

OCCUPATIONAL SAFETY AND HEALTH
STANDARD BOARD

PETITION FILE NO. 561

BOARD STAFF EVALUATION

Submitted by:

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INTRODUCTION

The Occupational Safety and Health Standards Board (Board) received Petition 561 (Petition) from Michael Gunland, CHST (Petitioner) on January 24, 2017. The Petition seeks changes in existing Title 8 Section 1735(v) concerning the protection measures required to prevent mechanical equipment used for demolition work from running over the edge of a floor opening.

BACKGROUND

Title 8 Section 1735(v) sets out requirements intended to prevent mechanical equipment used during building demolition from falling through floor openings. The Petition as submitted on January 24, 2017, proposed to add an engineered cable system as a new requirement within Section 1735(v) in addition to the currently required curbs or stop-logs. The Petition also mentioned that the proposal was to include the cable system as an alternative protection measure. Observing conflicting information in the Petition, Board staff contacted the Petitioner and discussed his intended request. On March 13, 2017, the Petitioner submitted a letter to the Board with revised requested action and proposed text.

REQUESTED ACTION

The Petitioner's requested action is to add an engineered cable system consisting of two wire cables as an alternative to the existing protection measures (curbs or stop-logs) in Section 1735(v). The Petition also proposes specific requirements for the cable system in terms of its design, construction, and calculations performed. The Petitioner's proposed amendment for Section 1735(v) is below in underline-strikeout format:

Subchapter 4. Construction Safety Orders

Article 31. Demolition

§1735. Demolishing Buildings.

(v) Where mechanical equipment is used for demolition work, floor openings shall ~~have curbs or stop-logs to prevent equipment from running over the edge.~~ meet one of the following requirements:

(1) Curbs, or stop-logs shall be installed to prevent mechanical equipment from running over the edge,
or

(2) A cable system consisting of two wire ropes shall be designed by a registered professional engineer, and of such construction to prevent the equipment from falling into the opening.

(A) Calculations for a cable system must include;

1. The specific location in a structure, and for a specified equipment traveling at a certain speed.

2. The size of the wire ropes for each specific location in a structure to satisfy the requirement that the equipment is prevented from falling over.

PETITIONER'S ASSERTIONS

The Petitioner is relying primarily on information from the National Demolition Association (NDA) for the assertions made in the Petition. The NDA believes the cable system is equal or superior to the stop-log design and provides a safe method to dispose of materials through floor openings. The Petitioner asserts that the currently used curbs and stop-logs have some disadvantages:

- Curbs and stop-logs would not prevent some of the heavier equipment such as a skid steer from running over the edge and falling through the opening.
- The operator has to raise the bucket in the air to clear the currently required curb/stop-log, which increases the likelihood of the skid steer falling into the opening.
- Any installed barrier/guardrails may have to be removed to allow the skid steer to deposit the material in the opening, and this presents a potential fall hazard.

The Petitioner asserts that the proposed cable system eliminates hazards in the following ways:

- Forward travel of the equipment prevents the skid steer from falling into the floor opening.
- Material can be pushed into the floor opening through the wire rope cables without raising the bucket into the air.
- Since material can be pushed into the floor opening, there will be no need to remove the barriers/guardrails. This eliminates the fall hazard.

In addition, the Petitioner asserts that presently required protection measures (curbs or stop-logs), unchanged since inception, are less adequate than the proposed cable system in restricting the travel of heavier equipment commonly in use today.

STAFF EVALUATION

Board staff reviewed the Petition and accompanying information to evaluate whether adding the proposed cable system as an alternative to curbs or stop-logs in Section 1735(v) would be necessary, and if the proposed cable system would provide safety at least equivalent to that provided by the existing curbs and stop-logs. Staff also reviewed standards, guidelines, and recommendations related to preventing mobile mechanical equipment from running over the edge of a floor opening during demolition operations.

