



ANSI E1.46 — 2018

STANDARD FOR THE PREVENTION OF FALLS FROM THEATRICAL STAGES AND RAISED PERFORMANCE PLATFORMS

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Interest category codes:

CP = custom-market producer
DE = designer
DR = dealer rental company
G = general interest
MP = mass-market producer
U = user

Table of Contents

| | |
|--|-----|
| NOTICE AND DISCLAIMER..... | ii |
| Investors in Innovation..... | iv |
| Contact Information..... | vi |
| Acknowledgments..... | vii |
| 1 Scope (mandatory)..... | 1 |
| 2 Problem (informative)..... | 1 |
| 2.1 Fall protection is needed..... | 1 |
| 2.2 Adequate fall protection often is not provided..... | 1 |
| 3 Solution..... | 1 |
| 3.1 Purpose of this Standard (informative)..... | 1 |
| 3.2 Language used in this Standard (mandatory)..... | 1 |
| 3.3 Definitions (mandatory)..... | 1 |
| 3.4 Requirements (mandatory)..... | 2 |
| 3.4.1 Stages and raised performance platforms shall have a fall protection plan..... | 2 |
| 3.4.2 The fall protection plan shall be implemented..... | 2 |
| 3.4.3 The fall protection plan shall be evaluated on a regular schedule..... | 3 |
| 3.4.4 The fall protection plan shall be revised for improvement..... | 3 |
| 3.4.5 The fall protection plan shall be documented..... | 3 |
| 4 General guidance (informative)..... | 3 |
| 4.1 Use risk assessment..... | 3 |
| 4.1.1 General..... | 3 |
| 4.1.2 Identify the affected parties..... | 3 |
| 4.1.3 Identify the hazards..... | 3 |
| 4.1.4 Assess and rank the risk..... | 4 |
| 4.1.5 Record the risk assessment..... | 5 |
| 4.2 Design a fall protection plan to control the risk..... | 5 |
| 4.2.1 Consider the hierarchy of controls in developing the plan..... | 5 |
| 4.2.2 The fall protection plan should be reasonable..... | 6 |
| 4.2.3 Share the plan with others and revise as necessary..... | 6 |
| 4.3 Implement the fall protection plan..... | 6 |
| 4.3.1 Buy and install needed equipment..... | 6 |
| 4.3.2 Train the people needing to be trained..... | 6 |
| 4.3.3 Train and retrain people as needed..... | 6 |
| 4.3.4 Enforce the use of the plan..... | 6 |
| 4.4 Review and revise the plan to improve it..... | 6 |
| 4.4.1 Review and revise the plan on a regular basis..... | 6 |
| 4.4.2 Review and revise the plan if the venue or the people using it change significantly..... | 6 |
| 4.4.3 Review and revise the plan whenever a fall occurs or almost occurs..... | 7 |
| 5 Specific guidance (informative)..... | 7 |
| 5.1 The front edge of the stage..... | 7 |
| 5.1.1 Elimination or substitution of the fall hazard..... | 7 |
| 5.1.2 Engineering controls to isolate the hazard..... | 8 |
| 5.1.2.1 Standard guardrails..... | 8 |
| 5.1.2.2 Other barriers..... | 8 |
| 5.1.2.3 Fire safety curtains..... | 9 |
| 5.1.3 Administration: implementation of safe work practices, procedures, and policies..... | 9 |
| 5.1.3.1 Performer Blocking as protection..... | 9 |
| 5.1.3.2 Stage edge marking..... | 9 |
| 5.1.3.3 Safe passage marking..... | 10 |
| 5.1.3.4 Escorts..... | 10 |

| | |
|---|----|
| 5.1.3.5 Verbal warnings and signage..... | 10 |
| 5.1.4 Personal protective equipment..... | 10 |
| 5.2 Raised performance platforms..... | 10 |
| 5.3 Orchestra Pit Bridges and Passerelles..... | 10 |
| 5.4 Traps and holes in the stage floor..... | 11 |
| 5.5 Stage lifts..... | 11 |
| 5.6 Choral and orchestra risers..... | 11 |
| Annex A (Informative) – Federal OSHA Regulations..... | 12 |
| 29 CFR 1910.28, Duty to have fall protection and falling object protection. (general industry)..... | 12 |
| 29 CFR 1926.501, Duty to have fall protection. (construction industry)..... | 14 |
| 29 CFR 1926.502 Fall protection systems criteria and practices. (construction industry)..... | 14 |
| 29 CFR 1926.503 Training requirements. (construction industry)..... | 23 |
| Annex B (Informative) – Example Of An Orchestra Lift Safety Program..... | 25 |
| Annex C (Informative) – Example of a Plan for Installing an Apron Extension..... | 26 |
| Annex D (Informative) – Selected Building Code Requirements..... | 28 |

1 Scope (mandatory)

This Standard offers guidance to people working in the entertainment industry on preventing falls by performers, technicians, and members of the public from theatrical stages and raised performance platforms into orchestra pits, into audience areas, into stage traps, and from raised surfaces to surfaces that are lower. Its guidance is intended to be applied to stages and raised platforms used for performance of a show or event to an audience. It is not intended to offer guidance for fall protection in off-stage areas or audience spaces, such as theatre lobbies, although the recommendations in this Standard may be used in those areas at the discretion of the reader. The guidance offered in this Standard may be applied on a per show basis or to a performance venue.

