tunnel, and Elevated Highway Construction.	.....	634	2,477	844	5,116	1,199	18,847	281	15,674	1,480	34,521
1623	Water, Sewer, Pipeline, and Communications and Power Line Construction.	.....	6,673	26,154	8,669	51,686	10,874	133,018	1,989	43,469	12,863	176,487
1629	Heavy Construction Not Elsewhere Classified.	.....	12,089	38,171	13,400	54,575	14,644	101,419	487	71,341	15,131	172,760
17	Construction—Special Trade Contractors.	22,730	537,914	1,617,998	582,095	2,176,861	611,076	3,165,136	7,899	335,227	618,975	3,500,363
176	Roofing, Siding, and Sheet Metal Work.	1,060	37,688	116,697	41,185	160,798	43,671	244,033	451	13,315	44,122	257,348
179	Miscellaneous Special Trade Contractors.	20,210	104,192	312,739	112,313	414,931	117,545	589,432	1,340	58,755	118,885	648,187
1791	Structural Steel Erection	.....	3,099	10,986	3,724	18,914	4,346	40,696	117	10,412	4,463	51,108
Construction Totals.	.....	38,980	819,414	2,462,035	886,153	3,302,736	931,785	4,882,566	14,868	750,526	946,653	5,643,092

(a) U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics Survey, 1993. Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis, 1998, based on Dun & Bradstreet, National Profile of Businesses software, Dun & Bradstreet Information Services, 1996.

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The workers directly benefitting from the proposed standard are identified in occupational surveys as structural metal workers; in the industry, they are known as iron workers. According to the Bureau of Labor Statistics' Occupational Employment Statistics Survey [BLS, 1993], there were 38,980 structural metal workers in construction in 1993, the majority of whom are found in SIC 179, Miscellaneous Special Trade Contractors (20,210 structural metal workers), and SIC 154, Contractors—Nonresidential Buildings (13,760 structural metal workers) (Table 1). For this preliminary economic analysis, OSHA used this estimate of the number of iron workers affected by the proposed rule in its benefits and cost analyses. In addition to these construction workers, structural metal workers and other workers in general industry who perform steel erection repair or renovation operations that are defined

by OSHA as construction may fall within the scope of the proposed standard. At this time, however, OSHA lacks data on the number of, and types of work performed by, workers not classified in construction SICs that perform steel erection activities. OSHA requests information on the number of structural metal workers and workers in other trades who perform steel erection outside of the construction industry.

*Proposed Changes to OSHA's Steel Erection Standard*

The proposed steel erection standard modifies and strengthens the Agency's existing standard in a number of areas. For example, the proposed standard includes a scope and application section that identifies the types of construction projects and activities subject to the rule. Structures excluded from coverage under the scope of the standard are steel electrical transmission towers, steel communication and broadcast towers, steel water towers, steel light towers,

steel tanks, and reinforced and pre-cast concrete. The proposed rule also includes a new section addressing site layout and construction sequence. Other proposed revisions to the existing standard include:

- Explicit requirements for hoisting and rigging and the resulting protection of workers and the public from the hazards of overhead loads;
- Additional and strengthened requirements for the structural steel assembly of beams, columns, joists, decking, and pre-engineered metal buildings, including the protection of employees from tripping hazards and slippery surfaces on walking/working surfaces;
- Strengthened and clarified requirements for fall protection for connectors, decking assemblers, and other iron workers during the erection of structural steel; and
- New requirements for training in fall hazards, multiple lift rigging,

connecting, and controlled decking zones.

For this analysis, OSHA has identified those requirements that would create substantial impacts or generate substantial benefits. OSHA estimates that current industry practice is at 10 percent with regard to providing fall arrest systems and personnel nets (i.e., 10 percent of affected firms currently use this equipment); at 75 percent for safety training; at 80 percent for column anchor bolts; and at 87 percent for guardrail systems [Ex. 11]. OSHA anticipates that the proposed standard's requirements pertaining to overhead loads, trips and slips, falls, falling objects, collapses, and worker training will both generate substantial benefits for affected employers and impose costs on them.

*Evaluation of Risk and Potential Benefits*

For this preliminary economic analysis, OSHA developed a profile of the risks facing iron workers who are

performing steel erection operations. OSHA's risk profile for steel erection is based on data from the Bureau of Labor Statistics' National Census of Fatal Occupational Injuries, data from the Bureau's Survey of Occupational Injuries and Illnesses, and an analysis by a SENRAC workgroup of OSHA fatality/catastrophe inspection data obtained from the Agency's Integrated Management Information System.

OSHA anticipates that the proposed standard will significantly reduce the number of accidents and fatalities currently reported in the steel erection industry, particularly those accidents caused by falls from elevated levels and by objects such as dislodged structural members and building materials striking workers. OSHA believes that the proposed standard's more protective requirements for fall protection, structural stability, and training will help to save lives and prevent injuries in the iron worker workforce. For accidents involving events or exposures potentially addressed by the proposed

standard, OSHA estimates that approximately 28 fatalities and 1,836 lost-workday injuries currently occur annually among structural metal workers (see Table 2, below); this is the current industry risk baseline used in this analysis. OSHA projects that full compliance with the proposed standard would prevent 26 of these fatalities and 1,152 of these lost-workday injuries. Twelve of these fatalities and 328 serious injuries could be prevented if employers were currently in compliance with OSHA's existing steel erection standard. The proposed standard will prevent an additional 14 fatalities and 824 injuries not prevented by the existing standard. Further, OSHA believes that compliance with the steel erection standard will be enhanced because the proposed revision is clearer, allows for more flexibility in compliance, is easier to understand, and is effectively targeted toward steel erection hazards.

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TABLE 2.—SUMMARY OF ESTIMATED NUMBER OF DEATHS AVERTED AND INJURIES AVOIDED BY FULL COMPLIANCE WITH THE PROPOSED STEEL ERECTION STANDARD

	Number of fatalities and lost-workday injuries currently occurring among iron workers	Number of fatalities and lost-workday injuries preventable by compliance with the existing standard	Additional number of fatalities and lost-workday injuries preventable by compliance with the proposed standard	Total number of fatalities and lost-workday injuries preventable by compliance with the existing and proposed standards	Number of fatalities and lost-workday injuries judged not to be preventable by either standard
Fatalities .....	28	12	14	26	2
Lost-Workday Injuries .....	1,836	328	824	1,152	684

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis, 1998.

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In addition to saving lives and improving overall safety in the steel erection industry, OSHA believes that the proposed standard, once fully implemented by erection contractors, would yield substantial cost savings to parties within and connected with the industry and ultimately to society as a whole. These monetized benefits take the form of reductions in employer and insurer accident-related costs in several areas: value of lost output associated with temporary total disabilities and permanent partial disabilities, an income-based measure derived from

estimates of workers' compensation indemnity payments; reductions in accident-related medical costs; administrative expenses incurred by workers' compensation insurers; and indirect costs related to productivity losses, work stoppages, and accident investigations and reports. Applying data from the construction and insurance industries on the direct costs of accidents and data from the literature on the indirect costs of accidents and other tort and administrative-related costs to OSHA's preliminary estimate of avoided injuries (see Chapter III in the preliminary economic analysis [Ex. 11]),

the Agency monetized the value of the cost savings employers and society will accrue by avoiding these injuries. In sum, OSHA estimates that annual costs savings of \$11.6 million would result from full compliance with the current rule and an additional \$28.7 million would be saved as a result of compliance with the proposed rule (Table 3). Thus annual monetized benefits of \$40.3 million are expected after the proposed steel erection standard is implemented as a final rule.

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TABLE 3.—SUMMARY OF ANNUAL INCREMENTAL MONETIZED BENEFITS OF PREVENTABLE LOST-WORKDAY INJURIES ATTRIBUTABLE TO THE PROPOSED STEEL ERECTION STANDARD

Lost Output Associated with Temporary Disabilities .....	\$4,356,347
Lost Output Associated with Permanent Disabilities .....	14,450,838
Medical Costs .....	3,923,949
Insurance Costs (Administrative) .....	2,384,945

TABLE 3.—SUMMARY OF ANNUAL INCREMENTAL MONETIZED BENEFITS OF PREVENTABLE LOST-WORKDAY INJURIES ATTRIBUTABLE TO THE PROPOSED STEEL ERECTION STANDARD—Continued

Indirect Costs .....	3,607,994
Costs Associated with Liability Claims Avoided .....	N/Q
<b>Total Cost Savings .....</b>	<b>28,724,074</b>

N/Q—Not Quantified.

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis, 1998.

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In addition to these monetized benefits, cost savings attributable to a decline in the number of third-party liability suits can be expected. Although quantification of these tort-related legal defense costs and dollar awards is difficult because of the unavailability of a sufficient volume of data, OSHA believes that these employer costs are substantial and would be slashed significantly through compliance with the proposed standard.

*Technological Feasibility and Compliance Costs*

Consistent with the legal framework established by the OSH Act, Executive Order 12866 and court decisions, OSHA has assessed the technological feasibility of the proposed steel erection standard. The proposed standard clarifies and strengthens the Agency's existing standard, provides more specific requirements in some areas, and introduces requirements for some steel erection hazards newly addressed by the Agency. Many of the proposed revisions are consistent with current construction means and methods used by leading firms within the steel erection industry. The success of these firms in this competitive industry demonstrates that the requirements of the proposed standard can be met with existing equipment and production methods.

Moreover, the proposed standard is based on a consensus draft recommended to the Agency by a negotiated rulemaking committee

consisting of divergent industry interests—including small employers—who would be affected by any changes to subpart R. The committee reached consensus on the language of the draft, thereby implicitly acknowledging the feasibility of the proposed revisions to the standard.

Therefore, based on the fact that many firms in the industry are already implementing the controls and practices required by the proposed standard and that the negotiated rulemaking committee reached consensus on the draft underlying the proposed revisions, OSHA has preliminarily determined that the proposed steel erection standard is technologically feasible.

OSHA developed estimates of the costs of compliance for construction employers subject to the proposed standard; OSHA's analysis is based on data gathering and analysis carried out by Faucett Associates under contract to OSHA. OSHA estimated annualized compliance costs for two compliance scenarios: (1) costs to achieve compliance with OSHA's existing steel erection standard, and (2) costs to achieve compliance with the proposed standard. OSHA's cost estimates take into account the extent of current industry compliance, i.e., the extent to which employers are already in compliance with the requirements of OSHA's existing standard and with the requirements of the proposed steel erection standard. Accounting for these costs, i.e., subtracting them from the

costs attributed to the proposed standard, is important because only those costs employers would actually incur to come into compliance with the proposed standard are properly attributed to that standard.

Table 4 presents OSHA's annualized compliance cost estimates, by provision or safety control, for establishments in the industries subject to the proposed standard. For establishments to achieve full compliance with OSHA's existing steel erection standard, annualized compliance costs are estimated to total \$28.0 million. OSHA projects that full compliance with the proposed standard would, after deducting costs incurred to achieve compliance with the existing standard, result in net (or incremental) annualized costs of \$49.4 million for affected establishments. Among incremental annualized costs, expenditures for fall arrest systems account for \$14.4 million, or 29 percent of total costs; expenditures for the safe design and erection of steel joists required by the proposed standard account for \$13.9 million, or 28 percent of total costs; and expenditures for anchor bolts necessary for structural stability account for \$13.7 million, or 28 percent of total costs. Other control costs associated with compliance with the proposed steel erection standard are those for railings, cables, and barriers (\$4.7 million); paperwork associated with administrative controls (\$3.4 million); and training (\$0.7 million).

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TABLE 4.—ANNUALIZED COMPLIANCE COST OF THE PROPOSED STANDARD BY INDUSTRY GROUP AND PROPOSED CONTROLS (a)  
[1995 dollars]

SIC	Industry group and size	Fall arrest systems	Personnel nets	Proposed controls			Training	Paperwork	Total
				Railings, cables and barriers	Anchor bolts	Joist erection			
154 .....	General Building Contractors—Nonresidential Buildings								
	Establishments with 1–9 Employees.	\$1,005,697	(\$104,757)	\$324,360	\$958,333	\$971,949	\$50,944	\$233,655	\$3,440,181
	Establishments with 1–99 Employees.	3,664,730	(381,730)	1,181,959	3,492,139	3,541,752	185,637	851,432	12,535,919
	Establishments with 100+ Employees.	1,428,486	(148,796)	460,719	1,361,211	1,380,550	72,360	331,882	4,886,413
	All Establishments .....	5,093,216	(530,525)	1,642,679	4,853,350	4,922,302	257,997	1,183,315	17,422,332

TABLE 4.—ANNUALIZED COMPLIANCE COST OF THE PROPOSED STANDARD BY INDUSTRY GROUP AND PROPOSED CONTROLS (a)—  
Continued  
[1995 dollars]

SIC	Industry group and size	Fall arrest systems	Personnel nets	Proposed controls			Training	Paperwork	Total
				Railings, cables and barriers	Anchor bolts	Joist erection			
161	Highway and Street Construction, except Elevated Highways								
	Establishments with 1–9 Employees.	18,716	(1,949)	6,036	17,834	18,088	948	4,348	64,020
	Establishments with 1–99 Employees.	57,156	(5,954)	18,434	54,464	55,238	2,895	13,279	195,514
	Establishments with 100+ Employees.	24,276	(2,529)	7,830	23,133	23,461	1,230	5,640	83,041
	All Establishments	81,432	(8,482)	26,264	77,597	78,700	4,125	18,919	278,555
162	Heavy Construction, except Highway and Street Construction								
	Establishments with 1–9 Employees.	134,569	(14,017)	43,402	128,232	130,054	6,817	31,265	460,320
	Establishments with 1–99 Employees.	524,969	(54,682)	169,314	500,245	507,352	26,592	121,967	1,795,757
	Establishments with 100+ Employees.	315,264	(32,839)	101,680	300,416	304,684	15,970	73,246	1,078,421
	All Establishments	840,233	(87,521)	270,994	800,662	812,037	42,562	195,213	2,874,178
176	Roofing, Siding and Sheet Metal Work								
	Establishments with 1–9 Employees.	150,303	(15,656)	48,476	143,224	145,259	7,614	34,920	514,141
	Establishments with 1–99 Employees.	361,729	(37,679)	116,666	344,693	349,590	18,323	84,041	1,237,363
	Establishments with 100+ Employees.	30,626	(3,190)	9,878	29,184	29,599	1,551	7,115	104,764
	All Establishments	392,355	(40,869)	126,544	373,877	379,189	19,875	91,157	1,342,127
1791	Structural Steel Erection								
	Establishments with 1–9 Employees.	1,821,328	(189,715)	587,420	1,735,552	1,760,209	92,259	423,152	6,230,206
	Establishments with 1–99 Employees.	5,131,108	(534,472)	1,654,900	4,889,457	4,958,922	259,916	1,192,118	17,551,950
	Establishments with 100+ Employees.	2,349,553	(244,737)	757,785	2,238,900	2,270,708	119,016	545,875	8,037,100
	All Establishments	7,480,661	(779,209)	2,412,685	7,128,357	7,229,630	378,933	1,737,994	25,589,050
	Establishments with 1–9 Employees.	3,130,613	(326,095)	1,009,694	2,983,176	3,025,558	158,581	727,340	10,708,868
All Significantly Affected Industry Groups.	Establishments with 1–99 Employees.	9,739,692	(1,014,517)	3,141,274	9,280,999	9,412,855	493,364	2,262,838	33,316,503
	Establishments with 100+ Employees.	4,148,205	(432,090)	1,337,891	3,952,844	4,009,003	210,127	963,759	14,189,738
	All Establishments	13,887,897	(1,446,607)	4,479,165	13,233,843	13,421,857	703,491	3,226,597	47,506,242
Other Affected Industry Groups (b).		540,414	(56,291)	74,296	514,963	522,279	27,375	125,555	1,848,590
Total		14,428,311	(1,502,898)	4,653,461	13,748,806	13,944,136	730,865	3,352,152	49,354,832

Note: Figures in the table may not sum to totals due to rounding.

(a) Total compliance costs were distributed among industry groups according to the percentage of iron workers employed in that group (see Table 1). Within SIC groups, costs were distributed by share of revenue for firms in the size class.