RELEVANT STANDARDS

Federal Standard

Federal 29 CFR 1926.856, provides requirements for removal of walls, floors, and materials using equipment in demolition work, and paragraph 1926.856(b) specifies the protection measures to prevent equipment from running over the edge. 1926.856(b) states, "The floor

openings shall have curbs or stop-logs to prevent equipment from running over the edge.” No other types of protection measures besides curbs or stop-logs have been permitted by the federal standard for many decades. The earliest found reference requiring curbs or stop-logs for this purpose was in a federal final rule adopted in 1979 (Federal Register, Vol 44, No. 29 – Friday, February 9, 1979. page 8672.), and it is a requirement not having changed since.

California Standard

Section 1735(v) specifies requirements for protection measures to prevent equipment running over the edge of floor opening in demolition operations. Like the federal standard, it allows only curbs or stop-logs for this purpose. Section 1735(v) was last revised in 1995. The 1995 revision clarified that the curbs or stop-logs are required on floors where mechanical equipment is in use.

Consensus Standards

American National Standards Institute (ANSI)

Section 10.2 of ANSI A10.6-2006 provides requirement for removing materials through floor openings in demolition operations. Section 10.2.3 does not specifically require use of curbs or stop-logs, and allows for other protective measures including barricades. However, protection requirements in Section 10.2 are not specific to whether the material is being removed by machinery such as a skid steer, a type of front-end loader, or using other methods.

International Building Code (IBC)

Section 406.4.3 of the IBC -2015 requires vehicle barriers where there is potential for a vehicle falling more than one foot. Section 406.4.3 does not require the vehicle barrier to be of a specific type, and allows all forms of vehicle barriers that are compliant to its loading requirements of Section 1607.8.3. Section 406.4.3 is provided for parking structures and garages, and is not specific to demolition operation.

Other Standards, Guidelines, Codes

British Code of Practice

The British Standard (BS) 6187:2011 (enacted by the British government as Code of Practice) provides in its Section 17.5(a) that when machinery is used for demolition work, adequate edge protection and restraint systems need to be provided to prevent machinery from falling down the floor openings. Thus, it does not limit the protection measure to curbs or stop-logs. However, BS 6187:2011 is not a set of mandatory requirements, and provides only guidance and recommendations.

Australian Code of Practice

Section 4.6 of the Australian Code of Practice for Demolition Work (enacted by the Australian government) requires the floor openings to be protected by an adequate “vehicle buffer”

during the removal of debris by machinery. It also requires the vehicle buffer to be high enough to prevent the machinery from riding over, and solid enough to stop the loaded machinery. Like the preceding BS, this Code of Practice allows for all types of protection measures including curbs or stop-logs. However, it is also not mandatory, and provides only guidance and recommendations.

Federal OSHA's Letter

In the letter attached to the petition as EXHIBIT A, Federal OSHA outlines its review of the proposed cable system to indicate that the use of wire cables could potentially prevent equipment from running over the edge of an opening, provided:

- The cable system is specific for a certain location in a structure and for specified equipment traveling at a certain speed.
- The wire ropes are designed for each specific location in the structure to prevent the mechanical equipment from falling over.
- The cable barrier is designed by a structural engineer.
- The design documents contain the signature and seal of a registered engineer.

Per the EXHIBIT A letter, Federal OSHA's acceptance of the proposed cable system as an alternative to curbs or stop-logs is strictly conditional upon location-specific design that is for specified equipment travelling at a certain speed, and approved by a registered structural engineer.

Position of Division

The Division provided its evaluation of this petition in a memo from Juliann Sum, dated April 25, 2017. The Division concludes that although the protective cable systems have the potential to prevent mechanical equipment from running over the edge of floor openings, effectively controlling the work environment to conform to the many limitations of these systems would be problematic. The Division believes this Petition should be denied.

Analysis

Protective Cable System as an Option to Curbs or Stop-Logs

Curbs and stop-logs have been the most common types of restraint and barrier systems used on floor openings in demolition operations to prevent mechanical equipment from running over the edge of floor opening and falling through. They have been demonstrated to provide the required protection, and are the only measures allowed in Section 1735(v); however, they may not be the only feasible means that can prevent heavy mechanical equipment from falling through floor openings.