2 Problem (informative)

2.1 Fall protection is needed

Management, supervisors, and workers have a responsibility to ensure that all persons are kept safe from fall hazards. Workplace health and safety regulations in virtually all industrialized nations require this, but it is also good management. Falls and the injuries that result are expensive in money and time. Even when there is no significant injury, a fall stops a show, stops work, and generally wastes time and damages morale.

2.2 Adequate fall protection often is not provided

Because a standard guardrail historically has not been installed across the front of a stage, and because a guardrail would be visibly obtrusive in most stage shows, there is the common perception that stages and raised performance platforms are special places where fall protection is not needed. The expectation is that people understand that the edge of a stage or raised platform, or an open trap in a stage floor, is a danger and will take appropriate action to protect themselves. This expectation is often proven to be unfounded, with expensive results.

3 Solution

3.1 Purpose of this Standard (informative)

The purpose of this Standard is to encourage people in safety management positions to accept their responsibility to provide fall protection against falls from stages and raised performance platforms for all the people whom they might need to protect in an entertainment venue. The purpose of this Standard also is to help them successfully fulfill that responsibility. It lays out what is required to provide this protection, and offers suggestions on some of the methods that might be used.

This Standard is not written as a compliance or enforcement document.

3.2 Language used in this Standard (mandatory)

3.2.1 "Shall," "shall not," and "shall not be" indicate mandatory requirements.

3.2.2 "Should" indicates something that is recommended but not mandatory. "Should not" indicates something that is not recommended but that is not prohibited.

3.3 Definitions (mandatory)

Competent Person: a person who is capable of identifying existing and predictable hazards in the workplace, and who is authorized to take prompt corrective measures to eliminate hazards.

Orchestra pit bridge: in a theatre, a narrow walkway that extends over the orchestra pit from the stage.

Passerelle: in a theatre, a narrow walkway that extends from the stage and that encircles the orchestra pit, separating the pit from the auditorium.

Performer Blocking: how the performers are placed and move around on the stage during rehearsals or performances of a play, dance, or other entertainment event.

Qualified Person: a person who by possession of a recognized degree or certificate of 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 and work.

Raised performance platform: an area raised above the surrounding floor area that functions as a stage.

Reasonable: an action or specification that would be considered both adequate and moderate under the circumstances by a Qualified Person.

Safety Monitoring System: a fall protection system in which a competent person is present and is responsible for recognizing and warning other people of imminent fall hazards.

Stage: a space within an assembly occupancy or outdoor assembly area that is used by entertainers, politicians, or public speakers to offer entertaining acts or speeches for the benefit of an observing audience.

3.4 Requirements (mandatory)

3.4.1 Stages and raised performance platforms shall have a fall protection plan

3.4.1.1 The management of performance venues or of theater production companies shall ensure that a fall protection plan be developed, documented, implemented and evaluated for theatrical stages and raised performance platforms that are under their jurisdiction or control.

3.4.1.2 The fall protection plan shall provide reasonable measures to protect employees, volunteers, visitors, and members of the public from falls from stages and raised performance platforms to lower levels, such as an orchestra pit, first row of the auditorium, or a lower stage level, or into open stage traps.

3.4.1.3 The fall protection plan shall be developed for all the operating modes of the stage or performance platform, including, but not limited to:

- Unoccupied with no production on stage or in residence
- Unoccupied with production on stage or in residence (e.g., overnight or non-working days)
- Move-in or setup
- Move-out or strike
- Rehearsal
- Dress rehearsal
- Technical rehearsal
- Performance
- Maintenance or work call
- Visitor to site to perform task or observe activities
- Tours of facility
- Public/audience access (e.g., award shows, receptions on-stage)

3.4.1.4 The fall protection plan shall be effective at all times: 24 hours a day, every day of the year.

3.4.1.5 The fall protection plan may be developed on the basis of serving a performance venue regardless of particular shows or events that are occurring in the venue, or it may be developed for a particular show or event, but there always shall be a fall protection plan in effect for a stage or raised performance platform that provides reasonable protection whenever there is the possibility of any person falling from a higher floor level to a lower level.

3.4.2 The fall protection plan shall be implemented

3.4.2.1 Equipment needed to implement the plan shall be installed.

3.4.2.2 People needing training to implement the plan shall be trained.

3.4.2.3 People needing to be assigned specific tasks to implement the plan shall be assigned those tasks.

3.4.2.4 People with assigned tasks shall perform them.

3.4.3 The fall protection plan shall be evaluated on a regular schedule

3.4.3.1 The fall protection plan shall be evaluated annually or more frequently on a regular basis.

3.4.3.2 The fall protection plan shall be evaluated whenever a fall occurs that the plan was designed to prevent.

3.4.3.3 The fall protection plan shall be evaluated whenever the hazard conditions change.

3.4.4 The fall protection plan shall be revised for improvement

3.4.4.1 The fall protection plan and its implementation shall be reviewed and revised based on the results of the evaluations done per 3.4.3 and its subclauses.

3.4.4.2 Revisions to the fall protection plan shall be implemented quickly, not more than 14 days after the revision is finalized for non-critical changes, but before the next authorized use of the stage or raised performance platform if the risk needing mitigation is extreme.