(b) Other industries potentially affected by the proposed steel erection standard employ a small percentage of iron workers. These industry groups are: SIC 171, Plumbing, Heating and Air-Conditioning; SIC 173, Electrical Work; SIC 174, Masonry, Stone Work, Title Setting and Plastering; and SIC 175, Carpentry and Floor Work. Because firms in these industries are seldom involved directly in structural steel erection, OSHA has grouped them separately.

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis, 1998, based on cost analysis by Jack Faucett Associates (See Appendix C of the preliminary economic analysis [Ex. 11]) and Dun & Bradstreet, National Profile of Businesses software, Dun & Bradstreet Information Services, 1996.

### Economic Impacts

OSHA analyzed the impacts of these compliance costs on prices, profits, construction output and other economic indices in the steel erection industry. In particular, OSHA examined economic impacts on SIC 1791, Structural Steel Erection, where the majority of the 39,000 structural metal workers are employed. This analysis shows that structural steel erectors will not be severely impacted by the costs

associated with full implementation of the proposed standard.

OSHA examined the potential economic impacts of the proposed standard by making two assumptions used by economists to bound the range of possible impacts: the assumption of no-cost pass-through, i.e., that employers will be unable to pass any of the costs of compliance forward to their customers, and the assumption of full-cost pass-through, i.e., that employers will be able to pass all of the costs of

compliance forward to their customers. As summarized in Table 5, below, OSHA estimates that, if affected firms in SIC 1791 were forced to absorb these compliance costs entirely from profits (a highly unlikely scenario), profits would be reduced by an average of 4.6 percent. If, at the other extreme, affected firms were able to pass all of these compliance costs forward to general contractors and project owners, OSHA projects that the price (revenue) increase

required to pay for these costs would be less than 1 percent (0.28 percent).

In addition to examining the economic effects of the proposed standard on firms in SIC 1791, OSHA estimated the impacts of the proposed standard on two other construction industry divisions involving steel erection: (1) the entire construction sector; and (2) construction activity where structural steel constitutes the physical core of the project, termed "steel-frame construction" by OSHA.

For the dollar value of business for the entire construction sector, OSHA totaled 1996 sales data for SICs 15, 16, and 17 provided in a Dun & Bradstreet national business database [D&B, 1996a]. OSHA derived pre-tax income (Column 2 in Table 5) for the construction sector by, first, calculating industry profit using Dun & Bradstreet data on post-tax return on sales (post-tax profits) and, second, applying a formula that converts post-tax income to pre-tax

income based on tax rates in the U.S. corporate tax code. OSHA found that, for the construction sector as a whole, price impacts under full cost pass-through would be 0.01 percent, and profit impacts assuming no cost pass-through would be 0.06 percent. Thus in the context of the construction sector as a whole, the proposed standard would have little impact.

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TABLE 5.—POTENTIAL ECONOMIC IMPACTS OF THE PROPOSED STEEL ERECTION STANDARD ON SELECTED SECTORS WITHIN THE CONSTRUCTION INDUSTRY [Worst-Case Conditions]

	Dollar value of business (a) (\$ millions)	Pre-tax income (b) (\$ million)	Compliance costs as a percent of revenue (c)	Compliance costs as a percent of profit (c)
Construction Sector as a Whole .....	\$768,155.9	\$77,830.1	0.01	0.06
Steel-Frame Construction (d) .....	119,979.2	12,156.4	0.04	0.41
SIC 1791, Structural Steel Erection .....	9,285.7	562.4	0.28	4.55

(a) Based on data from Dun & Bradstreet, National Profile of Businesses, 1996.

(b) Based on data from Dun & Bradstreet, National Profile of Businesses, 1996; Dun & Bradstreet, Industry Norms and Key Business Ratios, 1996; and OSHA profit calculations.

(c) Revenue and profit impacts were calculated by dividing annual compliance costs for each of the three construction sectors shown in the table by, respectively, dollar value of business and pre-tax income. Compliance costs assigned to these sectors are based on total costs of \$49.4 million and were applied as follows: construction sector as a whole—\$49.4 million; steel-frame construction—\$49.4 million; and SIC 1791, Structural Steel Erection—\$25.6 million.

(d) Steel-Frame Construction is defined by OSHA as the body of construction projects where steel framing constitutes the physical core of the structure. Dollar value of business and pre-tax income for Steel-Frame Construction were computed by applying the percentage of the value of the steel market share (15.6 percent), excluding that for tanks and towers, of all construction starts to the dollar value of business and pre-tax income for the entire construction sector. Data on the steel market share for 1995 are based on memoranda to OSHA from Construction Resources Analysis, College of Business Administration, University of Tennessee, Knoxville [Exs. 9-143 and 9-144].

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis, 1998.

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OSHA calculated the value of steel-frame construction using data provided by the Construction Resources Analysis office of the University of Tennessee, College of Business Administration on the value of the steel market share of the entire construction industry. In this calculation, OSHA applied the percentage of the value of the steel market share (15.6 percent), excluding that for tanks and towers, of all construction starts to the dollar value of business and pre-tax income for the entire construction sector, thereby eliminating all non-steel construction (as defined in the proposed standard) from the earnings total. Price increases for steel frame construction as a whole are of particular interest because they represent the price increases to the ultimate customers of steel erection services, the purchasers of buildings, bridges, etc. Under the worst-case price increase scenarios, the price of such projects would increase by 0.04 percent. It is exceedingly unlikely that a customer would fail to go ahead with a project as a result of a price increase of this magnitude; as a result cost pass-

through at the project level is probably feasible.

OSHA believes that, prior to the generation of the cost savings projected to accrue from implementation of the standard, most steel erectors will handle the increase in direct costs by increasing their prices somewhat and absorbing the remainder from profits. Within steel erection markets, the particular blend of impacts experienced by a given firm will depend on the degree of competition with concrete erection and other alternative types of construction in the firm's local market area. Although these minimal economic impacts would be felt by most affected employers after implementation of the standard, OSHA anticipates—based on testimony by members of SENRAC and other industry representatives whose current fall protection programs and other safety measures mirror those required by the proposed standard [Exs. 6-3, 6-8, and 6-10]—that offsetting cost savings will soon reverse any negative economic impacts.

*Regulatory Flexibility Screening Analysis*

The Regulatory Flexibility Act of 1980 (RFA), as amended in 1996 (5 U.S.C. 601 *et seq.*), requires regulatory agencies to determine whether regulatory actions will adversely affect small entities. The significance of any economic impact is measured by the effect on profits, market share, and an entity's financial viability. Pursuant to the RFA, OSHA has assessed the small-business impacts of the proposed steel erection standard. On the basis of this regulatory flexibility screening assessment and the underlying data, summarized below, OSHA has preliminarily determined that the proposed standard will have a significant impact on a substantial number of small entities. Thus, OSHA has conducted a full Initial Regulatory Flexibility Analysis, as required. OSHA's Initial Regulatory Flexibility Analysis follows the screening analysis presented in this section.

The Small Business Administration (SBA) defines small entities, or "concerns," in terms of number of employees or annual receipts. For employers in SIC 17, small concerns are

defined by SBA as those with \$7.0 million or less in annual receipts. OSHA has determined that in SIC 1791, Structural Steel Erection, based on 1996 data from Dun & Bradstreet (D&B) and using D&B's estimate of the dollar value of business to represent annual receipts, the class of establishments with 99 or fewer employees comes closest to the class of firms qualifying as small concerns under the SBA definition. Not all firms in this class would have annual receipts of less than \$7.0 million; however, OSHA would rather overestimate the number of small firms than try to extrapolate the number of small firms from the limited data available. Establishments with fewer than 99 employees represent 97.4 percent of the 4,463 establishments and employ 79.6 percent of the 51,108 workers in SIC 1791, according to Dun & Bradstreet's national market profile [D&B, 1996a].

OSHA projects that the magnitude of compliance costs for most safety measures mandated by the proposed standard will depend on the size of an employer's workforce. For requirements pertaining to fall protection, joist erection, and structural assembly, to name a few provisions, labor and equipment costs will vary by project size and duration. For the requirements for training, costs will vary by employment size. Thus, in some cases, smaller firms erecting smaller structures will incur relatively lower compliance costs. In sum, the proposed standard is designed to minimize requirements that

would impose significant fixed capital costs and give larger firms a competitive advantage through economies of scale.

In this regulatory flexibility screening assessment, OSHA assessed the impacts of compliance costs within the industry group with the largest concentration of affected employers and employees, SIC 1791, Structural Steel Erection. According to data from the Bureau of Labor Statistics, of the approximately 39,000 iron workers in construction, 20,210 are employed in SIC 179, Miscellaneous Special Trade Contractors. OSHA believes that the great majority of these workers are found in SIC 1791, Structural Steel Erection, because the other industries in SIC 179 (glass and glazing, excavation work, wrecking and demolition, installation and erection of building equipment (such as installing elevators, revolving doors and industrial machinery) and specialty trade contractors not elsewhere classified), are unlikely to employ significant numbers of iron workers. This contention is supported by the fact that available data on iron worker deaths (see Table III-2 in the preliminary economic analysis [Ex. 11]) show that SIC 1791 accounted for more than 90 percent of iron worker deaths in SIC 179 in 1992-93. Total employment for all trades in SIC 1791 is 51,108 workers, according to Dun & Bradstreet. BLS and D&B data indicate that iron workers constitute roughly 40 percent of the labor force in SIC 1791, the largest concentration of iron workers in any four-digit group where iron

workers are employed. In addition, only firms in SIC 1791 earn the majority of their revenues from steel erection. (According to the definitions used in the SIC system, firms classified in all other sectors must earn a minority of their total revenues from their steel erection business.)

Compared with all other industry groups in the construction industry, firms in SIC 1791 have the greatest number of iron workers per firm and the highest percentage of iron workers relative to total employment. Since the costs of compliance are approximately proportional to the number of iron workers in a given firm, establishments in SIC 1791 will experience the greatest economic impact.

To assess the financial impacts of the proposed standard on small firms in SIC 1791, OSHA distributed compliance costs within size classes according to an estimate of the percent of revenue (gross sales) earned by establishments within those size classes. Applying Dun & Bradstreet revenue figures, OSHA has determined that costs represent less than one percent (0.28 percent) of revenues for firms with 99 or fewer employees, so that under the extreme case of full-cost pass-through to consumers, prices would rise by no more than one percent (see Table 6, below). Similarly, for the very smallest firms, those with fewer than ten employees, price impacts are projected to be low: 0.28 percent.

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TABLE 6.—POTENTIAL ECONOMIC IMPACTS OF THE PROPOSED STEEL ERECTION STANDARD ON SMALL FIRMS IN THE STEEL ERECTION INDUSTRY UNDER WORST-CASE CONDITIONS

	Annual compliance costs (a) (\$ millions)	Compliance cost per establishment (a)	Dollar value of business (b) (\$ millions)	Revenue per establishment (b)	Pre-tax income (c) (\$ millions)	Pre-tax income per establishment (c)	Compliance costs as a percent of revenue	Compliance costs as a percent of profit
SIC 1791, Structural Steel Erection .....	\$25.6	\$5,733.6	\$9,285.7	\$2,080,606.0	\$562.4	\$126,024.2	0.28	4.55
SIC 1791, 1-99 Employees .....	17.6	4,038.6	6,369.2	1,465,541.8	395.8	91,074.8	0.28	4.43
SIC 1791, 1-9 Employees .....	6.2	2,010.4	2,260.8	729,530.4	95.8	30,898.0	0.28	6.51

(a) Based on Table 5 of this summary of the preliminary economic analysis and data on number of establishments from Dun & Bradstreet, National Profile of Businesses, 1996. Compliance costs for size groups were derived by applying the percentage of revenue in the size groups to total costs for all of SIC 1791.

(b) Based on data from Dun & Bradstreet, National Profile of Businesses, 1996.

(c) Based on data from Dun & Bradstreet, National Profile of Businesses, 1996; Dun & Bradstreet, Industry Norms and Key Business Ratios, 1995-96; and OSHA profit calculations.

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis, 1998.

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Under the alternate scenario of full-cost profit absorption (an extremely unlikely scenario) among steel erection contractors with 99 or fewer employees, profit impacts would be 4.4 percent; for

firms with one to nine employees, profit impacts would be 6.5 percent. Thus, costs as a percentage of profits and revenues for SIC 1791 are lower when a small entity is defined to include all firms within the SBA size standards

(less than \$7 million in revenue) than for small entities employing fewer than 10 workers. The difference in these projected profit impacts for the two smaller size categories of firms reflects a difference in the 1995-96 profit rates



for the two groups [D&B, 1996b] applied by OSHA in this impacts analysis: (1) an average 3.6 percent rate of net-profit-after-tax-to-net-sales for establishments with fewer than ten employees (roughly defined as those with assets of less than \$250,000) and (2) an average 4.9 percent post-tax profit/sales ratio for establishments with one to ninety-nine employees (roughly defined as those with assets of \$250,000 to \$1 million) (see Chapter VI in the preliminary economic analysis for further explanation).

OSHA believes that most small erectors will, along with the rest of the industry, receive economic benefits from compliance with the proposed rule that will more than offset these direct cost impacts. As noted above, employer representatives on the committee commented on numerous occasions that the measures required by the proposed standard will, in fact, improve profitability and competitiveness [Exs. 6-3, 6-8, and 6-10]. Therefore, OSHA anticipates that most small entities will experience minimal economic impacts as a result of implementation of the proposed standard if some or all compliance costs can be passed forward to final consumers and/or cost savings are realized. However, OSHA believes that, when compliance costs exceed 5 percent of profits in an industry earning reasonable profits, the standard's impact may be significant in the context of the Regulatory Flexibility Act. Thus, OSHA has conducted a full Initial Regulatory Flexibility Analysis, as required by that act.

#### *Regulatory Flexibility Analysis*

The Regulatory Flexibility Act, as amended in 1996, requires that an Initial Regulatory Flexibility Analysis contain the following elements:

(1) A description of the reasons why action by the agency is being considered;

(2) A succinct statement of the objectives of, and legal basis for, the proposed rule;

(3) A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply;

(4) A description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;

(5) An identification, to the extent practicable, of all relevant Federal rules that may duplicate, overlap or conflict with the proposed rule; and

(6) A description of any significant alternatives to the proposed rule that accomplish the stated objectives of applicable statutes and minimize any significant economic impact of the proposed rule on small entities.

In addition, a Regulatory Flexibility Analysis must contain a description of any significant alternatives to the proposed rule that, first, accomplish the stated objectives of applicable statutes (in this case the OSH Act and the Regulatory Flexibility Act) and that, second, minimize any significant economic impact of the proposed rule on small entities.

#### **Reasons for the Proposed Rule**

According to OSHA's analysis of accident data for an eleven-year period (1984-1994), 319 iron worker fatalities involved hazardous conditions that are addressed by OSHA's current and proposed steel erection standards. Based on a review of BLS injury census data for the period 1992-1993, OSHA estimates that an average of 28 fatalities and 1,836 lost-workday injuries annually involve circumstances that would be addressed by provisions in the proposed OSHA steel erection standard. For an industry with an estimated workforce of only 38,980 workers, these fatality and injury levels clearly demonstrate that the risk confronting these workers is significant. Therefore, OSHA has developed proposed regulatory text that is designed to address this risk.

#### **Objectives of the Proposed Rule**

The objective of this proposal is to reduce the risk of occupational exposure to a variety of hazards on steel erection construction worksites, such as those involving falls, slips, trips, being struck by or crushed by objects or loads, and structural collapses. These occupational hazards will be reduced by this proposal through the use of engineering controls, work practice controls, inspections of worksite conditions, training, communication, and recordkeeping. Implementation of these measures has been shown to minimize or eliminate occupational exposure to these hazards during the erection of steel structures and thus to reduce the risk of injury or death among iron workers.

#### **Description of the Number of Small Entities**

For this rulemaking, OSHA has identified the population at risk of injury in the construction workforce and the industry groups where steel erection is conducted, but cannot give a precise estimate of the number of small entities to which the proposed rule will apply.