The protection measures required in Section 1735(v) do not allow for any options other than curbs or stop-logs. The earliest reference found on the requirement for curbs or stop logs is in

a federal final rule from 1979 (Federal Register, Vol 44, No. 29 – Friday, February 9, 1979, page 8672.) The reference to curbs or stop-logs in the Section 1735(v) already existed when the standard was revised in 1995 to reference the use of mechanical equipment. Both consensus standards (ANSI and IBC), and the two guidelines (British Code of Practice and Australian Code of Practice) do not limit the protection measures to only certain types and allow for options in protection measures. Board staff believes the state standard might benefit from taking into account technological changes and advances, and allowing alternative protection measures in addition to the existing curbs or stop-logs.

Petitioner's Proposed Protective Cable System

The Petitioner's proposed protection measure is an engineered cable system consisting of two wire rope cables. The cable system was conceptualized by the member companies belonging to the National Demolition Association (NDA), and is supported by NDA's Safety Committee.

Board staff notes the following regarding the Petitioner's proposal to add a cable system as an alternative to the existing means:

- The proposal would add a new alternative, and thus provide flexibility to employers.
- It considers an alternate technology, and thus allow for technological changes and advances.
- It would continue to allow employers to use the curbs and stop-logs, therefore, does not impact California employers' current practice for safety.

Even though the Applicant's proposal to add a protective cable system as an alternative to the curbs and stop-logs may have merit, Board staff does not find the two wire rope cable system as proposed by the Petitioner having demonstrated protection equivalent to curbs and stop-logs in terms of its design, construction and installation for the following reasons:

- The proposed design from Conn Engineering uses a beam clamp that has a maximum working load capacity of 25 tons. As this clamp is proof tested to two times the working load, its ultimate strength amounts to 50 tons, and for a planned working load of 16 tons, as provided in Conn Engineering's "Engineering Analysis" sheet, Board staff calculates the safety factor be only slightly over 3 (50 divided by 16). Section 1710(d)(2)(B) requires a safety factor of 5 five for all components of the multiple lift rigging assembly. In staff's opinion, the force exerted by the heavy equipment on the protective cable and the beam clamps cannot be considered less hazardous in terms of the clamps ability to withstand impact than the forces exerted on the beam clamps when hoisting and rigging multiple lift assemblies used in structural steel erection (Section 1710). Therefore, Board staff finds the beam clamp used in Conn Engineering's design may not be adequate for safety.

- Conn Engineering's design does not take into account floor slopes, a key operating variable that can be a major concern in demolition operations. An inclined slope can potentially render the working load more hazardous.
- The proposed design assumes that the load will be applied at the center of the cable span and horizontally, which is not always going to be the case in practical use.
- The design does not account for the elevated center of gravity due to lifting of the bucket for removal of materials that cannot be pushed through.

For these reasons, and in the absence of a comprehensive evaluation based on all variables and constraints, Board staff is unable to verify the Petitioner's claim that the two wire cable system as proposed is adequate for safety or provides protection equivalent to that provided by the curbs or stop-logs.

The Petitioner describes the advantages of the proposed cable system over the curbs and stop-logs. However, Board staff could not substantiate most of the assumptions provided by the Petitioner for reasons discussed below:

- The Petitioner claims that the proposed cable system eliminates the raising of the bucket into the air. Board staff disagrees with this claim since not all types of materials for removal can be pushed into the floor opening without raising the load when the cables are in place. There will be a need to raise the load over the cables even with the proposed cable system.
- Board staff disagrees with the Petitioner's claim that curbs and stop-logs are less adequate than the proposed cable system in restricting the travel of heavier equipment. Curbs and stop-logs come in different shapes, sizes and capacities. When needed, custom curbs and stop-logs can be designed and constructed to meet the needs of the heavier equipment.
- The Petitioner claims that the proposed cable system eliminates the need for guardrails or barriers. Section 1620(a) requires guardrails to have the top rail at 42 to 45 inches height and a mid-rail half way between, but the two cables of the proposed system do not satisfy this requirements as the cables are installed at the heights of 48 and 72 inches.
- Board staff finds the requirement for two cables in the Petitioner's proposal restrictively prescriptive. Since demolition operations in California currently utilize only curbs or stop-logs, staff explored other operations to find out if any protection measures other than the curbs and stop-logs were used to prevent equipment from running over the edge of a floor opening. Staff found that cable systems are sometimes used as vehicle barrier systems in parking garages where a vehicle has a potential to go over the edge of a floor. The IBC has loading requirements for these cable systems and does not specifically require a fixed number of wire cables in their installations. An article