3.4.5 The fall protection plan shall be documented

4 General guidance (informative)

4.1 Use risk assessment

4.1.1 General

Start with a risk assessment to determine what fall risks there might be and their severity. The risk assessment will allow you to prioritize which risks are most in need of reduction or elimination. The risk assessment should be performed for all possible stage or platform conditions, including the unoccupied facility, move-in, move-out, and performance. The risk assessment might be one large document or multiple documents covering the different uses or operating modes of the stage or performance platform.

Information on risk assessment can be found many places. One source is the ASSE's Risk Assessment Institute on the Institute's website <http://www.oshrisk.org>. More information also is available in *Safe Stages Best Practices*, Theatre Alberta (2007); *A Practical Guide to Health and Safety in the Entertainment Industry*, Marco van Beek (2000); and other publications.

4.1.2 Identify the affected parties

The risk assessment needs to identify the at-risk persons and the risk. Identifying those at risk will help you avoid overlooking some people at risk, such as delivery people who might cross a stage to make a delivery to a production office. What constitutes reasonable risk remediation depends at least partially on who is at risk. Risk remediation for an open stage trap might include training for performers and technicians, but training would be impractical for protecting people who are not part of the theatre or production staff.

4.1.3 Identify the hazards

Within the theatre industry, hazards should be identified and assessed on three levels:

- for the facility/venue/worksite
- for each department (Wardrobe, Props, Scenic Construction, Scenic Art, Stage, Front of House, etc.)
- for each production and the activities involved

In its simplest form, a hazard assessment answers the question "What if ...?"

- there isn't a guardrail on the staircase where the sword fight takes place?
- the actors are late to their positions at the top of the act and rush onstage?

- the carpenters need to do last-minute touch-ups on the set just before curtain?
- the electricians have to do a last minute refocus or relamp?
- the janitor has to access the supplies closet on stage left to service the toilets on stage right, and does this late at night after the show?

There are a number of ways to identify hazards:

- **walk around** the worksite and look at how work is done
- **ask** technicians and performers at the venue what they consider unsafe
- **think** about what could possibly go wrong, being sure not to overlook things that people may have “worked around” for years
- **review** incidents that have occurred at the venue
- **talk** to others in the industry to find out what hazards they have identified or what sort of incidents they have had

4.1.4 Assess and rank the risk

Hazard recognition and risk assessment are sequential tasks. Recognition of the hazard is the first step. The next step is to determine the severity and likelihood of a possible injury caused by the hazard. Risk is the product of the severity of a hazard times the probability of it happening. Something that would be very bad but unlikely to happen is a lower risk than something that would be not so bad but much more likely.

Once the likelihood and severity of an injury are identified the appropriate steps can be taken to abate the hazard.

Risk assessment and hazard determination are ongoing activities as conditions change. Hazards that were once unlikely may become probable as equipment ages or the use of the equipment or space changes. Risk reduction solutions that were once impractical may become reasonable.

Sample Risk Assessment Table

| | | Severity | | | | |
|--------------------|----------------------|----------------------|--------------|-----------------|--------------|----------------|
| | | Insignificant (1) | Minor (2) | Moderate (3) | Major (4) | Extreme (5) |
| Probability | Very Unlikely (1) | 1 | 2 | 3 | 4 | 5 |
| | Unlikely (2) | 2 | 4 | 6 | 8 | 10 |
| | Possible (3) | 3 | 6 | 9 | 12 | 15 |
| | Probable (4) | 4 | 8 | 12 | 16 | 20 |
| | Very Likely (5) | 5 | 10 | 15 | 20 | 25 |

Low risk 1 – 3
 Moderate risk 4 – 8
 High risk 9 – 14
 Extreme risk 15 – 25

The above "Sample Risk Assessment Table" is one of many possible risk assessment tables. Different tables will have different number ranges and different criteria for separating different risk levels, but all serve the function of helping a person doing a risk assessment rank the risk levels of various hazards. The details of the table used matter little; what matters is that hazards are identified and ranked, so that risks can be addressed in reasonable priority. The risk ranking helps in developing an agenda for what needs to be mitigated first.

In entertainment venues, probability and severity are difficult to establish accurately because there usually is little reliable accident data. That is, people do not fall from stages often enough for one to know that the probability of a person falling during an hour of work is a certain percentage. Nor do they fall and are injured often enough for one to state precise percentage probabilities of death, permanent disability, or multi-week loss of work. However, it is important to try. Simply the attempt, on an intuitive basis, of assessing how likely a fall is to occur and the damage that might come from that fall is often enough to allow an understanding of what must be done. Certainly, making no attempt to assess risk or to control it because too much is unknown would be to neglect a basic duty of care for workers and other people.

4.1.5 Record the risk assessment

The risk assessment should be recorded in a format that is convenient and durable and that can be shared with the affected parties, those people at risk or needing to carry out the risk remediation. Stating the risk assessment in writing is an obvious and usually convenient format, but it might not be appropriate if some of the people needing access to the risk assessment cannot read. Audio or video recordings might be better media in some instances.

4.2 Design a fall protection plan to control the risk

Design a fall protection plan to reduce the risks of the identified hazards.

4.2.1 Consider the hierarchy of controls in developing the plan

In the safety management industry, it is generally understood that some controls to reduce risk are more effective than others, either in that they work better or they are more likely to be reliably implemented. The controls are then ranked in a hierarchy, with the better ones being ranked higher. There are slight differences between the different hierarchies outlined in safety standards, but they generally look like the following:

Elimination or Substitution

Completely eliminate the hazard by removing it, or replace the activity, process, or substance with a less hazardous one

Engineering

Use mechanical aids or guards to isolate the hazard from those who might be hurt.