In SIC 1791, Structural Steel Erection, where the majority of iron workers are employed, there are roughly 4,346 establishments defined as small by the SBA, i.e., these entities earn less than \$7 million in annual revenue. If all establishments in SIC 1791 were affected by the proposed standard, then small entities would comprise 97 percent of all affected entities using the SBA size standard. There are 3,724 very small establishments, i.e., those employing fewer than 20 employees, in SIC 1791; these very small establishments comprise 83 percent of all establishments in the industry.

OSHA also examined the impact of the proposed standard on the Fabricated Structural Metal Industry (SIC 3441), which produces iron and steel for structural purposes such as the construction of bridges and buildings. This sector would need to bore holes in certain joists—those that are connected to steel structures in bays spanning 40 feet or more—to enable them to be bolted rather than welded (proposed section 1926.757). OSHA's impact analysis assumes that this sector would bear all of the \$13.9 million in annual costs associated with the provision of the proposed standard concerning open web joists. In fact, because of contractual arrangements among fabricators, steel erectors and building owners, most of the costs of this provision would be transmitted through steel erectors to building owners and would appear in the bid price of the project or would be incurred as onsite costs.

For purposes of this analysis, OSHA has defined small firms in this industry using the SBA definition of small firms: firms with fewer than 500 employees. Department of Commerce data show that there were 2,356 small firms in this sector in 1993. (Small firms represented 97.5 percent of all firms.) Department of Commerce data also show that these small firms had total revenues of over \$6.6 billion, almost 73 percent of all industry revenues. Dun and Bradstreet data show that in fiscal year 1995, the median profits for firms in this sector were a healthy 3.5 percent of sales. Small firms were assumed to bear costs in proportion to their revenues. Even if all of the costs of this provision of the standard are borne by the fabricated structural metal industry, these costs represent only 0.15 percent of revenues and 4.3 percent of profits for small firms in this sector. Thus the costs of the standard would not cause a significant impact on small firms in this sector.

The Steel Joist Institute has argued that some small firms may lack the equipment to prepare joists as required

by the standard, and that as a result such firms could be severely impacted. However, buildings requiring joists in bays spanning 40 feet or more represent only a portion of the total market. To the extent that there are small firms lacking suitable equipment, such firms could still produce fabricated steel for a variety of steel erection projects and for portions of other projects. As a result, OSHA does not anticipate a significant impact, if any, on those firms that lack the proper equipment to prepare certain joists for bolting. However, OSHA solicits comment on two issues: (1) whether there are small firms lacking suitable equipment to prepare joists in the manner prescribed by the regulation; and (2) the percentage of the steel framing market that requires the use of joists in bays spanning 40 feet or more.

#### **Description of the Proposed Reporting, Recordkeeping and Other Compliance Requirements**

The proposed rule would require, in the following sections of the proposal, that employers establish and maintain records for the use of engineering controls, work practices, inspections, and training:

- Site layout, site-specific erection plan, and construction sequence;
- Hoisting and rigging;
- Structural steel assembly;
- Open web steel joists;
- Pre-engineered metal buildings; and
- Training

Most steel erection employers would be affected by the reporting and recordkeeping requirements in these sections, with the exception of the requirements pertaining only to pre-engineered buildings. Of an estimated 17,587 steel erection projects constructed annually, 7,391 pre-engineered metal buildings are erected each year.

In estimating the cost of establishing and maintaining the records for each of these control areas, OSHA used the wage rate of the applicable professional personnel. To give two examples: (1) for the cost of certifying crane visual inspections, OSHA applied the wage rate for a crane operator; and (2) for the costs of documentation of alternative methods for joist erection, OSHA applied the wage rates of a project manager and a structural engineer. All recordkeeping requirements included in the proposed rule could be performed by the existing staff in any of the covered industries. A detailed description of the proposed requirements appears in Chapter II, INDUSTRY PROFILE and Chapter III, COSTS OF COMPLIANCE, in the preliminary economic analysis.

#### **Relevant Federal Rules**

OSHA is proposing to revise the current safety standard for steel erection that has been in place with little change for over 25 years. OSHA believes that this thorough and comprehensive revision to existing subpart R will provide greater protection and eliminate ambiguity and confusion, thereby improving safety in this important segment of the construction industry.

At present there are no other federal workplace rules or guidelines that overlap with the OSHA steel erection standard.

#### **Significant Alternatives Considered**

OSHA is confident that the proposed steel erection standard has been written in such a way as to minimize impacts on small employers while still ensuring significant protection for affected employees. Through the efforts of key stakeholders participating in the negotiated rulemaking, the proposed standard features, wherever possible, performance language that permits maximum flexibility for achieving safety outcomes. For example, the proposal provides an opportunity to those employers, who select alternative means and methods for complying with certain sections of the standard, to incorporate these alternatives into a site-specific erection plan. The committee considered small contractors when it elected not to recommend that OSHA propose a universal requirement for a site-specific erection plan for all steel erection sites. Instead, the proposal provides guidelines for establishing a site-specific erection plan in a non-mandatory appendix to assist employers who choose to develop such a plan, as recommended by the committee.

Other areas of the proposed standard that are particularly responsive to the concerns of small contractors include rules for the safe use of cranes and other lifting equipment and the proper assembly of metal buildings other than those constructed of heavy structural steel. In light of the number of small steel erectors potentially affected by the hoisting and rigging section of the proposed standard, OSHA has attempted to minimize the burden of the pre-shift visual crane inspections by having the inspection checklist apply only to the most essential safety elements, as recommended by SENRAC. Additionally, since there are a large number of small builders who erect pre-engineered metal structures exclusively, OSHA determined that a separate section in the proposal dedicated to this type of steel erection would ease compliance for small erectors.

The Regulatory Flexibility Act emphasizes the importance of performance-based standards for small businesses. OSHA considers the proposed standard to be highly performance oriented and believes that smaller contractors will benefit especially from that orientation. For example, in proposed § 1926.760, Fall Protection, employers are required to protect certain employees exposed to fall distances of 15 feet or greater. Paragraph (a)(2) of § 1926.760 lists the types of general safety systems—e.g., guardrail systems, safety net systems, or personal fall arrest systems—that must be used by employers to provide fall protection to their employees. However, the proposed standard does not mandate particular engineering solutions by structure type, site location, crew size, or other criteria. Employers are free to select any one system or combination of systems that is most compatible with company practice and employee protection so long as the performance measure—fall protection at 15 feet—is achieved. OSHA welcomes comment on other ways that the standard can be made more performance oriented.

As another example of OSHA's sensitivity to the potential impacts on small businesses, the proposal minimizes paperwork burden where training, notifications, and other forms of communication are required, as recommended by SENRAC. Regarding training provisions, general instruction in fall hazards is mandated for all employees exposed to that risk, but the scope of additional special training is limited to three particularly hazardous activities: multiple lift rigging, connecting, and decking. Employers are to ensure that the training is provided but do not have to document or certify the program. Other requirements where communication will be necessary, including those involving field curing of concrete footings and modification of anchor bolts, were written in such a way as to limit the notifications to cover only the most essential information. Supplementary explanatory materials, presented in appendices to the proposed standard, are intended to assist employers in complying with the rule and otherwise providing a safer workplace.

Another approach recommended by the Regulatory Flexibility Act is compliance date phase-ins for small businesses. Throughout their deliberations, SENRAC recognized the importance of effective outreach to the steel erection community prior to and following promulgation of the proposed standard. In fact, as stated recently by a committee member, many employers in

the industry are aware of, and have already begun to align their safety programs with, the proposed revisions to subpart R (Ex. 9-156). At present, the proposed standard contains no dates for implementation. Barring evidence in the record that would compel the Agency to delay the compliance dates, OSHA anticipates that the final standard will become effective for all employers within a few months after it is published. At this time, OSHA believes that any compliance extensions for affected employers, including small employers, would only marginally ease the economic burden, given the progress in occupational safety already underway throughout industry and the non-capital-intensive nature of the rule, and would delay unnecessarily the protection of workers who would otherwise benefit from compliance with the proposed rule. OSHA welcomes comment on the appropriateness of compliance phase-in dates for the proposed standard.

In sum, throughout the pre-proposal process of negotiated rulemaking for OSHA's steel erection standard, the needs and concerns of small employers have been considered and addressed on a regular basis. After considering a number of alternatives as candidates for the requirements in the proposed rule and adopting those that were consistent with the mandate imposed by the OSH Act, OSHA has developed a proposed rule that will minimize the burden on small employers, while maintaining the necessary level of worker protection.

#### *Non-Regulatory Alternatives*

The primary objective of this proposed standard is to minimize the number of construction worker injuries and fatalities. To develop this proposed steel erection standard, OSHA employed negotiated rulemaking using an advisory committee composed of representatives from the construction industry (both labor and management and both small and larger firms), the insurance industry, the engineering field, and Federal and State government regulatory and research agencies. OSHA examined a number of non-regulatory approaches to enhancing workplace safety, including the operation of the classical free market, the tort liability insurance system and the workers' compensation insurance system.

OSHA believes that these social and economic alternatives to a Federal workplace regulation fail to adequately protect workers from the hazards associated with structural steel erection in the construction industry. The private market offers economic signals that could have the potential to direct

workers toward desirable combinations of risk and reward, but market imperfections and institutional rigidities prevent workplaces from achieving the most optimal safety outcomes, creating inefficient, inadequately compensated risks for workers. Tort liability laws and workers' compensation provide some protection, but fall far short of fully compensating injured employees for the loss of wages, the medical costs, and the legal and other costs resulting from workplace accidents. Furthermore, these approaches are inherently reactive, rather than proactive, and largely fail to introduce progressive safety programs at all levels of industry. Therefore, OSHA believes that this proposed revision to the steel erection standard provides the necessary remedy.

#### **VIII. Environmental Assessment**

The proposed standard has been reviewed in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq.*), the regulations of the Council on Environmental Quality (CEQ) (40 CFR Part 1500), and DOL NEPA Procedures (29 CFR Part 11). The provisions of the standard focus on the reduction and avoidance of accidents occurring during structural steel erection. Consequently, no major negative impact is foreseen on air, water or soil quality, plant or animal life, the use of land or other aspects of the environment.

#### **IX. Federalism**

This proposed Rule has been reviewed in accordance with Executive Order 12612 (52 FR 41685, October 30, 1987) regarding Federalism. The Order requires that agencies, to the extent possible, refrain from limiting state policy options, consult with States prior to taking any actions that would restrict State policy options, and take such actions only when there is clear constitutional authority and the presence of a problem of national scope. The Order provides for preemption of State law only if there is a clear Congressional intent for the agency to do so. Any such preemption is to be limited to the extent possible.

Section 18 of the Act, expresses Congress' clear intent to preempt state laws relating to issues on which Federal OSHA has promulgated occupational safety and health standards. Under the OSH Act, a State can avoid preemption only if it submits, and obtains Federal approval of, a plan for the development of such standards and their enforcement. Occupational safety and health standards developed by such State Plan States must, among other

things, be at least as effective in providing safe and healthful employment and places of employment as the Federal standards. Where such standards are applicable to products distributed or used in interstate commerce, they may not unduly burden commerce or must be justified by compelling local conditions (see Sect. 18(c)(2)).

The Federal standard on steel erection addresses hazards which are not unique to any one state or region of the country. Nonetheless, states with occupational safety and health plans approved under Section 18 of the OSH Act can develop their own State standards to deal with any special problems which might be encountered in a particular state. Moreover, because this standard is written in general, performance-oriented terms, there is considerable flexibility for State plans to require, and for employers to use, methods of compliance which are appropriate to the working conditions covered by the standard.

In brief, this proposed rule addresses a clear national problem related to occupational safety and health hazards of steel erection in the construction industry. Those States which have elected to participate under Section 18 of the OSH Act will not be preempted by this standard and will be able to address any special conditions within the framework of the Federal Act while ensuring that the State standards are at least as effective as that standard. State comments are invited on this proposal and will be fully considered prior to promulgation of a final rule.

#### **X. Unfunded Mandates**

For the purposes of the Unfunded Mandates Reform Act of 1995, as well as Executive Order 12875, this rule does not include any Federal mandate that may result in increased expenditures by State, local, and tribal governments, or increased expenditures by the private sector of more than \$100 million in any year.

#### **XI. OMB Review Under the Paperwork Reduction Act**

This proposed rule contains collections of information as defined in OMB's regulations at 60 FR 44978 (August 29, 1995) in § 1926.752(a)(1), § 1926.752(a)(2), § 1926.753(a)(1)(iv), § 1926.753(a)(5), § 1926.753(c)(2), § 1926.754(c)(3), § 1926.757(a)(3), § 1926.757(a)(11), § 1926.757(e)(4)(i), § 1926.758(g), and § 1926.761.

The paperwork estimates contained in this section are based on OSHA's preliminary economic analysis (PEA). A more detailed discussion of project and

time estimates can be found in Chapter V, Costs of Compliance, of OSHA's PEA (Ex. 11).

Under the Paperwork Reduction Act of 1995, agencies are required to seek OMB approval for all collections of information. As a part of the approval process, agencies are required to solicit comment from affected parties with regard to the collection of information, including the financial and time burdens estimated by the agencies for the collection of information. OSHA believes it is necessary for employers to prepare certifications and or obtain required information for the above-mentioned requirements.

Proposed § 1926.752(a)(1) requires that the controlling contractor provide the steel erector with written notification that the concrete in the footings, piers and walls or the mortar in the masonry piers and walls has attained, on the basis of an appropriate ASTM standard test method of field cured samples, either 75 percent of the intended minimum compressive design strength or sufficient strength to support loads imposed during steel erection. OSHA believes it is necessary for employers to provide the written verification that the concrete in footings, piers and walls or the mortar in masonry piers has cured properly prior to beginning steel erection activities. To comply with this requirement, the controlling contractor must provide the steel erector with documentation to this effect. Since the concrete supports the steel structure, the steel erector must be assured that the concrete is adequate to support the structure to prevent the possibility of collapse from erecting steel on improperly cured concrete. OSHA estimates that 12,311 projects will require these tests to be performed. The number of tests will vary depending on the size of the project. The average is estimated to be three tests per project, and the time for the notification to be transferred is estimated at five minutes. The tests are already required to be performed in accordance with the American Concrete Institute (ACI) building code and OSHA's Concrete standard (subpart Q), and it is usual and customary that the testing facility provide a written certification to the controlling contractor. Therefore, the only burden taken is the transfer of the information from the controlling contractor to the steel erector. The total estimated annual respondent burden for steel erection worksites is \$92,716 and 3,078 burden hours.

Proposed § 1926.752(a)(2) requires that the controlling contractor provide the steel erector with written notification that any repairs,

replacements and modifications to anchor bolts have been conducted in accordance with § 1926.755(b). As explained in the discussion for this proposed paragraph, without notification from the controlling contractor, the steel erector may not know that an anchor bolt has been damaged and subsequently repaired. Improper repair has in the past caused columns to collapse. This notification is intended to prevent those collapses. OSHA estimates that 5,862 projects have anchor bolts that need repair. Approximately half of those projects are not currently getting the approval of the structural engineer of record. For the projects that are already getting the engineer's approval, it is estimated that it will take the engineer five minutes to transfer a piece of paper to the controlling contractor. For the projects that are not currently obtaining engineer approval, it is estimated that the approval time for repairs to anchor bolts will take an average of three hours for the whole process. The total estimated annual respondent burden for steel erection worksites is \$459,891 and 9,458 burden hours.

Proposed § 1926.753(a)(1)(iv) requires that the employer obtain and/or prepare a certification record of the pre-shift inspection required by paragraph § 1926.753(a)(1)(i), which includes the date the crane items were inspected; the signature of the person who inspected the crane items; and a serial number, or other identifier, for the crane inspected. OSHA believes it is necessary for the employer to obtain and/or prepare the certification record required to verify that each crane operator has inspected the crane and determined that it is in the proper working condition to perform his/her duties safely. This requirement can be complied with by the simple use of a crane operator's log book. OSHA estimates that 17,586 projects will require the use of a crane (the number of projects differs from the total number of steel erection projects due to rounding calculations; see Ex. 11). Each inspection is estimated to take ten minutes. The length of each project varies and one shift is estimated per day. The total estimated annual respondent burden for steel erection worksites is \$2,336,390 and 56,848 burden hours.