reviewed by staff mentions use of cable systems with seven and 11 barrier cables¹. This leads staff to believe that cable systems are adaptable as they can be designed to have different number of cables other than the two specifically proposed by the Petitioner.

Petitioner's Proposed Amendment to Section 1735(v)

The Petitioner proposes specific requirements for the design, construction, and calculations for the cable system. Board staff believes these elements are key to safety, and need to be covered appropriately in any new regulation concerning an engineered barrier system like the proposed protective cable system.

Design:

Subsection v(2) of the Petitioner's proposal requires the cable system to be designed by a registered professional engineer. Federal OSHA concludes in its letter that the cable system needs to be designed by a registered structural engineer. Board staff agrees with Federal OSHA's conclusion. A registered structural engineer's design is expected to consider all variables and constraints, operational and environmental conditions, and regulatory requirements, including the safety factors. Staff agrees with Federal OSHA's conclusion that the design should be conditional upon a location-specific design that is for specified equipment travelling at a certain speed; however, believes the design should include other variables such as floor slope, elevated center of gravity due to lifting of the bucket for removal of materials that cannot be pushed through, location and angle of the force applied on the cables, and other elements considered relevant by the engineer. The design should also consider safety factor that is adequate for all involved components.

Construction:

Subsection v(2) of Petitioner's proposal requires the cable system to be constructed in such a way that it can prevent mechanical equipment from running over the edge of a floor opening. Board staff agrees with this performance requirement; however, considers the requirement not adequately protective. Staff believes the cable system must be approved for construction and installation to provide safety at least equivalent to that provided by the curb or stop log. Requiring proper approval ensures at least equivalent protection through quality assurance in construction and installation of the cable system.

Calculations:

The Petitioner's proposed text requires the calculations performed to be specific to the work location, type of equipment in use, and the equipment's speed. In addition, it also requires the calculations for the size of the wire ropes to be specific for the work location. Board staff agrees with these requirements for calculations. Staff also agrees that the size (diameter) and breaking strength of the wire ropes must be such that equipment is prevented from falling through the

¹ Rogers, J., Design of pre-stressed barrier cable systems, Technical Notes, Post Tensioning Institute, Issue 14, December 2004, <http://www.post-tensioning.org/Uploads/Technote14.pdf>.

floor opening. However, staff also believes other variables such as floor slope, center of gravity, location and angle of force applied on the cable, etc., all site-specific constraints and conditions, and safety factors must also be considered.

Both the Board and Division have identified deficiencies and expressed concern on several aspects of the Petitioner's proposed protective cable system.

In conclusion, Board staff finds that the Petitioner's recommendation to add a protective cable system as an alternative to the curbs or stop-logs may have merit. However, the two wire cable system has deficiencies and the proposed regulatory language for Section 1735(v) is not demonstrated to be adequately protective.

STAFF RECOMMENDATION

Board staff recommends the Petition as presented by the Petitioner be DENIED. However, the idea of adding a protective cable system as an alternative to the existing curbs and stop-logs in Section 1735(v) may have merit, even though the Petitioner's proposed two wire cable system is not demonstrated to be adequately protective. Staff believes that with further evaluation by an entity such as the National Institute for Occupational Safety and Health (NIOSH) or the NDA, and experimentation trials as might be accomplished via the Division's temporary/experimental variance process as provided by Labor Code Section 6452, the Petitioner could return to the Board in the future with a new petition request for consideration of a protective cable system.