Administration

Implement safe work practices, procedures, and policies

Personal Protective Equipment

Provide suitable PPE to protect endangered people.

Elimination is obviously the most effective way of reducing the risk of a hazard. It takes it to zero. Using PPE is the least effective because it has to be done properly every time the hazard might be encountered. People get tired, they make mistakes, they take short cuts, and all these things might result in PPE being used ineffectively or not at all. PPE, if it is to be effective, has to work in concert with strong administrative controls.

The hierarchy of controls is a guide, not a set of rigid categories into which every part of a fall protection plan must be made to fit neatly. Some ways of reducing or eliminating a fall risk might fall into two or more categories or require the simultaneous implementation of steps that fit into another category. For example,

fall arrest harnesses and lanyards would be PPE, but they would probably not be used and would be ineffective unless administration steps were taken to require their use.

4.2.2 The fall protection plan should be reasonable

"Reasonable" is a flexible term. There are a great number of things that can be done to protect people from falling from a stage or raised performance platform, but what would seem to be unreasonable in some circumstances, may be perfectly reasonable in others. For example, putting all people on stage in harnesses that are tethered to the back wall of the stage so that they cannot fall into the orchestra pit would probably not be a reasonable fall protection plan for use during a performance. However, at Goodspeed Opera House there is a vertical shaft from the stage to the loading dock three floors below. During a load-out or load-in, those workers near the shaft moving equipment and scenery in or out are indeed tethered so that they cannot fall into the shaft. All other workers are kept well away from the edge. Tethering the workers in this case, during load-in and load-out, is reasonable and effective fall protection.

A reasonable fall protection plan is both adequate and moderate. It does the job, but it requires no more work or effort than is necessary to do the job.

4.2.3 Share the plan with others and revise as necessary

Show the plan to other people, particularly those affected by it, to see if they think it is reasonable and practical. Consider their comments and revise as necessary.

4.3 Implement the fall protection plan

The fall protection plan must be implemented to be effective.

4.3.1 Buy and install needed equipment

If the plan needs equipment, such as guardrails, safety nets, edge-marking paint, procure it and install it.

4.3.2 Train the people needing to be trained

The plan should identify who needs to do what. Make sure they receive adequate training and actually learn what they are being trained to do.

4.3.3 Train and retrain people as needed

As new people come into the venue, they will need training; the training you did last month, before they were on site, will do no good.

Retrain people when it appears that they have forgotten their role in the fall protection plan.

4.3.4 Enforce the use of the plan

Supervisors should be taking notice of whether the fall protection plan is being followed or not. If it is not being followed due to indifference or haste, it needs to be enforced.

If the plan is not being followed because it is impractical or not reasonable, the plan needs to be revised.

4.4 Review and revise the plan to improve it

4.4.1 Review and revise the plan on a regular basis

Determine a reasonable revision schedule and follow it. Once a year is a commonly used frequency, easy to defend if challenged, but more frequently might be appropriate if the use or occupancy of the venue changes frequently.

4.4.2 Review and revise the plan if the venue or the people using it change significantly

Obviously, if the venue changes and that changes the hazards, the fall protection plan will need to be reviewed and possibly revised. However, if the population at risk changes significantly, that also should trigger a review and possible revision. A fall protection plan that is designed for a venue that is only used by old age pensioners probably will not be adequate if that venue expands its use to cover dance recitals by the local children's dance school.

4.4.3 Review and revise the plan whenever a fall occurs or almost occurs

The goal is no falls. If a fall occurs or is narrowly averted, the fall protection plan is not working as intended. Is there a reasonable modification that can be made to avoid a mishap in the future?

5 Specific guidance (informative)

5.1 The front edge of the stage

The front of the stage is an obvious fall hazard. It is a particularly high risk when there is an orchestra pit between the stage and the first row of the audience, but there is still a considerable risk if there is no pit and a person falling would land in the first row of seats.

Reasonable fall protection for the front of the stage changes with the use of the space. For example, a guard rail is effective fall protection when a performance is not going on, but might be visually in the way during a show. Careful Performer Blocking and rehearsal of the show's cast would be effective fall protection during the performance, but would be impractical for protecting audience members called up to the stage during an awards event. There is no one solution for this hazard for all situations other than eliminating the drop from the stage to the floor adjacent and below it.

5.1.1 Elimination or substitution of the fall hazard

Completely eliminating the stage-edge fall hazard by removing it might not be practical. (Can you eliminate the raised stage in a proscenium theatre?) However, sometimes it is possible and often the hazard can be reduced by reducing the possible fall distance, so elimination or substitution should be considered.

In a traveling or outdoor performance situation, is a raised stage necessary? If a performance can be done in front of an audience adequately without setting up platforms, don't set up platforms. Perhaps the audience will be on a hillside looking down on an outdoor playing space; then perhaps no raised stage is necessary. If there needs to be a delineation between the audience and the playing space, perhaps a change of floor or ground surface will suffice. Another alternative is to delineate the playing space with a line on the ground. Mimmers performing at Warwick Castle one summer used a thick rope laid on the grass to delineate the performance space, to separate where they were performing from where the audience could stand or sit.