Proposed § 1926.753(a)(5) prohibits safety latches on hooks from being deactivated or made inoperable except as determined by a qualified rigger during hoisting and placing of purlins and single joists or as included in a site-specific erection plan. In the situation where an employer elects to deactivate a safety latch and create a potential

safety hazard, the employer must receive approval from a qualified rigger or include a means for safely performing the activity in a site-specific erection plan. OSHA estimates that 7,391 projects will contain joist erection operations. Assuming that all of the employers will seek such an exemption and will elect to use a site-specific erection plan, it is estimated to take five minutes to document a means of performing the alternative method of erection and it will occur an average of ten times per project. The total estimated annual respondent burden for steel erection worksites is \$299,489 and 6,159 burden hours.

Proposed § 1926.753(c)(2) requires that components of a multiple lift rigging assembly be specifically designed and assembled with a certified capacity for total assembly and for each individual attachment point and that the certification must be based on the manufacturer's specifications with a 5 to 1 safety factor for all components. OSHA believes it is necessary for employers to prepare this certification since multiple lifts are highly specialized operations and improperly designed assemblies could result in multiple steel members free falling. Special precautions must be taken when performing multiple lifts. Preparing this certification is essential to a safe multiple lift. OSHA estimates that employers will elect to perform multiple lifts on approximately 1,870 projects. The number of pieces of lifting equipment varies based on the project size. Assuming an average of two pieces of lifting equipment per project, one certificate per lifting assembly, and five minutes to prepare the certificate based on information already available from the manufacturer's specifications, the total estimated annual respondent burden for steel erection worksites is \$17,422 and 312 burden hours.

Proposed § 1926.754(c)(3) prohibits workers from walking the top surface of any structural steel member which has been finish-coated with paint or similar material unless documentation or certification is provided that the finish paint or coating has not decreased the coefficient of friction (COF). The documentation or certification must be available at the site and to the steel erector. As explained in the summary and explanation section, coated steel can be an extremely dangerous hazard to steel erectors. OSHA believes it is necessary for the documentation to be prepared to assure the steel erector that the surface the employees are walking on is not any more slippery than uncoated steel. Without this documentation, slips and falls will

continue to occur due to slippery coated surfaces. OSHA estimates that 17,587 projects will have coated or painted steel and that only one certification need be prepared for all of the surfaces coated with the particular coating being used on each project. Assuming that it will take the manufacturer five minutes to prepare the documentation and the employer five minutes to transfer the information to the steel erector, the total estimated annual respondent burden for steel erection worksites is \$132,086 and 2,932 burden hours.

Proposed § 1926.757(a)(3) requires that, when steel joists at columns span more than 60 feet (18.3 m), the joists shall be set in tandem with all bridging installed unless an alternative method of erection, which provides stability to the steel joist, is designed by a qualified person and is included in a site-specific erection plan. OSHA believes that a site-specific erection plan is necessary because the employer is choosing an alternative erection method to the one required in the standard. It is necessary to document the alternative method to ensure that it provides equivalent safety to the method specified in the standard. OSHA estimates that 7,391 projects will contain joist erection. Approximately 5 percent of the joists used span more than 60 feet. It is estimated that it will take the employer five minutes to include a description of the alternative erection method in the site-specific erection plan for all occurrences on the project. The total estimated annual respondent burden for steel erection worksites is \$1,497 and 31 burden hours.

Proposed § 1926.757(a)(11) prohibits modifications from being made to steel joists that affect the strength of the joist without approval of the project structural engineer of record. OSHA believes it is necessary for this approval to be obtained from the engineer since any deviation from the initial design of the joist could alter the performance of the joist and ultimately affect the strength of the joist. Committee members stated that the approval could simply be a phone call to the engineer to evaluate the effect of the modification. OSHA estimates that 7,391 projects will include joist erection. A modification to a joist is only expected to occur about 5 percent of the time. It is usual and customary that any modifications be approved by the project structural engineer of record, therefore, the only burden taken is for the transfer of information. When a modification occurs, the engineer would review the modification once, and it would take five minutes for the transfer of information. The total estimated

annual respondent burden for steel erection worksites is \$928 and 31 burden hours.

Proposed § 1926.757(e)(4)(i) prohibits placing a bundle of decking on fewer than three steel joists unless the employer has determined from a qualified person and documented in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load. OSHA believes it is necessary for employers to provide this documentation in a site-specific erection plan since it is the employer who has elected to deviate from the standard requirement. Landing decking bundles on joists has been determined by the Committee to be a dangerous activity. If an employer elects to perform this activity in a manner other than that described in the standard, it is essential that there be documentation that the alternative means is as safe as the requirement in the standard. This documentation would simply be an entry in the site-specific erection plan to describe the procedure to be used as approved by a qualified person. OSHA estimates that 7,391 projects will include joist erection. It is anticipated that only 2 percent of employers will elect to deviate from the standard. Only in very rare instances would an employer elect not to place deck bundles over at least three joists. For those who choose another means, it is expected that it will take an employer five minutes to describe the procedure in the site-specific erection plan covering all occurrences on the project. The total estimated annual respondent burden for steel erection worksites is \$599 and 12 burden hours.

Proposed § 1926.758(g) prohibits purlins and girts from being used as an anchorage point for a fall arrest system unless written direction is obtained from a qualified person. OSHA believes that it is necessary to require written notification to verify that these lightweight members are capable of supporting the forces of a fall arrest system. Tying-off to purlins or girts can be extremely dangerous if the employer and employees do not know that these members have adequate strength for that use. OSHA estimates that 7,391 steel erection jobs will contain purlin and girt erection and approximately 10 percent of employers will elect to use the members as anchorage points for a fall arrest system. One written record can be obtained for the entire job and it is estimated that it will take an employer 30 minutes to prepare the written approval. The total estimated annual respondent burden for steel erection

worksites is \$11,133 and 370 burden hours.

Proposed § 1926.761 requires the employer to provide training for employees exposed to fall hazards, to those who will be engaged in multiple lift activities, to those who will work in controlled decking zones and to workers performing "connecting" activities. Information currently available to OSHA indicates that many workers are already receiving training in the above mentioned activities either to comply with other requirements in the construction standards or as a normal business practice. It should be noted that employers would have to instruct employees on the safe way to rig materials for multiple lifts and to "connect" as a normal business activity to accomplish the work of erecting the structure. Nearly all workers covered by the proposed rule are now using some fall protection measure, either while connecting, while working in decking operations or performing other tasks. OSHA estimates that it will take 30 minutes for an instructor to prepare for each training session and 60 minutes to communicate (or deliver) information to workers as required by the proposed standard. OSHA estimates the 38,980 employees will be trained in groups of 7 resulting in 5569 initial training sessions. To account for turnover, OSHA estimates 13% of the workforce (5067 employees) will receive turnover training annually thereafter and 2% of the workforce (780 employees) will need remedial training annually. These employees will also be instructed in groups of 7 and the preparatory time and delivery time remain the same. There are no records or other record keeping activities associated with this collection of information. The total estimated first year respondent burden for training is \$536,975 and 9606 burden hours. For the second and subsequent years, only turnover and remedial training will be taken as a burden. Therefore, the total estimated respondent burden for the second and subsequent years is reduced to \$70,043 and 1253 hours.

The total estimated annual respondent burden for all of the information collection requirements in this proposal for steel erection worksites is \$3,889,127 and 88,834 burden hours.

OSHA believes that compliance with all of these requirements will help to reduce the number of fatalities and injuries in steel erection work.

OSHA requests comment from the public on all aspects of this collection of information. Specifically, OSHA requests comment on whether each proposed collection of information:

- Ensures that the collection of information is necessary for the proper performance of the function of the agency, including whether the information will have practical utility;

- Estimates accurately the projected burden including the validity of the methodology and assumptions used accurately;

- Enhances the quality, utility, and clarity of the information to be collected; and

- Minimizes the burden of the collection of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology, e.g., permitting electronic submissions of responses.

Comments on the collections of information for the proposed provisions should be sent to the OMB Desk Officer for OSHA at Room 10235, 726 Jackson Place, N.W., Washington, D.C. 20503. Commenters are encouraged to send a copy of their comments on the collection of information to OSHA along with their other comments. The supporting statements for the collection of information requirements are available in both OSHA and OMB Docket Offices.

The proposed collections of information have been submitted to OMB for review under 44 U.S.C. § 3507(d) of the Paperwork Reduction Act of 1995. OMB is currently reviewing these OSHA proposed collections of information to determine their consistency with the Act. At this time OMB has not approved these collections of information.

## XII. State Plan Standards

The 25 States and territories with their own OSHA approved occupational safety and health plans must adopt a comparable standard within six months of the publication date of a final standard. These 25 states and territories are: Alaska, Arizona, California, Connecticut (for state and local government employees only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York (for state and local government employees only), North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming. Until such time as a state standard is promulgated, Federal OSHA will provide interim enforcement assistance, as appropriate, in these states.

## XIII. Public Participation

### Comments

Interested persons are invited to submit written data, views, and arguments with respect to this proposal. These comments must be postmarked or e-mailed by November 12, 1998.

Comments are to be submitted in quadruplicate or 1 original (hardcopy) and 1 disk (5¼ or 3½) in WP 5.0, 5.1, 6.0, 6.1, 8.0 or ASCII to: the Docket Officer, Docket S-775, U.S. Department of Labor, Occupational Safety and Health Administration, Room N2625, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 219-7894. Written comments of 10 pages or less may be transmitted by facsimile (fax) to the Docket Office at (202) 219-5046, provided an original and three (3) copies are sent to the Docket Office thereafter. Comments may be submitted electronically by e-mail to [steelerection@osha-no.osha.gov](mailto:steelerection@osha-no.osha.gov). If the e-mail contains attached electronic files, the files must be in WordPerfect 5.0, 5.1, 6.0, 6.1, 8.0 or ASCII. When submitting a comment by e-mail, please include your name and address.

Any information not contained on disk or in the e-mail (e.g., studies, articles) must be submitted in quadruplicate. Written submissions must clearly identify the issues or specific provisions of the proposal which are addressed and the position taken with respect to each issue or provision. The data, views and arguments that are submitted will be available for public inspection and copying at the above address. All timely submissions received will be made a part of the record of this proceeding. The preliminary economic analysis and the exhibits cited in this document will be available for public inspection and copying at the above address. OSHA invites comments concerning the conclusions reached in the preliminary economic analysis.

### Public Hearing

OSHA will hold an informal public hearing to begin at 10:00 a.m. on December 1, 1998. The hearing will be held in the Auditorium of the Frances Perkins Building, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C., 20210.

### Notice of Intention To Appear at the Informal Hearing

Pursuant to section 6(b)(3) of the Occupational Safety and Health Act, OSHA will provide interested persons with an opportunity to submit oral testimony concerning the issues raised by the proposed standard, including

economic and environmental impact, at the informal public hearing. The hearing is scheduled for December 1, 1998. If OSHA receives sufficient requests to participate in the hearing, the length of the hearing period may be extended. Conversely, the hearing may be shortened if there are few requests.

All persons desiring to participate at the hearing, including exercising their right to question witnesses, must file, in quadruplicate, a notice of intention to appear. The notice of intention to appear must be postmarked on or before November 12, 1998. The notice of intention to appear, which will be available for inspection and copying at the OSHA Technical Data Center Docket Office (Room N2625), telephone (202) 219-7894, must contain the following information:

1. The name, address, and telephone number of each person to appear;
2. The capacity in which the person will appear;
3. The approximate amount of time required for the presentation;
4. The specific issues that will be addressed;
5. A brief statement of the position that will be taken with respect to each issue addressed; and
6. Whether the party intends to submit documentary evidence and, if so, a brief summary of it.

The notice of intention to appear shall be mailed to: the Docket Officer, Docket S-775, U.S. Department of Labor, Occupational Safety and Health Administration, Room N2625, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 219-7894.

A notice of intention to appear also may be transmitted by facsimile to (202) 219-5046 (Attention: Docket Officer), by the same date, provided the original and three copies are sent to the same address and postmarked no more than three days later.

Individuals with disabilities wishing to attend the hearings should contact the Docket Officer to obtain appropriate accommodations at the hearing.

### Filing of Testimony and Evidence Before the Hearing

Any party requesting more than ten minutes for a presentation at the hearing or who will present documentary evidence, must provide in quadruplicate, the complete text of its testimony, including all documentary evidence to be presented at the hearing. One copy must be unstapled and unbound and suitable for copying. These materials must be postmarked no later than November 17, 1998 and sent

to the Docket Officer at the address given above.

Each submission will be reviewed in light of the amount of time requested in the notice of intention to appear. In instances where the information contained in the submission does not justify the amount of time requested, a more appropriate amount of time will be allocated and the participant will be notified of that fact. Any party who has not substantially complied with the above requirements, may be limited to a ten minute presentation and may be requested to return for questioning at a later time. Any party who has not filed a notice of intention to appear may be allowed to testify, as time permits, at the discretion of the Administrative Law Judge who presides at the hearing.

Notices of intention to appear, testimony and evidence will be available for inspection and copying at the Docket Office at the address above.

*Conduct and Nature of the Hearing*

The hearing is scheduled to commence at 10:00 a.m. on December 1, 1998. At that time, any procedural matters relating to the proceeding will be resolved. OSHA rulemaking hearings are informal, as established in the legislative history of section 6 of the Act and codified in 29 CFR part 1911, OSHA's hearing regulations (cf. 29 CFR 1911.15(a)). Although the presiding officer is an Administrative Law Judge and questioning by interested persons is allowed on crucial issues, the proceeding will be essentially legislative in nature. The intent, in essence, is to provide an opportunity for effective oral presentation by interested persons which can be carried out expeditiously and in the absence of rigid procedures which might unduly impede or protract the rulemaking process.

Additionally, since the hearing is primarily for information gathering and clarification, it is an informal administrative proceeding rather than an adjudicative one.

The technical rules of evidence, for example, do not apply. The regulations that govern hearings and the pre-hearing guidelines to be issued for this hearing will ensure fairness and due process and also facilitate the development of a clear, accurate and complete record. Those rules and guidelines will be interpreted in a manner that furthers that development. Thus, questions of relevance, procedure and participation generally will be decided so as to favor development of the record.

The hearing will be conducted in accordance with 29 CFR part 1911. It should be noted that § 1911.4 specifies that the Assistant Secretary may, upon

reasonable notice, issue alternative procedures to expedite proceedings or for other good cause.

The hearing will be presided over by an Administrative Law Judge who makes no decision or recommendation on the merits of OSHA's Proposal. The responsibility of the Administrative Law Judge is to ensure that the hearing proceeds at a reasonable pace and in an orderly manner. The Administrative Law Judge, therefore, will have the powers necessary and appropriate to conduct a full and fair informal hearing as provided in 29 CFR 1911, including the powers:

1. To regulate the course of the proceedings;
2. To dispose of procedural requests, objections and comparable matters;
3. To confine the presentation to the matters pertinent to the issues raised;
4. To regulate the conduct of those present at the hearing by appropriate means;
5. In the Judge's discretion, to question and permit the questioning of any witness, and to limit the time for questioning; and
6. In the Judge's discretion, to keep the record open for a reasonable stated time to receive written information and additional data, views, and arguments from any person who has participated in the oral proceedings.

Following the close of the hearing, the presiding Administrative Law Judge will certify the record of the hearing to the Assistant Secretary of Labor for Occupational Safety and Health.

**XIV. Authority**

This document was prepared under the direction of Charles N. Jeffress, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210.

**List of Subjects in 29 CFR Part 1926**

Structural steel erection, Construction industry, Construction safety, Occupational Safety and Health Administration, Occupational safety and health.

Signed at Washington, D.C., this 3d day of August, 1998.

**Charles N. Jeffress,**  
*Assistant Secretary of Labor.*

Accordingly, pursuant to sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, and 657); section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333), Secretary of Labor's Order No. 6-96 (62 FR 111), and 29 CFR part 1911, it is proposed to amend part 1926 of Title 29 of the Code of Federal Regulations as set forth below.

**PART 1926—[AMENDED]**

**Subpart M—[Amended]**

1. The authority citation for subpart M of Part 1926 would be revised to read as follows:

**Authority:** Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Sec. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders No. 1-90 (55 FR 9033) and No. 6-96 (62 FR 111); and 29 CFR Part 1911.

2. Paragraph (a)(2)(iii) of § 1926.500 would be revised to read as follows:

**§ 1926.500 Scope, application, and definitions applicable to this subpart.**

- (a) \* \* \*
- (2) \* \* \*
- (iii) Fall protection requirements for employees performing steel erection work (except for towers and tanks) are provided in subpart R of this part.

\* \* \* \* \*

**§ 1926.500 [Amended]**

3. Paragraphs (a)(2)(iv), (a)(2)(v), and (a)(2)(vi) of § 1926.500 would be redesignated as (a)(2)(v), (a)(2)(vi) and (a)(2)(vii) respectively.

4. Paragraph (a)(2)(iv) § 1926.500 would be added to be revised to read as follows:

**§ 1926.500 Scope, application, and definitions applicable to this subpart.**

- (a) \* \* \*
- (2) \* \* \*
- (iv) Requirements relating to fall protection for employees engaged in the erection of tanks and towers are provided in § 1926.105.

\* \* \* \* \*

5. Paragraph (a)(3)(iv) of § 1926.500 would be revised to read as follows:

**§ 1926.500 Scope, application, and definitions applicable to this subpart.**

- (a) \* \* \*
- (3) \* \* \*
- (iv) Section 1926.502 does not apply to the erection of tanks and towers. (Note: Section 1926.104 sets the criteria for body belts, lanyards and lifelines used for fall protection during tank and tower erection. Paragraphs (b), (c) and (f) of § 1926.107 provide definitions for the pertinent terms.)

\* \* \* \* \*

**Subpart R—[Amended]**

6. The authority citation for subpart R of Part 1926 would be revised to read as follows:

**Authority:** Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Sec. 4, 6, and 8,



Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 6-96 (62 FR 111), and 29 CFR part 1911.

7. Subpart R of Part 1926 would be revised to read as follows:

**Subpart R—Steel Erection**

- 1926.750 Scope and application.
- 1926.751 Definitions.
- 1926.752 Site layout, site-specific erection plan and construction sequence.
- 1926.753 Hoisting and rigging.
- 1926.754 Structural steel assembly.
- 1926.755 Anchor bolts.
- 1926.756 Beams and columns.
- 1926.757 Open web steel joists.
- 1926.758 Pre-engineered metal buildings.
- 1926.759 Falling object protection.
- 1926.760 Fall protection.
- 1926.761 Training.

**Appendix A to Subpart R—Guidelines for Establishing the Components of a Site-Specific Erection Plan: Non-Mandatory Guidelines for Complying With § 1926.752(d)**

**Appendix B to Subpart R—Acceptable Test Methods for Testing Slip-Resistance of Walking/Working Surfaces: Non-Mandatory Guidelines for Complying With § 1926.754(c)(3)**

**Appendix C to Subpart R—Illustrations of Bridging Terminus Points: Non-Mandatory Guidelines for Complying With § 1926.757(c)(3)**

**Appendix D to Subpart R—Illustration of the Use of Control Lines to Delineate Controlled Decking Zones (CDZs): Non-Mandatory Guidelines for Complying With § 1926.760(c)(3)**

**Appendix E to Subpart R—Training: Non-Mandatory Guidelines for Complying With § 1926.761**

**Appendix F to Subpart R—Installation of Perimeter Safety Cables: Non-Mandatory Guidelines for Complying With § 1926.756(f) to Protect the Unprotected Side or Edge of a Walking/Working Surface**

**Subpart R—Steel Erection**

**§ 1926.750 Scope and Application.**

(a) *Scope.* This subpart sets forth requirements to protect employees from the hazards associated with steel erection activities involved in the construction, alteration, and/or repair of single and multi-story buildings, bridges, and other structures where steel erection occurs. The requirements of this subpart apply to employers engaged in steel erection unless otherwise specified. This subpart does not cover electrical transmission towers, communication and broadcast towers, or tanks.

**Note:** Examples of structures where steel erection may occur include but are not limited to the following: single and multi-story buildings; pre-engineered metal buildings; lift slab/tilt-up structures; energy

exploration structures; energy production, transfer and storage structures and facilities; auditoriums; malls; amphitheaters; stadiums; power plants; mills; chemical process structures; bridges; trestles; overpasses; underpasses; viaducts; aqueducts; aerospace facilities and structures; radar and communication structures; light towers; signage; billboards; scoreboards; conveyor systems, conveyor supports and related framing; stairways; stair towers; fire escapes; draft curtains; fire containment structures; monorails; aerialways; catwalks; curtain walls; window walls; store fronts; elevator fronts; entrances; skylights; metal roofs; industrial structures; hi-bay structures; rail, marine and other transportation structures; sound barriers; water process and water containment structures; air and cable supported structures; space frames; geodesic domes; canopies; racks and rack support structures and frames; platforms; walkways; balconies; atriums; penthouses; car dumpers; stackers/reclaimers; cranes and craneways; bins; hoppers; ovens; furnaces; stacks; amusement park structures and rides; and artistic and monumental structures.

(b) *Application.* Steel erection activities include hoisting, connecting, welding, bolting, and rigging structural steel, steel joists and metal buildings; installing metal deck, siding systems, miscellaneous metals, ornamental iron and similar materials; and moving point-to-point while performing these activities.

**Note:** Activities which could be considered covered by this subpart when they occur during the process of steel erection include but are not limited to the following: rigging, hoisting, laying out, placing, connecting, guying, bracing, dismantling, burning, welding, bolting, grinding, sealing, caulking, and all related activities for construction, alteration and/or repair of materials and assemblies such as structural steel; ferrous metals and alloys; non-ferrous metals and alloys; glass; plastics and synthetic composite materials; structural metal framing and related bracing and assemblies; anchoring devices; structural cabling; cable stays; permanent and temporary bents and towers; falsework for temporary supports of permanent steel members; architectural precast concrete, stone and other architectural materials mounted on steel frames; safety systems for steel erection; steel and metal joists; metal decking and raceway systems and accessories; metal roofing and accessories; metal siding; bridge flooring; cold formed steel framing; elevator beams; grillage; shelf racks; multi-purpose supports; crane rails and accessories; miscellaneous, architectural and ornamental metals and metal work; ladders; railings; handrails; fences and gates; gratings; trench covers; floor plates; castings; sheet metal fabrications; metal panels and panel wall systems; louvers; column covers; enclosures and pockets; stairs; perforated metals; ornamental iron work; expansion control including bridge expansion joint assemblies; slide bearings; hydraulic structures; fascias; soffit panels; penthouse enclosures;

skylights; joint fillers; gaskets; sealants and seals; doors; windows; hardware, detention/security equipment and doors, windows and hardware; curtain walls/sloped glazing systems/structural glass curtain walls; translucent wall systems; conveying systems; building specialties; building equipment; machinery and plant equipment, furnishings and special construction.

**§ 1926.751 Definitions.**

*Anchored bridging* means that the steel joist bridging is connected to a bridging terminus point.

*Bolted diagonal bridging* means diagonal bridging which is bolted to a steel joist or joists.

*Bridging clip* means a device that is attached to the steel joist to allow the bolting of the bridging to the steel joist.

*Bridging terminus point* means a wall, beam, tandem joists (with all bridging installed and a horizontal truss in the plane of the top chord) or other element at an end or intermediate point(s) of a line of bridging that provides an anchor point for the steel joist bridging.

*Choker* means a wire rope or synthetic fiber rigging assembly that is used to attach a load to a hoisting device.

*Clipped connection* means the connection material on the end of a structural member intended for use in a double connection which has a notch at the bottom and/or top to allow the bolt(s) of the first member placed on the opposite side of the central member to remain in place. The notch(es) fits around the nut or bolt head of the opposing member to allow the second member to be bolted up without removing the bolt(s) holding the first member.

*Cold formed joist* means an open web joist fabricated with cold formed steel components.

*Cold forming* means the process of using press brakes, rolls, or other methods to shape steel into desired cross sections at room temperature.

*Competent person* (also defined in § 1926.32) means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

*Composite joists* means steel joists designed to act in composite action with concrete floor and/or concrete roof slabs. Typically, a portion of the top chord of the joist (or a lug or similar device attached to the top chord of the joist) is embedded in the concrete slab.

*Connector* means an employee who, working with hoisting equipment, is placing and connecting structural members and/or components.

*Construction load for joist erection* means any load other than the weight of the employee(s), the joists and the bridging bundle.

*Controlled Decking Zone (CDZ)* means an area in which certain work (e.g., initial installation and placement of metal deck) may take place without the use of guardrail systems, personal fall arrest systems or safety net systems and where access to the zone is controlled.

*Controlled load lowering* means lowering a load by means of a mechanical hoist drum device that allows a hoisted load to be lowered with maximum control using the gear train or hydraulic components of the hoist mechanism. Controlled load lowering requires the use of the hoist drive motor, rather than the load hoist brake, to lower the load.

*Controlling contractor* means a prime contractor, general contractor, construction manager or any other legal entity at the site who has, by contract with other parties, the overall responsibility for the project, its planning, quality and completion.

*Critical lift* means a lift that exceeds 75 percent of the rated capacity of the crane or derrick, or requires the use of more than one crane or derrick.

*Decking hole* means a gap or void more than 2 inches (5.1 cm) in its least dimension and less than 12 inches (30.5 cm) in its greatest dimension in a floor, roof or other walking/working surface. Pre-engineered holes in cellular decking are not included in this definition.

*Derrick floor* means an elevated floor of a building or structure that has been designated to receive hoisted pieces of steel prior to final placement.

*Double connection* means an attachment method where the connection point is intended for two pieces of steel which share common bolts on either side of a central piece.

*Erection bridging* means the bolted diagonal bridging that is required to be installed prior to releasing the hoisting cables from the steel joists.

*Fall restraint (Positioning device) system* means a body belt or body harness used to prevent an employee from free falling more than 24 inches (61 cm) and where self rescue can be assured. It consists of an anchorage, connectors, a body belt or harness and may include a lanyard, deceleration device, lifeline, or suitable combination of these.

*Girt (in pre-engineered metal buildings)* means a "Z" or "C" shaped member formed from sheet steel spanning between primary framing and supporting wall material.

*Headache ball* means a weighted hook that is used to attach loads to the hoist load line of the crane.

*Hoisting equipment* means commercially manufactured lifting equipment designed to lift and position a load of known weight to an erection location at some known elevation and horizontal distance from the equipment's center of rotation. "Hoisting equipment" includes but is not limited to cranes, derricks, tower cranes, barge-mounted derricks or cranes, gin poles and gantry hoist systems. A "come-a-long" (a mechanical device, usually consisting of a chain or cable attached at each end, that is used to facilitate movement of materials through leverage) is not considered "hoisting equipment."

*Leading edge* means the unprotected side and edge of a floor, roof, or formwork for a floor or other walking/working surface (such as deck) which changes location as additional floor, roof, decking or formwork sections are placed, formed or constructed.

*Metal deck* means a commercially manufactured, structural grade, cold rolled metal panel formed into a series of parallel ribs; for this subpart, this includes metal floor and roof decks, standing seam metal roofs, other metal roof systems and other products such as bar gratings, checker plate, expanded metal panels, and similar products. After installation and proper fastening, these decking materials serve a combination of functions including, but not limited to: a structural element designed in combination with the structure to resist, distribute and transfer loads, stiffen the structure and provide a diaphragm action; a walking/working surface; a form for concrete slabs; a support for roofing systems; and a finished floor or roof.

*Multiple lift rigging* means a rigging assembly manufactured by wire rope rigging suppliers that facilitates the attachment of up to five independent loads to the hoist rigging of a crane.

*Opening* means a gap or void 12 inches (30.5 cm) or more in its least dimension in a floor, roof or other walking/working surface. For the purposes of this subpart, skylights and smoke domes that do not meet the strength requirements of § 1926.760(d)(1) shall be regarded as openings.

*Permanent floor* means a structurally completed floor at any level or elevation (including slab on grade).

*Personal fall arrest system* means a system used to arrest an employee in a fall from a working level. A personal fall arrest system consists of an anchorage, connectors, a body belt or body harness

and may include a lanyard, deceleration device, lifeline, or suitable combination of these. (As of January 1, 1998, the use of a body belt for fall arrest is prohibited by subpart M of this part.)

*Pre-engineered metal building* means a field-assembled building system consisting of framing, roof and wall coverings, and generally made of steel. Typically, in a pre-engineered metal building, many of these components are cold-formed shapes. These individual parts are fabricated in one or more manufacturing facilities and shipped to the job site for assembly into the final structure. Engineering design of the system is normally the responsibility of the pre-engineered metal building manufacturer.

*Project structural engineer of record* means the registered, licensed professional responsible for the design of structural steel framing and whose seal appears on the structural contract documents.

*Purlin (in pre-engineered metal buildings)* means a "Z" or "C" shaped member formed from sheet steel spanning between primary framing and supporting roof material.

*Qualified person* (also defined in § 1926.32) means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work, or the project.

*Safety deck attachment* means an initial attachment that is used to secure an initially placed sheet of decking to keep proper alignment and bearing with structural support members.

*Seat* means a structural attachment mounted to a structural member beneath a connection point, designed to support an incoming member that is to be connected to the first member.

*Shear connector* means headed steel studs, steel bars, steel lugs, and similar devices which are attached to a structural member for the purpose of achieving composite action with concrete.

*Steel erection* means the erection of steel buildings, bridges and other structures, including the installation of steel flooring and roofing members and all planking and decking used during the process of erection.

*Steel joist* means an open web, secondary load-carrying member of 144 feet (43.9 m) or less suitable for the support of floors and roofs. This does not include structural steel trusses or cold-formed joists.

*Steel joist girder* means an open web, primary load-carrying member,

designed by the manufacturer, suitable for the support of floors and roofs. This does not include structural steel trusses.

*Steel truss* means an open web member designed of structural steel components by the project structural engineer of record. For the purposes of this subpart, a steel truss is considered equivalent to a solid web structural member.

*Unprotected sides and edges* means any side or edge (except at entrances to points of access) of a walking/working surface, e.g., floor, roof, ramp or runway, where there is no wall or guardrail system at least 39 inches (1.0 m) high.

**§ 1926.752 Site layout, site-specific erection plan and construction sequence.**

(a) *Approval to begin steel erection.* Before authorizing the commencement of steel erection, the controlling contractor must provide the steel erector with the following written notifications:

(1) The concrete in the footings, piers and walls or the mortar in the masonry piers and walls has attained, on the basis of an appropriate ASTM standard test method of field-cured samples, either 75 percent of the intended minimum compressive design strength or sufficient strength to support loads imposed during steel erection.

(2) Any repairs, replacements and modifications to the anchor bolts were conducted in accordance with § 1926.755(b).

(b) *Site layout.* The controlling contractor shall provide and maintain the site layout as follows:

(1) Adequate access roads into and through the site for the safe delivery and movement of derricks, cranes, trucks, other necessary equipment, and the material to be erected and means and methods for pedestrian and vehicular control; and

(2) A firm, properly graded, drained area, readily accessible to the work with adequate space for the safe storage of materials and the safe operation of the erector's equipment.

(c) *Overhead protection.* All hoisting operations in steel erection shall be pre-planned in accordance with §§ 1926.753(b) and 1926.759 to ensure that no employee is required to be exposed to overhead hazards.

(d) *Site-specific erection plan.* Where employers elect, due to conditions specific to the site, to develop alternate means and methods that provide employee protection in accordance with § 1926.753(a)(5), § 1926.757(a)(3) or § 1926.757(e)(4)(i), a site-specific erection plan shall be developed by a qualified person and be available at the work site. Guidelines for establishing a

site-specific erection plan are contained in appendix A to this subpart.

**§ 1926.753 Hoisting and rigging.**

The following provisions supplement the requirements of § 1926.550 regarding the hazards associated with hoisting and rigging.

(a) *General.* (1) Pre-shift visual inspection of cranes.