Reducing the possible fall distance reduces the risk, although it does not eliminate the hazard. It substitutes a lesser risk for a greater one. The impact of a fall is proportional to the distance fallen. That is, a person falling six feet will hit twice as hard as a person falling three feet. Any reduction in possible fall distance, for example, by raising an orchestra pit floor with portable platforms, will reduce the probability of serious injury or death from the fall, although it will not reduce the probability of that fall.

Some theatres have addressed the hazard of falling into the orchestra pit by decking over part of the orchestra pit with expanded metal grating. Sound and air move through the grating, but it is strong enough to support people walking on it. This reduces the probability of someone falling into the pit by leaving only a small opening around where the conductor stands so that his face and arms can be seen by performers on stage. Since the grating is strong enough for people to walk on, experience has shown that people often do walk on the orchestra pit grating during non-performance times, even if it is venue policy that no one shall do this. Walking on the grating creates a fall hazard at the boundary of the orchestra pit grating and the auditorium seating, thus substituting the risk of falling into the audience for the risk of falling into the pit. However, the possible fall distance into the audience seating is much less than the fall distance into the pit, so the grating significantly lowers the overall risk.

Fabric nets also have been used successfully to control the risk of people falling into the orchestra pit. They have the disadvantage over gratings that they sag if someone falls onto one, so adequate space must be allowed below the net for the fall to be arrested before the falling person lands on a musician or the top of a musical instrument. However, they also have the advantage of being difficult to walk on, so few adults would even try to walk across an orchestra pit net. The fall risk at any opening in the net for the conductor is effectively nil: no adult is likely to get close enough to that opening to fall through it. However,

this assumes that the net is being used to protect adults. Children might think the net is a great thing to play on, and other controls will be needed to keep them off the net.

5.1.2 Engineering controls to isolate the hazard

Blocking access to the edge of the stage is an effective way to prevent falls at the stage edge.

5.1.2.1 Standard guardrails

A guardrail system, as defined by the OSHA regulations in 29 CFR 1926.502(b), is an effective way of keeping people from going over the stage edge into the orchestra pit or the first row of the auditorium. Unless the people on the stage willfully climb over or duck under the guardrail, it is a fall protection method that needs little supervision and that will work for almost anybody who is on stage: performers, technicians, visitors, delivery persons, and others completely oblivious to the stage edge fall hazard. Please note, as clause 1926.502(b)(1) says, if you have people onstage wearing stilts or for some other reason are abnormally tall, the standard guardrail height will need to be increased. Forty-two inches is the appropriate top rail height for people of average height. The design load for the guardrail also probably will need to be increased if the people on stage are unusually large or obese. The OSHA regulations are written to protect workers of average height and weight; if you have a special group on stage, you will need to adapt the guardrail system accordingly.

A guardrail system probably will be visibly obtrusive during performance, so it may need to be removable for actual performance, but it can be used much of the time. There is no reason not to have the guardrail in place when a theatre is supposedly vacant, during load-ins and load-outs, during technical work calls, and during initial rehearsals with the cast. After performers have learned their blocking—and assuming that the Performer Blocking does not take the performers perilously close to the stage edge—the guardrail can be removed, with the performers' careful training serving as the key part of the fall protection plan. However, until the performers are trained, training provides no fall protection.

Awards shows are a particular problem. People receiving awards will not have rehearsed walking on and off the stage and may be seriously distracted by the crowd, the honor being bestowed on them, and any celebratory drinks they may have had before the awards ceremony. A standard guardrail is an excellent way of keeping them from falling, but might be considered ugly. Figure out how to make the guardrail look good.

5.1.2.2 Other barriers

Other barriers that do not physically stop people from falling over the edge but that keep them safely away from it may be useful.

In the awards ceremony situation described in 5.1.2.1, scenic decoration on the floor paralleling the forestage edge, such as a flower garland, may be useful to keep people far enough from the edge that they cannot fall over it if they stumble. Six feet is generally considered the minimum safe distance back from a fall hazard, but this distance may need to be more depending on who is being protected and what they might be doing. Tall people (for example, performers on stilts or riding unicycles) or people running will need to be kept further way from the edge.

Crowd control barriers, such as chromed stanchions and velvet ropes, can be good-looking barriers to keep people a safe distance from the stage edge. Utilitarian saw horses may be suitable for work calls. However, since none of these barriers are fixed, procedures will need to be implemented to make sure that people don't move them for convenience with the result that they are moved too close to the stage edge.

Take care that barriers that do not meet the strength requirements of guard rails do not appear to have that strength. People should not be fooled into thinking they can lean on a barrier that will not support them.

In a proscenium theatre with a fire safety curtain system, some people find it useful to stretch a long truck load-strap from smoke pocket to smoke pocket across the proscenium opening. This might bow too much to prevent someone from reaching the stage edge, but it will serve as a tactile reminder to a person that the edge is near if that person bumps against it.

5.1.2.3 Fire safety curtains

The fire safety curtain in a proscenium theatre can be an effective barrier protecting people from the stage edge. The 2013 edition of NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, requires in clause 20.7.1.1 that "The fire safety curtain assembly shall be closed at all times except when there is an event, rehearsal, or similar activity." In NFPA 80 this is a fire protection measure, but it also effectively prevents people on stage from getting too close to the stage edge and falling. It also blocks the stage from the auditorium, so visitors in the auditorium will not be tempted to climb onto the forestage to access the stage, and thus put themselves at risk of falling from the stage edge.