(i) Cranes being used in steel erection activities shall be visually inspected prior to each shift by a competent person; the inspection shall include observation for deficiencies during operation. At a minimum, this inspection shall include the following:

(A) All control mechanisms for maladjustments;

(B) Control and drive mechanisms for excessive wear of components and contamination by lubricants, water or other foreign matter;

(C) Safety devices, including but not limited to, boom angle indicators, boom stops, boom kick-out devices, anti-two block devices, and load moment indicators where required;

(D) Air, hydraulic, and other pressurized lines for deterioration or leakage, particularly those which flex in normal operation;

(E) Hooks and latches for deformation, chemical damage, cracks, or wear;

(F) Wire rope reeving for compliance with hoisting equipment manufacturer's specifications;

(G) Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, or moisture accumulation;

(H) Hydraulic system for proper fluid level;

(I) Tires for proper inflation and condition;

(J) Ground conditions around the hoisting equipment for proper support, including ground settling under and around outriggers, ground water accumulation, or other similar conditions;

(K) The hoisting equipment for level position; and

(L) The hoisting equipment for level position after each move and setup.

(ii) If any deficiencies are identified, an immediate determination shall be made by the competent person as to whether the deficiency constitutes a hazard.

(iii) If the deficiency is determined to constitute a hazard, the hoisting equipment shall be removed from service until the deficiency has been corrected.

(iv) The employer shall obtain and/or prepare a certification record of the pre-shift inspection required by paragraph (a)(1)(i) of this section which includes

the date the hoisting equipment items were inspected; the signature of the person who inspected the hoisting equipment items; and a serial number, or other identifier, for the hoisting equipment inspected.

(v) The operator shall be responsible for those operations under the operator's direct control. Whenever there is any doubt as to safety, the operator shall have the authority to stop and refuse to handle loads until safety has been assured.

(2) A qualified rigger (i.e., a rigger who is also a qualified person) shall inspect the rigging prior to each shift in accordance with § 1926.251.

(3) The headache ball, hook or load shall not be used to transport personnel except as provided in paragraph (a)(1)(v)(4) of this section.

(4) Paragraph (g)(2) of § 1926.550 notwithstanding, cranes or derricks may be used to hoist employees on a personnel platform when work under this subpart is being conducted, provided that all other provisions of § 1926.550(g) are met.

(5) Safety latches on hooks shall not be deactivated or made inoperable except:

(i) When a qualified rigger has determined that the hoisting and placing of purlins and single joists can be performed more safely by doing so; or

(ii) When equivalent protection is provided in a site-specific erection plan.

(b) *Working under loads.* (1) Routes for suspended loads shall be pre-planned to ensure that no employee is required to work directly below a suspended load, except for:

(i) Employees engaged in the initial connection of steel; or

(ii) Employees necessary for the hooking or unhooking of the load.

(2) When working under suspended loads, the following criteria shall be met:

(i) Materials being hoisted shall be rigged to prevent unintentional displacement;

(ii) Hooks with self-closing safety latches or their equivalent shall be used to prevent components from slipping out of the hook; and

(iii) All loads shall be rigged by a qualified rigger.

(c) *Multiple lift rigging procedure.* (1) A multiple lift shall only be performed if the following criteria are met:

(i) A multiple lift rigging assembly is used;

(ii) A maximum of five (5) members is hoisted per lift;

(iii) Only structural members are lifted; and

(iv) All employees engaged in the multiple lift have been trained in these

procedures in accordance with § 1926.761(c)(1).

(2) Components of the multiple lift rigging assembly shall be specifically designed and assembled with a maximum capacity for total assembly and for each individual attachment point. This capacity, certified by the manufacturer or a qualified rigger, shall be based on the manufacturer's specifications with a 5 to 1 safety factor for all components.

(3) The total load shall not exceed:

(i) The rated capacity of the hoisting equipment specified in the hoisting equipment load charts; or

(ii) The rigging capacity specified in the rigging rating chart.

(4) The multiple lift rigging assembly shall be rigged with the members:

(i) Attached at their center of gravity and maintained reasonably level;

(ii) Rigged from the top down; and

(iii) Rigged at least 7 feet (2.1 m) apart.

(5) The members on the multiple lift rigging assembly shall be set from the bottom up.

(6) Controlled load lowering shall be used whenever the load is over the connectors.

#### § 1926.754 Structural steel assembly.

(a) Structural stability shall be maintained at all times during the erection process.

(b) The following additional requirements shall apply for multi-story structures:

(1) The permanent floors shall be installed as the erection of structural members progresses, and there shall be not more than eight stories between the erection floor and the upper-most permanent floor, except where the structural integrity is maintained as a result of the design.

(2) At no time shall there be more than four floors or 48 feet (14.6 m), whichever is less, of unfinished bolting or welding above the foundation or uppermost permanently secured floor, except where the structural integrity is maintained as a result of the design.

(3) A fully planked or decked floor or nets shall be maintained within 2 stories or 30 feet (9.1 m), whichever is less, directly under any erection work being performed.

(c) *Walking/working surfaces*—(1) *Shear connectors and other similar devices*—(i) *Tripping hazards*. Shear connectors (such as headed steel studs, steel bars or steel lugs), reinforcing bars, deformed anchors or threaded studs shall not be attached to the top flanges of beams, joists or beam attachments so that they project vertically from or horizontally across the top flange of the

member until after the decking, or other walking/working surface, has been installed.

(ii) *Installation of shear connectors on composite floors, roofs and bridge decks*. When shear connectors are utilized in construction of composite floors, roofs and bridge decks, employees shall lay out and install the shear connectors after the decking has been installed, using the deck as a working platform. Shear connectors shall not be installed from within a controlled decking zone (CDZ), as specified in § 1926.760(c)(8).

(2) *Metal decking*. [Reserved]

(3) *Skeletal structural steel*. Workers shall not be permitted to walk the top surface of any structural steel member installed after [effective date of final rule] which has been finish-coated with paint or similar material unless documentation or certification, based on an appropriate ASTM standard test method, is provided that the finished coat has not decreased the coefficient of friction (COF) from that of the original steel before it was finish-coated. Such documentation or certification shall be available at the site and to the steel erector (see appendix B of this subpart).

(d) *Plumbing-up*. (1) Connections of the equipment used in plumbing-up shall be properly secured.

(2) Plumbing-up equipment shall be removed only with the approval of a competent person.

(e) *Decking*—(1) *Hoisting, landing and placing of deck bundles*. (i) Bundle packaging and strapping shall not be used for hoisting unless specifically designed for that purpose.

(ii) If loose items such as dunnage, flashing, or other materials are placed on the top of deck bundles to be hoisted, such items shall be secured to the bundles.

(iii) Bundles of decking on joists shall be landed in accordance with § 1926.757(e)(4).

(iv) Bundles shall be landed on framing members so that enough support is provided to allow the bundles to be unbanded without dislodging the bundles from the supports.

(v) At the end of the shift or when environmental or jobsite conditions require, decking shall be secured against displacement.

(2) *Roof and floor openings*. Metal deck at roof and floor openings shall be installed as follows:

(i) Where structural design and constructability allow, framed deck openings shall have structural members turned down to allow continuous deck installation.

(ii) Roof and floor openings shall be covered during the decking process. Where structural design does not allow openings to be covered, they shall be protected in accordance with § 1926.760(a)(2).

(iii) Decking holes and openings shall not be cut until essential to the construction process, and openings shall be protected immediately in accordance with § 1926.760(d) or be otherwise permanently filled.

(3) *Space around columns*. Wire mesh, exterior plywood, or equivalent, shall be used around columns where planks or decking do not fit tightly.

(4) *Floor decking*. Floor decking shall be laid tightly and secured to prevent accidental movement or displacement.

(5) *Derrick floors*. (i) A derrick floor shall be fully decked and/or planked and the steel member connections completed to support the intended floor loading.

(ii) Temporary loads placed on a derrick floor shall be distributed over the underlying support members so as to prevent local overloading of the deck material.

#### § 1926.755 Anchor bolts.

(a) *General requirements for erection stability*. (1) All columns shall be anchored by a minimum of 4 anchor bolts. Each column anchor bolt assembly, including the welding of the column to the base plate, shall be designed to resist a 300 pound (136.2 kg) eccentric load located 18 inches (.46 m) from the column face in each direction at the top of the column shaft.

(2) Columns shall be set on level finished floors, pre-grouted leveling plates, leveling nuts, or shim packs which are adequate to transfer the construction loads.

(3) Unstable columns shall be evaluated by a competent person and be guyed or braced where deemed necessary.

(b) *Repair, replacement or field modification*.

(1) Anchor bolts shall not be repaired, replaced or field-modified without the approval of the project structural engineer of record.

(2) Such approval under paragraph (b)(1) of this section shall state whether the repair, replacement or modification has made guying or bracing of the column necessary.

(3) Prior to the erection of a column, the controlling contractor shall provide written notification to the steel erector if there has been any repair, replacement or modification of the anchor bolts of that column.

**§ 1926.756 Beams and columns.**

(a) *General.* During the final placing of solid web structural members, the load shall not be released from the hoisting line until the members are secured with at least two bolts per connection drawn up wrench-tight or the equivalent as specified by the project structural engineer of record, except as specified in paragraph (b) of this section.

(b) *Diagonal bracing.* Solid web structural members used as diagonal bracing shall be secured by at least one bolt per connection drawn up wrench-tight or the equivalent as specified by the project structural engineer of record.

(c) *Double connections at columns and/or at beam webs over a column.* When two structural members on opposite sides of a column web, or a beam web over a column, share common connection holes, at least one bolt with its wrench-tight nut shall remain connected to the first member unless a shop-attached or field-bolted seat or similar connection device is present to secure the second member and prevent the column from being displaced. When seats are provided, the connection between the seat and the structural member that it supports shall be bolted together before the nuts are removed for the double connection.

(d) *Column splices.* Each column splice shall be designed to resist a 300 pound (136.2 kg) eccentric load located 18 inches (.46 m) from the column face in each direction at the top of the column shaft.

(e) *Perimeter columns.* Perimeter columns shall extend a minimum of 48 inches (1.2 m) above the finished floor to permit installation of perimeter safety cables prior to erection of the next tier except where structural design and constructibility do not allow. (See appendix F to this subpart.)

(f) *Perimeter safety cables.* (1) Perimeter safety cables shall be installed at the perimeter during the structural steel assembly of multi-story structures.

(2) Perimeter safety cables shall consist of 1/2-inch wire rope or equivalent installed at 42–45 inches above the finished floor and at the midpoint between the finished floor and the top cable.

(3) Holes or other devices shall be provided by the fabricator/supplier and shall be in or attached to perimeter columns at 42–45 inches above the finished floor and the midpoint between the finished floor and the top cable to permit installation of perimeter safety cables except where structural design and constructibility allow. (See appendix F to this subpart.)

**§ 1926.757 Open web steel joists.**

(a) *General.* (1) In steel framing, where steel joists or steel joist girders are utilized and columns are not framed in at least two directions with solid web structural steel members, the steel joist or steel joist girder shall be field-bolted at or near columns to provide lateral stability to the column during erection.

(2) Where steel joists at or near columns span 60 feet (18.3 m) or less, the joist shall be designed with sufficient strength to allow one employee to release the hoisting cable without the need for erection bridging.

(3) Where steel joists at columns span more than 60 feet (18.3 m), the joists shall be set in tandem with all bridging installed unless an alternative method of erection, which provides equivalent stability to the steel joist, is designed by a qualified person and is included in the site-specific erection plan.

(4) A stabilizer plate shall be provided on each column for steel joists and steel joist girders and shall extend at least 3 inches (76 mm) below the bottom chord of the joist with a 13/16 inch (21 mm) hole to provide an attachment point for guying or plumbing cables.

(5) Bottom chords of steel joist girders and steel joists required by paragraph (a)(1) of this section shall be stabilized to prevent rotation during erection.

(6) A steel joist shall not be placed on any support structure unless such structure is stabilized.

(7) When steel joist(s) are landed on a structure, they shall be secured to prevent unintentional displacement prior to installation.

(8) Except for steel joists that have been pre-assembled into panels, connections of individual steel joists to steel structures in bays of 40 feet (12.2 m) or more shall be fabricated to allow for field bolting during erection.

(9) A bridging terminus point shall be established before bridging is installed. (See appendix C to this subpart.)

(10) Steel joists and steel joist girders shall not be used as anchorage points for a fall arrest system unless written direction to do so is obtained from a qualified person.

(11) No modification that affects the strength of a steel joist shall be made without the approval of the project structural engineer of record.

(b) *Attachment of steel joists and steel joist girders.* (1) Each end of "K" series steel joists shall be attached to the support structure with a minimum of two 1/8-inch (3 mm) fillet welds 1 inch (25 mm) long or with two 1/2-inch (13 mm) bolts, or the equivalent.

(2) Each end of "LH" and "DLH" series steel joists and steel joist girders shall be attached to the support

structure with a minimum of two 1/4-inch (6 mm) fillet welds 2 inches (51 mm) long, or with two 3/4-inch (19 mm) bolts, or the equivalent.

(3) Except as provided in paragraph (b)(4) of this section, each steel joist shall be attached to the support structure, at least at one end, immediately upon placement in the final erection position and before additional joists are placed.

(4) Steel joists that have been pre-assembled into panels through the installation of bridging shall be attached to the structure at each corner before the hoisting cables are released.

(c) *Erection of steel joists.* (1) One end of each steel joist shall be attached to the support structure before an employee is allowed on the steel joist.

(2) On steel joists that span 40 feet (12.2 m) or less and that do not require erection bridging per Tables A and B, only one employee shall be allowed on the joist until all bridging is installed and anchored.

(3) Employees shall not be allowed on steel joists that span more than 40 feet except in accordance with § 1926.757(d).

(4) When permanent bridging terminus points cannot be used during erection, additional temporary bridging terminus points are required to provide stability. (See appendix C of this subpart.)

(d) *Erection bridging.* (1) Where the span of the steel joist is equal to or greater than the span shown in Tables A and B, or in bays of 40 feet (12.2 m) through 60 feet (18.3 m), the following shall apply:

(i) The row of erection bridging nearest the midspan of the steel joist shall be bolted diagonal bridging;

(ii) Hoisting cables shall not be released until this bolted diagonal erection bridging is installed; and

(iii) No more than one employee shall be allowed on these spans until all other bridging is installed and anchored.

(2) Where the span of the steel joist is over 60 feet (18.3 m) through 100 feet (30.5 m), the following shall apply:

(i) The two rows of erection bridging nearest the third points of the steel joist shall be bolted diagonal bridging;

(ii) Hoisting cables shall not be released until this bolted diagonal erection bridging is installed; and

(iii) No more than two employees shall be allowed on these spans until all other bridging is installed and anchored.

(3) Where the span of the steel joist is over 100 feet (30.5 m) through 144 feet (43.9 m), the following shall apply:

(i) All rows of bridging shall be bolted diagonal bridging;

(ii) Hoisting cables shall not be released until all bridging is installed; and

(iii) No more than two employees shall be allowed on these spans until all bridging is installed.

(4) For steel members spanning over 144 feet (43.9 m), the erection methods used shall be in accordance with § 1926.756.

(5) Where any steel joist specified in paragraphs (c)(2) and (d)(1), (d)(2), and (d)(3) of this section is a bottom chord bearing joist, a row of bolted diagonal bridging shall be provided near the support(s). This bridging shall be installed before the hoisting cable(s) is released.

(6) When bolted diagonal erection bridging is required by this section, the following shall apply:

(i) The bridging shall be indicated on the erection drawing;

(ii) The erection drawing shall be the exclusive indicator of the proper placement of this bridging;

(iii) Shop-installed bridging clips, or functional equivalents, shall be provided where the bridging bolts to the steel joists;

(iv) When two pieces of bridging are attached to the steel joist by a common bolt, the nut that secures the first piece of bridging shall not be removed from the bolt for the attachment of the second; and

(v) Bridging attachments shall not protrude above the top chord of the steel joist.

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TABLE A.—ERECTION BRIDGING FOR SHORT SPAN JOISTS

Joist	Span
8K1 .....	NM
10K1 .....	NM
12K1 .....	23-0
12K3 .....	NM
12K5 .....	NM

TABLE A.—ERECTION BRIDGING FOR SHORT SPAN JOISTS—Continued

Joist	Span
14K1 .....	27-0
14K3 .....	NM
14K4 .....	NM
14K6 .....	NM
16K2 .....	29-0
16K3 .....	30-0
16K4 .....	32-0
16K5 .....	32-0
16K6 .....	NM
16K7 .....	NM
16K9 .....	NM
18K3 .....	31-0
18K4 .....	32-0
18K5 .....	33-0
18K6 .....	35-0
18K7 .....	NM
18K9 .....	NM
18K10 .....	NM
20K3 .....	32-0
20K4 .....	34-0
20K5 .....	34-0
20K6 .....	36-0
20K7 .....	39-0
20K9 .....	39-0
20K10 .....	NM
22K4 .....	34-0
22K5 .....	35-0
22K6 .....	36-0
22K7 .....	40-0
22K9 .....	40-0
22K10 .....	40-0
22K11 .....	40-0
24K4 .....	36-0
24K5 .....	38-0
24K6 .....	39-0
24K7 .....	40-0
24K8 .....	40-0
24K9 .....	40-0
24K10 .....	40-0
24K12 .....	40-0
26K5 .....	38-0
26K6 .....	39-0
26K7 .....	40-0
26K8 .....	40-0
26K9 .....	40-0
26K10 .....	40-0
26K12 .....	40-0
28K6 .....	40-0
28K7 .....	40-0
28K8 .....	40-0
28K9 .....	40-0

TABLE A.—ERECTION BRIDGING FOR SHORT SPAN JOISTS—Continued

Joist	Span
28K10 .....	40-0
28K12 .....	40-0
30K7 .....	40-0
30K8 .....	40-0
30K9 .....	40-0
30K10 .....	40-0
30K11 .....	40-0
30K12 .....	40-0
10KCS1 .....	NM
10KCS2 .....	NM
10KCS3 .....	NM
12KCS1 .....	NM
12KCS2 .....	NM
12KCS3 .....	NM
14KCS1 .....	NM
14KCS2 .....	NM
14KCS3 .....	NM
16KCS2 .....	NM
16KCS3 .....	NM
16KCS4 .....	NM
16KCS5 .....	NM
18KCS2 .....	35-0
18KCS3 .....	NM
18KCS4 .....	NM
18KCS5 .....	NM
20KCS2 .....	36-0
20KCS3 .....	39-0
20KCS4 .....	NM
20KCS5 .....	NM
22KCS2 .....	36-0
22KCS3 .....	40-0
22KCS4 .....	40-0
22KCS5 .....	40-0
24KCS2 .....	39-0
24KCS3 .....	40-0
24KCS4 .....	40-0
24KCS5 .....	40-0
26KCS2 .....	39-0
26KCS3 .....	40-0
26KCS4 .....	40-0
26KCS5 .....	40-0
28KCS2 .....	40-0
28KCS3 .....	40-0
28KCS4 .....	40-0
28KCS5 .....	40-0
30KCS3 .....	40-0
30KCS4 .....	40-0
30KCS5 .....	40-0

NM=diagonal bolted bridging not mandatory for joists under 40 feet.

TABLE B.—ERECTION BRIDGING FOR LONG SPAN JOISTS

Joist	Span
18LH02 .....	33-0.
18LH03 .....	NM.
18LH04 .....	NM.
18LH05 .....	NM.
18LH06 .....	NM.
18LH07 .....	NM.
18LH08 .....	NM.
18LH09 .....	NM.
20LH02 .....	33-0.
20LH03 .....	38-0.
20LH04 .....	NM.
20LH05 .....	NM.
20LH06 .....	NM.
20LH07 .....	NM.

TABLE B.—ERECTION BRIDGING FOR LONG SPAN JOISTS—Continued

Joist	Span
20LH08	NM.
20LH09	NM.
20LH10	NM.
24LH03	35-0.
24LH04	39-0.
24LH05	40-0.
24LH06	40-0.
24LH07	40-0.
24LH08	40-0.
24LH09	40-0.
24LH10	40-0.
24LH11	40-0.
28LH05	40-0.
28LH06	40-0.
28LH07	40-0.
28LH08	40-0.
28LH09	40-0.
28LH10	40-0.
28LH11	40-0.
28LH12	40-0.
28LH13	40-0.
32LH06	40-0 through 60-0.
32LH07	40-0 through 60-0.
32LH08	40-0 through 60-0.
32LH09	40-0 through 60-0.
32LH10	40-0 through 60-0.
32LH11	40-0 through 60-0.
32LH12	40-0 through 60-0.
32LH13	40-0 through 60-0.
32LH14	40-0 through 60-0.
32LH15	40-0 through 60-0.
36LH07	40-0 through 60-0.
36LH08	40-0 through 60-0.
36LH09	40-0 through 60-0.
36LH10	40-0 through 60-0.
36LH11	40-0 through 60-0.
36LH12	40-0 through 60-0.
36LH13	40-0 through 60-0.
36LH14	40-0 through 60-0.
36LH15	40-0 through 60-0.

NM = diagonal bolted bridging not mandatory for joists under 40 feet.

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(e) *Landing and placing loads.* (1) During the construction period, the employer placing a load on steel joists shall ensure that the load is distributed so as not to exceed the carrying capacity of any steel joist.

(2) Except for paragraph (e)(4) of this section, no construction loads are allowed on the steel joists until all bridging is installed and anchored and all joist-bearing ends are attached.

(3) The weight of a bundle of joist bridging shall not exceed a total of 1000 pounds (454 kg). A bundle of joist bridging shall be placed on a minimum of 3 steel joists that are secured at one end. The edge of the bridging bundle shall be positioned within 1 foot (.30 m) of the secured end.

(4) No bundle of decking may be placed on steel joists until all bridging has been installed and anchored and all joist bearing ends attached, unless all of the following conditions are met:

(i) The employer has first determined from a qualified person and documented in a site-specific erection plan that the structure or portion of the structure is capable of supporting the load;

(ii) The bundle of decking is placed on a minimum of 3 steel joists;

(iii) The joists supporting the bundle of decking are attached at both ends;

(iv) At least one row of bridging is installed and anchored;

(v) The total weight of the decking does not exceed 4000 pounds (1816 kg); and

(vi) The edge of the bundle of decking is placed within 1 foot (.30 m) of the bearing surface of the joist end.

(5) The edge of the construction load shall be placed within 1 foot (.30 m) of the bearing surface of the joist end.

**§ 1926.758 Pre-engineered metal buildings.**

(a) Erection of pre-engineered metal buildings shall not begin until the site

layout has been completed in accordance with § 1926.752(b).

(b) Each column shall be anchored by a minimum of 4 anchor bolts.

(c) Rigid frames shall have 50 percent of their bolts or the number of bolts specified by the manufacturer (whichever is greater) installed and tightened on both sides of the web adjacent to each flange before the hoisting equipment is released.

(d) Construction loads shall not be placed on any structural steel framework unless such framework is safely bolted, welded or otherwise adequately secured.

(e) In girt and eave strut to frame connections, when girts or eave struts share common connection holes the following shall apply:

(1) At least one bolt with its wrench-tight nut shall remain connected to the second member unless a field-attached seat or similar connection device is present to secure the first member so



that the girt or eave strut is always secured against displacement; and

(2) The seat or similar connection device shall be provided by the manufacturer of the girt or eave strut.

(f) Both ends of all steel joists or cold-formed joists shall be fully bolted and/or welded to the support structure before:

(1) Releasing the hoisting cables;

(2) Allowing an employee on the joists; or

(3) Allowing any construction loads on the joists.

(g) Purlins and girts shall not be used as an anchorage point for a fall arrest system unless written direction to do so is obtained from a qualified person.

(h) Purlins may only be used as a walking/working surface when installing safety systems, after all permanent bridging has been installed and fall protection is provided.

(i) Construction loads may be placed only within a zone that is within 8 feet (2.5 m) of the centerline of the primary support member.

#### § 1926.759 Falling object protection.

(a) *Securing loose items aloft.* All materials, equipment, and tools, which are not in use while aloft, shall be secured against accidental displacement.

(b) *Overhead protection.* The controlling contractor shall ensure that no other construction processes take place below steel erection unless adequate overhead protection for the employees below is provided.

#### § 1926.760 Fall protection.

(a) *General requirements.* (1) Except as provided by paragraph (a)(3) of this section, each employee covered by this subpart who is on a walking/working surface with an unprotected side or edge more than 15 feet (4.6 m) above a lower level shall be protected from fall hazards.

(2) Protection from fall hazards required by this subpart shall consist of perimeter safety cable systems, guardrail systems, safety net systems, or personal fall arrest or fall restraint (positioning device) systems. Guardrail systems, safety net systems, personal fall arrest systems and fall restraint (positioning device) systems shall conform to the criteria set forth in § 1926.502.

(3) Connectors and employees working in controlled decking zones shall be protected from fall hazards as provided in paragraphs (b) and (c) of this section, respectively.

(b) *Connectors.* Each connector shall:

(1) Be protected from fall hazards of more than two stories or 30 feet (9.1 m) above a lower level, whichever is less;

(2) Have completed connector training in accordance with § 1926.761; and

(3) Be provided, at heights over 15 and up to 30 feet above a lower level, with a personal fall arrest or fall restraint (positioning device) system and wear the equipment necessary to be able to be tied off; or be provided with other means of protection from fall hazards in accordance with paragraph (a)(2) of this section.

(c) *Controlled decking zone (CDZ).* A controlled decking zone may be established in that area of the structure over 15 and up to 30 feet above a lower level where metal deck is initially being installed and forms the leading edge of a work area. In each CDZ, the following shall apply:

(1) Each employee working at the leading edge in a CDZ shall be protected from fall hazards of more than two stories or 30 feet (9.1 m), whichever is less.

(2) Access to a CDZ shall be limited exclusively to those employees engaged in leading edge work.

(3) The boundaries of a CDZ shall be designated and clearly marked. The CDZ shall not be more than 90 feet (27.4 m) wide and 90 feet (27.4 m) deep from any leading edge. The CDZ shall be marked by the use of control lines or the equivalent. Examples of acceptable procedures for demarcating CDZ's can be found in Appendix D to this subpart.

(4) Each employee working in a CDZ shall have completed CDZ training in accordance with § 1926.761.

(5) During initial placement, deck panels shall be placed to ensure full support by structural members.

(6) Unsecured decking in a CDZ shall not exceed 3000 square feet (914.4 m<sup>2</sup>).

(7) Safety deck attachments shall be performed in the CDZ from the leading edge back to the control line and shall have at least two attachments per deck panel.

(8) Final deck attachments and installation of shear connectors shall not be performed in the CDZ.

(d) *Covering roof and floor openings.*

(1) Covers for roof and floor openings required by § 1926.754 (e)(2)(ii) and (e)(2)(iii) shall be capable of supporting, without failure, the greater of either:

(i) 30 psf for roofs and 50 psf for floors; or

(ii) twice the weight of the employees, equipment and materials that may be imposed on the cover at any one time.

(2) All covers shall be secured when installed to prevent accidental displacement by the wind, equipment or employees.

(3) All covers shall be painted with high-visibility paint or shall be marked

with the word "HOLE" or "COVER" to provide warning of the hazard.

(4) Smoke dome or skylight fixtures, which have been installed, are not considered covers for the purpose of this section unless they meet the strength requirements of paragraph (d)(1) of this section.

(e) *Custody of fall protection.* Fall protection provided by the steel erector shall remain in an area to be used by other trades after the steel erection activity has been completed only if the controlling contractor or its authorized representative:

(1) Has directed the steel erector to leave the fall protection in place; and

(2) Has inspected and accepted control and responsibility of the fall protection prior to authorizing persons other than steel erectors to work in the area.

#### § 1926.761 Training.

The following provisions supplement the requirements of § 1926.21 regarding the hazards addressed in this subpart.

(a) *Training personnel.* Training required by this section shall be provided by a qualified person(s).

(b) *Fall hazard training.* The employer shall provide a training program for all employees exposed to fall hazards. The program shall include training and instruction in the following areas:

(1) The recognition and identification of fall hazards in the work area;

(2) The use and operation of perimeter safety cable systems, personal fall arrest systems, fall restraint (positioning device) systems, safety net systems, controlled decking zones and other protection to be used;

(3) The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used;

(4) The procedures to be followed to prevent falls to lower levels and through or into holes and openings in walking/working surfaces and walls; and

(5) The fall protection requirements of § 1926.760.

(c) *Special training programs.* In addition to the training required in paragraphs (a) and (b) of this section, the employer shall provide special training to employees engaged in the following activities.

(1) *Multiple lift rigging procedure.* The employer shall ensure that each employee who performs multiple lift rigging has been provided training in the following areas:

(i) The nature of the hazards associated with multiple lifts; and

(ii) The proper procedures and equipment to perform multiple lifts required by § 1926.753(c).

(2) *Connector procedures.* The employer shall ensure that each connector has been provided training in the following areas:

- (i) The nature of the hazards associated with connecting; and
- (ii) The establishment, access, proper connecting techniques and work practices required by §§ 1926.760(b) and 1926.756(c).

(3) *Controlled decking zone procedures.* Where CDZs are being used, the employer shall ensure that each employee has been provided training in the following areas:

- (i) The nature of the hazards associated with work within a controlled decking zone; and
- (ii) The establishment, access, proper installation techniques and work practices required by §§ 1926.760(c) and 1926.754(e).

**Note to Appendices to Subpart R:** The following appendices to subpart R of this part serve as non-mandatory guidelines to assist employers in complying with the appropriate requirements of subpart R of this part.

**Appendix A to Subpart R—Guidelines for Establishing the Components of a Site-Specific Erection Plan: Non-Mandatory Guidelines for Complying With § 1926.752(d)**

(a) *General.* This appendix serves as a guideline to assist employers who elect to develop a site-specific erection plan in accordance with § 1926.752(d) with alternate means and methods to provide employee protection in accordance with

§§ 1926.752(d), 1926.753(a)(5), 1926.757(a)(3) and 1926.757(e)(4)(i).

(b) *Development of a site-specific erection plan.* Pre-construction conference(s) and site inspection(s) are held between the erector and the controlling contractor, and others such as the project engineer and fabricator before the start of steel erection. The purpose of such conference(s) is to develop and review the site-specific erection plan that will meet the requirements of this section.

(c) *Components of a site-specific erection plan.* In developing a site-specific erection plan, a steel erector considers the following elements:

- (1) The sequence of erection activity, developed in coordination with the controlling contractor, that includes the following:
  - (i) Material deliveries;
  - (ii) Material staging and storage; and
  - (iii) Coordination with other trades and construction activities.
- (2) A description of the crane and derrick selection and placement procedures, including the following:
  - (i) Site preparation;
  - (ii) Path for overhead loads; and
  - (iii) Critical lifts, including rigging supplies and equipment.
- (3) A description of steel erection activities and procedures, including the following:
  - (i) Stability considerations requiring temporary bracing and guying;
  - (ii) Erection bridging terminus point;
  - (iii) Anchor bolt notifications regarding repair, replacement and modifications;
  - (iv) Columns and beams (including joists and purlins);
  - (v) Connections;
  - (vi) Decking; and
  - (vii) Ornamental and miscellaneous iron.

(4) A description of the fall protection procedures that will be used to comply with § 1926.760.

(5) A description of the procedures that will be used to comply with § 1926.759.

(6) A description of the special procedures required for hazardous non-routine tasks.

(7) A certification for each employee who has received training for performing steel erection operations as required by § 1926.761.

(8) A list of the qualified and competent persons.

(9) A description of the procedures that will be utilized in the event of rescue or emergency response.

(d) *Other plan information.* The plan:

- (1) Includes the identification of the site and project; and
- (2) Is signed and dated by the qualified person(s) responsible for its preparation and modification.