5.1.3 Administration: implementation of safe work practices, procedures, and policies

Carefully planned safe work practices are useful fall protection tools when fall risks cannot be reasonably controlled by elimination, replacement, or engineering controls.

5.1.3.1 Performer Blocking as protection

Performers on stage can be considered protected from a fall during performance if their Performer Blocking is carefully planned and rehearsed so that they never come so close to the stage edge that a misstep will cause them to fall. However, while they are learning the Performer Blocking other protection must be provided. A guardrail system as described in 5.1.2.1 is good protection during early rehearsals. Unless the guardrail is designed into a show's setting, it eventually will be removed; the performers will have to make the transition from having fall protection that requires no effort on their part to a fall protection that requires them to move in prescribed ways.

It may be useful to have a transition period during rehearsals in which a Safety Monitoring System is used. That is, one or more people are given the responsibility of watching the performers rehearsing and verbally warning the performers if they deviate from their Performer Blocking and are in danger of falling. This is not radically different from what deputy or assistant stage managers do normally, but it has the added responsibility of calling out the warnings and not simply noting blocking errors. Furthermore, the safety monitors must have monitoring as their primary task during these rehearsals. See the OSHA regulations starting at clause 1926.502(h) in Appendix A for OSHA's rules on Safety Monitoring Systems in the construction industry.

5.1.3.2 Stage edge marking

Where a fall hazard exists the edge should be clearly marked to be apparent even under poor lighting conditions. Persons exposed to the fall hazard should be fully informed of the hazard and be given an opportunity to become familiar with the hazard and how it is marked.

Stage edge marking can be done with contrasting paint, but that is difficult to see in low-light. Luminous markers may be useful, such as LEDs or fiber-optic points set in or near the floor so as to be visible to those exposed to the fall hazard but not the audience.

Contrasting floor textures are useful when the people needing to be protected cannot see well, whether that is because they are performers wearing masks or temporarily blinded by flashing lights, or because they are people with limited sight. ISO 23599:2012, *Assistive products for blind and vision-impaired persons — Tactile walking surface indicators*, is an international standard for the pavement textures commonly used world-wide to signal safe paths and hazards to people navigating with white canes. *Guidance on the use of Tactile Paving Surfaces*, published by the UK government and available for free download, is a useful, easy to read guide. However, if performers are the only people at risk and needing the non-visual edge-marking, almost any marking scheme can be used, for example a shift from a hard surface to carpet, or a change from a smooth surface to a ribbed one, as long as it is explained and demonstrated to the performers.

Do not create a trip hazard with a tactile edge marking. A footlight trough, for example, will indeed mark the stage edge, but it also might trip a performer, thus assuring that he goes into the orchestra pit head-first.

5.1.3.3 Safe passage marking

In addition to marking a stage edge that is a fall hazard, it may be useful to mark the safe paths or paths a performer can take to exit the stage. An assistant stage manager in the wings with a flashlight is one way to do this. LEDs also have been used with success: red LEDs to mark edges and obstacles to avoid, while green LEDs mark the clear path offstage.

5.1.3.4 Escorts

Escorts who are trained to lead people and to keep them away from a fall hazard may be useful for fall protection, particularly when the people being led might be distracted and a physical barrier is not practical. An example of such a situation would be an awards ceremony, particularly if the winners are not informed in advance of their awards. No rehearsal is then possible, and the winner probably will be thinking about many things but not about the stage edge when getting the award or returning to the auditorium. Escorts stationed at steps from the house to the stage can help lead the people past the hazard safely.

5.1.3.5 Verbal warnings and signage

Verbal warnings and signage are effective in making people aware of fall hazards and instructing them how to protect themselves. They rarely are effective by themselves—that is, it does little good to warn someone about an edge if the edge is obscured in darkness—but they are effective when used with other controls.

Verbal warnings need to be issued judiciously, not continuously. They lose their power when they are heard so often that they become part of the ambient chatter.

5.1.4 Personal protective equipment

Personal protective equipment is at the bottom of the hierarchy of controls, the last choice, but it is the appropriate choice in some instances. For example, if an orchestra pit filler has to be installed from the stage, a guard rail would be in the way, and it is very hard for a person to do the job and not be very close to the stage edge. In this case, personal fall arrest equipment, which will stop the worker's fall if it occurs, or a positioning device system, which does not allow the worker to fall, would be useful. (The OSHA regulations for personal fall arrest and positioning device systems in the construction industry are reproduced in Appendix A of this Standard.)

5.2 Raised performance platforms

All the controls appropriate to a stage edge apply to a raised performance platform, with the possible exceptions of orchestra pit nets and fire safety curtains as barriers, since performance platforms are unlikely to have either orchestra pits or fire safety curtains.

The significant difference between a stage and a performance platform is that the platform may have several edges that constitute fall hazards. Some of those edges may be behind the performers, away from the audience, and so appropriate fall protection there probably will be different than the appropriate fall protection for the audience side.

Take care that any scenic barriers that do not meet the strength requirements of guard rails do not appear to have that strength. People should not be fooled into thinking they can lean on a barrier that will not support them. Also, do not put up barriers that hide a fall hazard and do not prevent people from encountering the hazard. One of the worst things to do would be to hang curtains that obscure an edge but that do not actually stop a person from going over the edge.