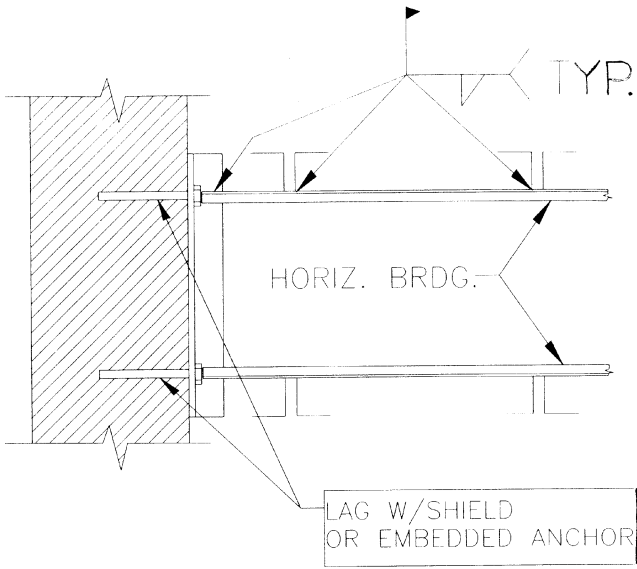
**Appendix B TO Subpart R—Acceptable Test Methods for Testing Slip-Resistance of Walking/Working Surfaces (§ 1926.754(c)(3)) Non-mandatory Guidelines for Complying With § 1926.754(c)(3).**

The following references provide acceptable test methods for complying with the requirements of § 1926.754(c)(3).

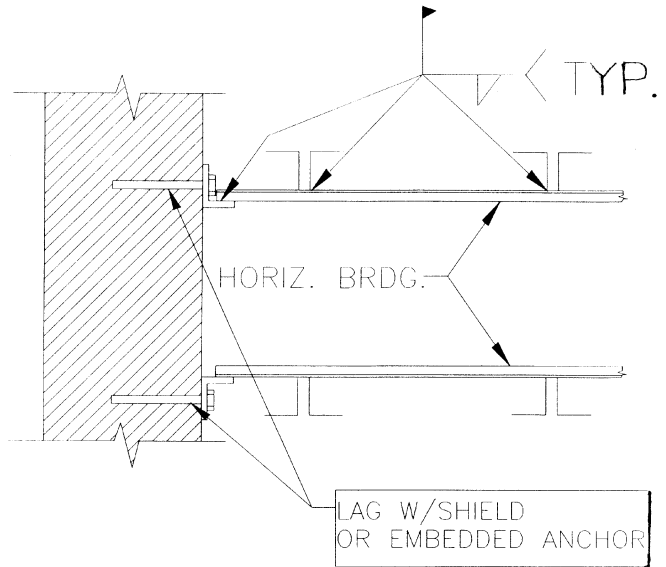
- Standard Test Method for Using a Portable Articulated Strut Slip Tester (PAST) (ASTM F1678–96)
- Standard Test Method for Using a Variable Incidence Tribometer (VIT) (ASTM F1679–96)

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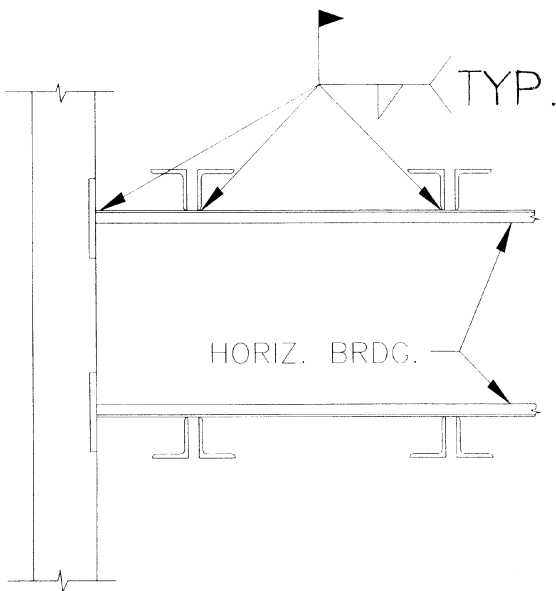
Appendix C to Subpart R—Illustrations of Bridging Terminus Points: Non-Mandatory Guidelines for Complying With § 1926.757(c)(3)



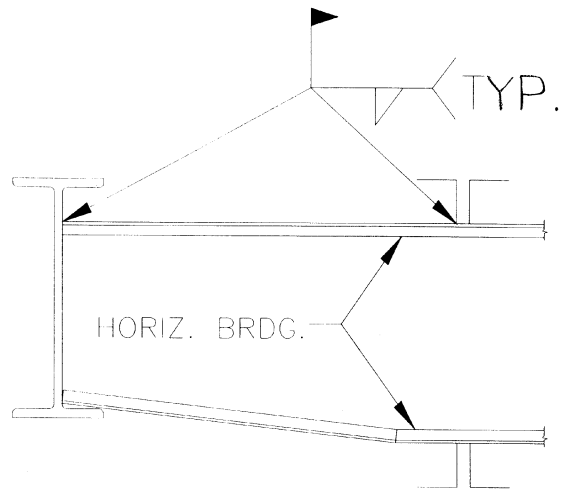
HORIZONTAL BRIDGING TERMINUS AT WALL



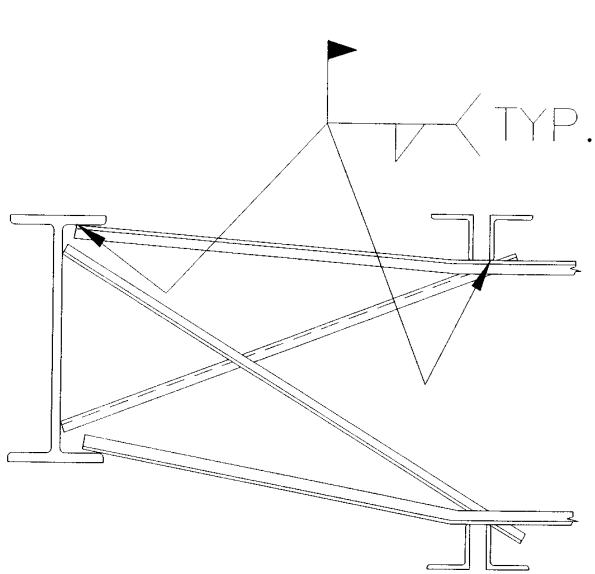
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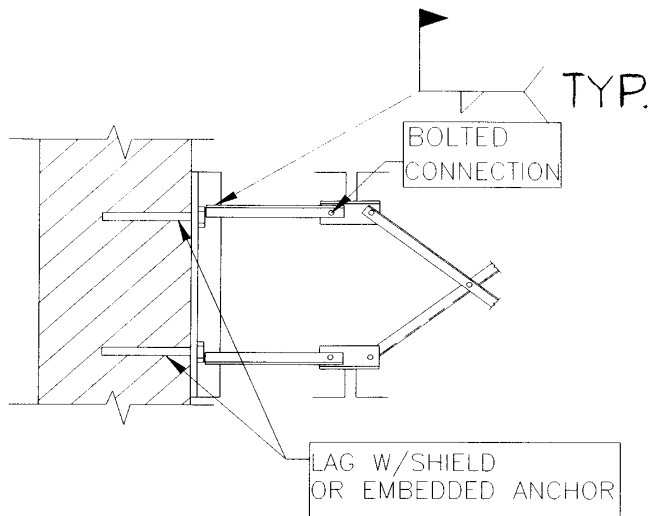
HORIZONTAL BRIDGING TERMINUS AT PANEL WALL



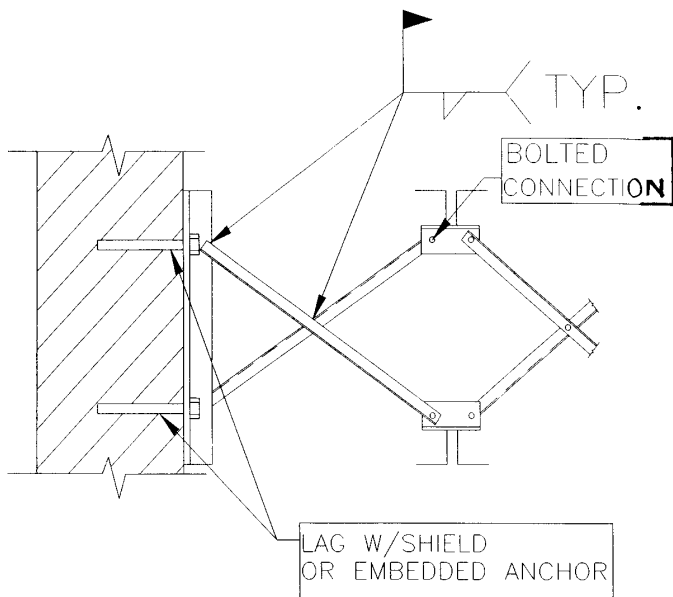
HORIZONTAL BRIDGING TERMINUS AT STRUCTURAL SHAPE



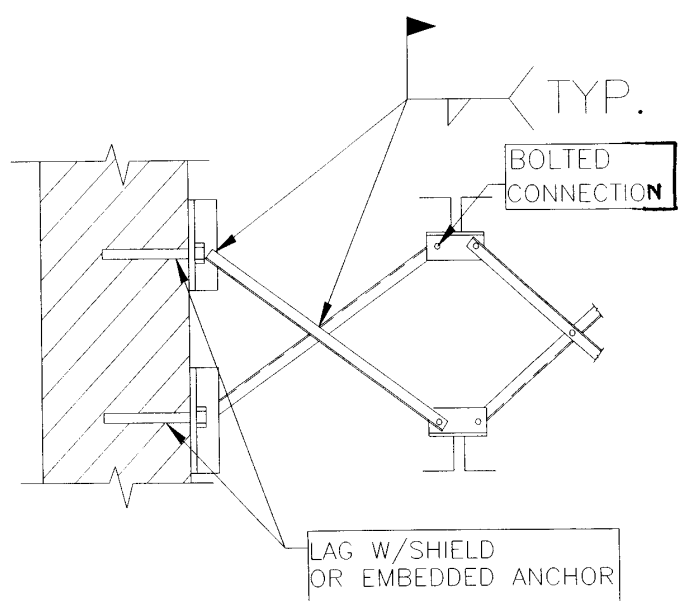
HORIZONTAL BRIDGING  
TERMINUS AT STRUCTURAL  
SHAPE WITH OPTIONAL  
"X-BRIDGING"



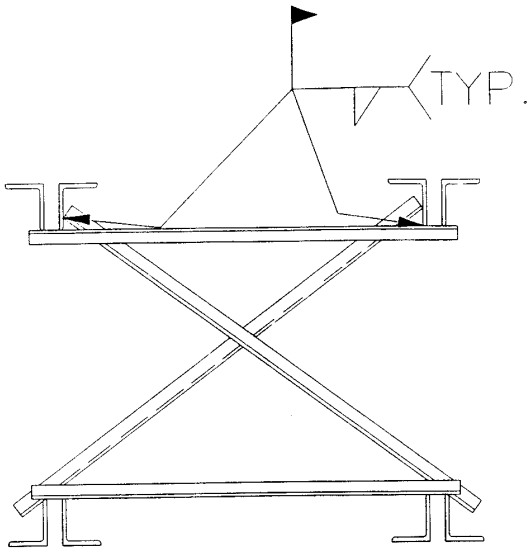
BOLTED DIAGONAL BRIDGING  
TERMINUS AT WALL



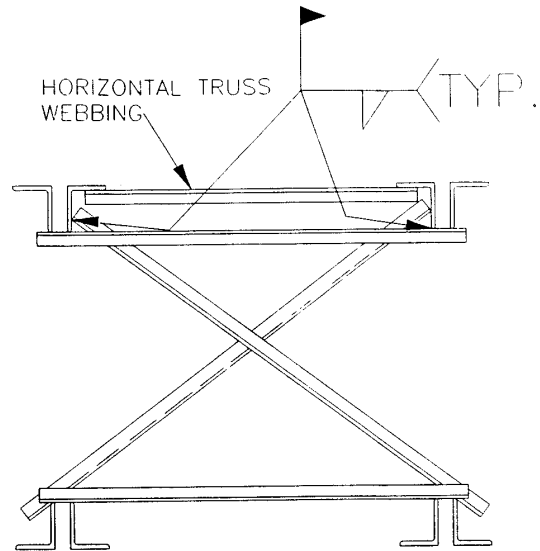
BOLTED DIAGONAL BRIDGING  
TERMINUS AT WALL



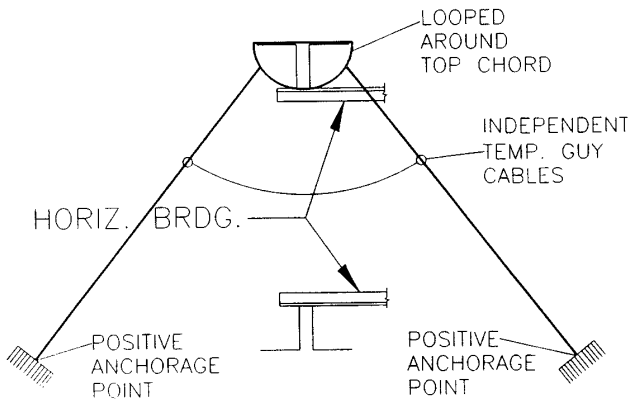
BOLTED DIAGONAL BRIDGING  
TERMINUS AT WALL



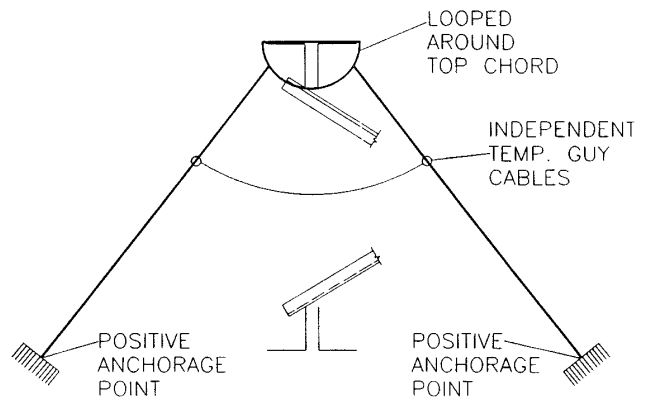
JOISTS PAIR BRIDGING TERMINUS POINT



JOISTS PAIR BRIDGING TERMINUS POINT W/HORIZ. TRUSS



HORIZONTAL BRIDGING TERMINUS POINT SECURED BY TEMP. GUY CABLES



DIAGONAL BRIDGING TERMINUS POINT SECURED BY TEMP. GUY CABLES

**Appendix D to Subpart R—Illustration of the use of Control Lines to Delineate Controlled Decking Zones (CDZs): Non-Mandatory Guidelines for Complying With § 1926.760(c)(3)**

(1) When used to control access to areas where leading edge and initial securement of metal deck and other operations connected with leading edge work are taking place, the controlled decking zone (CDZ) is defined by a control line or by any other means that restricts access.

(i) A control line for a CDZ is erected not less than 6 feet (1.8 m) nor more than 90 feet (27.4 m) from the leading edge.

(ii) Control lines extend along the entire length of the unprotected or leading edge and are approximately parallel to the unprotected or leading edge.

(iii) Control lines are connected on each side to a guardrail system, wall, stanchion or other suitable anchorage.

(2) Control lines consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions as follows:

(i) Each line is rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches (1.0 m) from the walking/working surface and its highest point is not more than 45 inches (1.3 m) from the walking/working surface.

(ii) Each line has a minimum breaking strength of 200 pounds (90.8 kg).

**Appendix E to Subpart R—Training: Non-Mandatory Guidelines for Complying With § 1926.761**

The training requirements of § 1926.761 will be deemed to have been met if employees have completed a training course on steel erection, including instruction in the provisions of this standard, that has been approved by the U.S. Department of Labor Bureau of Apprenticeship.

**Appendix F to Subpart R—Installation of Perimeter Safety Cables: Non-Mandatory Guidelines for Complying with § 1926.756(f) To Protect the Unprotected Side or Edge of a Walking/Working Surface.**

In multi-story structures, the project structural engineer of record (SER) may

facilitate the ease of erecting perimeter safety cables, where structural design allows, by placing column splices sufficiently high so as to accommodate perimeter safety cables located at 42–45 inches above the finished floor. The SER may also consider allowing holes to be placed in the column web, when the column is oriented with the web perpendicular to the structural perimeter, at 42–45 inches above the finished floor and at the midpoint between the finished floor and the top cable. When holes in the column web are allowed for perimeter safety cables, the column splice must be placed sufficiently high so as not to interfere with any attachments to the column necessary for the column splice. Column splices are recommended to be placed at every other or fourth levels as design allows. Column splices at third levels are detrimental to the erection process and should be avoided if possible.

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