5.3 Orchestra Pit Bridges and Passerelles

All the controls appropriate to a stage edge apply to orchestra pit bridges or passerelles. Complicating factors are that the bridge or passerelle is usually narrow and it has a fall hazard on two sides. It usually is not possible to keep well back from the edge, so the Performer Blocking and rehearsal must be done with great care. Clear marking of the edges is essential, particularly since performers on a bridge or passerelle are likely to be illuminated by followspots, which may impede their vision. Nets over the orchestra pit also may be useful.

5.4 Traps and holes in the stage floor

All the controls appropriate to a stage edge apply to an open trap or hole in the stage floor. A complicating factor is that a trap might be closed at times and provide a perfectly safe walking surface, and at other times might be open, creating a fall hazard. At a minimum, technicians and performers working around a trap need to be trained to understand its changing nature, and the trap must be designed so that its state—open or closed—is clear at all times. Guard rails or physical barriers should be used if possible. Certainly, the traps should be covered or blocked on all sides with guard rails if the trap is open and unattended. Do not allow anyone to open a trap and then leave it unattended or unprotected. Taking a lunch break and vacating the theatre, leaving a trap open and unprotected, would be gross negligence.

5.5 Stage lifts

Stage lifts, including orchestra pit lifts, create holes in the floor that appear and disappear. The guidance offered above for stage edges and traps is applicable. Keep in mind that if there is access to the space under the lift, there may be a fall hazard there, too.

Moving stage lifts often also present a crushing hazard, but mitigating that is outside the scope of this standard. See ANSI E1.42 for guidance on mitigating stage lift crushing hazards.

5.6 Choral and orchestra risers

Choral and orchestra risers are relatively low platforms, well lower than any action level that is required by OSHA regulations, whether for general industry, construction, or shipyards. A fall from a choral riser or orchestra riser is unlikely to cause death but might cause injury, and certainly will stop the show. The fall risk for them should be carefully considered, particularly since the rehearsals for the performers using them rarely spend much time on Performer Blocking.

It would be wise to consider using guard rails to protect any edge that is not used for performer access on any choral or orchestra riser that is 1'-0" (0.3 meters) or more above the stage, platform, or riser below it. Risers with chairs on them should have some means to keep a chair leg from slipping off the riser. Edge-stops—thin strips of wood or metal attached to the edge of the riser—are often used, but care must be taken that these do not create a tripping hazard. That is, a riser 16" above the stage floor with a row of chairs on it could have an edge-stop at each end to keep chairs from sliding off, but 16" is low enough that a musician might decide to step off the riser end to exit. The edge-stop then must not intrude into the path to trip the musician, or a guard rail must be there to stop the performer from using the riser end as an exit.

Choral and orchestra riser edges shall be clearly marked. If the risers are a uniform black, the edge will be difficult to see. Also keep in mind that musician's risers, particularly orchestra risers, often have power cords for music stand lights running over them. These add visual clutter, further making the edge difficult to see.

Annex A (Informative) – Federal OSHA Regulations

This selection of clauses from the US Federal Occupational Safety and Health Administration regulations dealing with fall protection are provided because they may offer useful guidance or suggest fall protection solutions, and because they may be reproduced here without infringing copyright. However, it should be noted that OSHA regulations are not applicable for all situations within the scope of this Standard, nor are they sufficient by themselves for achieving what this Standard is attempting to accomplish: no falls resulting in injury or death.

When the first edition of this Standard (E1.46) was approved by ANSI on 29 February 2016, it could be argued that the OSHA regulations 29 CFR 1910 (general industry) and 29 CFR 1926 (construction) both apply to shows in theatres: the general industry clauses apply when the show is running in production, and the construction clauses apply when a show is being loaded in or out. This is still generally the case, but in November 2016 a revision of 29 CFR 1910 was published which specifically exempted “the exposed perimeters of entertainment stages” from the fall protection requirements of section 1910.28, Duty to have fall protection and falling object protection. [Clause 1910.28(a)(2)(iii)] This exemption does not make it acceptable to have an employee fall off the front of the stage—the General Duty Clause, Section 5(a)(1) of the Occupational Safety and Health Act of 1970, requires employers to provide their employees with a place of employment that is “free from recognized hazards that are causing or are likely to cause death or serious harm”—but the exemption means that an employer won’t be held to the specific requirements of 1910.28. That is, the employer has to provide a safe workplace, but the OSHA regulations now have fewer specific requirements for a theatrical workplace. Never the less, many of the OSHA regulations, although not necessarily mandatory, may be useful for creating an effective fall protection program in an entertainment venue. A selection of them are listed here.

The OSHA fall protection regulations are highly detailed and reference specific work practices that are unlikely to be relevant to doing a show (e.g. overhand bricklaying), but an open-minded reading of the regulations will reveal general principles. These principals can be applied to performance venues. If the application is successful and the goal of no falls resulting in injury or death is achieved, the specifics of how the regulations were interpreted and applied are unlikely to be questioned.

Note that the OSHA regulations selected and quoted here as they read on the publication day of this standard. They may be revised at any time; users of this standard are encouraged to visit the OSHA website for the current regulations and guidance documents.

29 CFR 1910.28, Duty to have fall protection and falling object protection. (general industry)

1910.28(b)(3) Holes. The employer must ensure:

1910.28(b)(3)(i) Each employee is protected from falling through any hole (including skylights) that is 4 feet (1.2 m) or more above a lower level by one or more of the following:

1910.28(b)(3)(i)(A) Covers;

1910.28(b)(3)(i)(B) Guardrail systems;

1910.28(b)(3)(i)(C) Travel restraint systems; or

1910.28(b)(3)(i)(D) Personal fall arrest systems.

1910.28(b)(3)(ii) Each employee is protected from tripping into or stepping into or through any hole that is less than 4 feet (1.2 m) above a lower level by covers or guardrail systems.

1910.28(b)(3)(iii) Each employee is protected from falling into a stairway floor hole by a fixed guardrail system on all exposed sides, except at the stairway entrance. However, for any stairway used less than once per day where traffic across the stairway floor hole prevents the use of a fixed guardrail system (e.g., holes located in aisle spaces), the employer may protect employees from falling into the hole by using a hinged floor hole cover that meets the criteria in § 1910.29 and a removable guardrail system on all exposed sides, except at the entrance to the stairway.

1910.28(b)(3)(iv) Each employee is protected from falling into a ladderway floor hole or ladderway platform hole by a guardrail system and toeboards erected on all exposed sides, except at the entrance to the hole, where a self-closing gate or an offset must be used.

1910.28(b)(3)(v) Each employee is protected from falling through a hatchway and chutefloor hole by:

1910.28(b)(3)(v)(A) A hinged floor-hole cover that meets the criteria in § 1910.29 and a fixed guardrail system that leaves only one exposed side. When the hole is not in use, the employer must ensure the cover is closed or a removable guardrail system is provided on the exposed sides;

1910.28(b)(3)(v)(B) A removable guardrail system and toeboards on not more than two sides of the hole and a fixed guardrail system on all other exposed sides. The employer must ensure the removable guardrail system is kept in place when the hole is not in use; or

1910.28(b)(3)(v)(C) A guardrail system or a travel restraint system when a work operation necessitates passing material through a hatchway or chute floor hole.

[1910.28(b)4 through 1910.28(b)10 are omitted here.]

1910.28(b)(11) Stairways. The employer must ensure:

1910.28(b)(11)(i) Each employee exposed to an unprotected side or edge of a stairway landing that is 4 feet (1.2 m) or more above a lower level is protected by a guardrail or stair rail system;

1910.28(b)(11)(ii) Each flight of stairs having at least 3 treads and at least 4 risers is equipped with stair rail systems and handrails as follows:

Table D-2 -- Stairway Handrail Requirements

| Stair width | Enclosed | One open side | Two open sides | With earth built up on both sides |
|--|---|--|---|-----------------------------------|
| Less than 44 inches (1.1 m). | At least one handrail | One stair rail system with handrail on open side. | One stair rail system each open side. | |
| 44 inches (1.1 m) to 88 inches (2.2 m). | One handrail on each enclosed side | One Stair rail system with handrail on open side and one handrail on enclosed side. | One stair rail system with handrail on each open side. | |
| Greater than 88 inches (2.2 m). | One handrail on each enclosed side and one intermediate handrail located in the middle of the stair | One stair rail system with handrail on open side, one handrail on enclosed side, and one intermediate handrail located in the middle of the stair. | One stair rail system with handrail on each open side and one intermediate handrail located in the middle of the stair. | |
| Exterior stairs less than 44 inches (1.1 m). | | | | One handrail on least one side. |

Note to table: The width of the stair must be clear of all obstructions except handrails.

1910.28(b)(11)(iii) Each ship stairs and alternating tread type stairs is equipped with handrails on both sides.

29 CFR 1926.501, Duty to have fall protection. (construction industry)**1926.501(a)** "General."

1926.501(a)(1) This section sets forth requirements for employers to provide fall protection systems. All fall protection required by this section shall conform to the criteria set forth in 1926.502 of this subpart.

1926.501(a)(2) The employer shall determine if the walking/working surfaces on which its employees are to work have the strength and structural integrity to support employees safely. Employees shall be allowed to work on those surfaces only when the surfaces have the requisite strength and structural integrity.

1926.501(b)

1926.501(b)(1) "Unprotected sides and edges." Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems.

1926.501(b)(2) "Leading edges."

1926.501(b)(2)(i) Each employee who is constructing a leading edge 6 feet (1.8 m) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, or personal fall arrest systems. Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the requirements of paragraph (k) of 1926.502.

1926.501(b)(2)(ii) Each employee on a walking/working surface 6 feet (1.8 m) or more above a lower level where leading edges are under construction, but who is not engaged in the leading edge work, shall be protected from falling by a guardrail system, safety net system, or personal fall arrest system. If a guardrail system is chosen to provide the fall protection, and a controlled access zone has already been established for leading edge work, the control line may be used in lieu of a guardrail along the edge that parallels the leading edge.

[1926.501(b)(3) through 1926.501(b)(14) are omitted here]

1926.501(b)(15) "Walking/working surfaces not otherwise addressed." Except as provided in 1926.500(a)(2) or in 1926.501 (b)(1) through (b)(14), each employee on a walking/working surface 6 feet (1.8 m) or more above lower levels shall be protected from falling by a guardrail system, safety net system, or personal fall arrest system.

[The rest of 1926.501 is omitted here.]

29 CFR 1926.502 Fall protection systems criteria and practices. (construction industry)**1926.502(a)** "General."

1926.502(a)(1) Fall protection systems required by this part shall comply with the applicable provisions of this section.

1926.502(a)(2) Employers shall provide and install all fall protection systems required by this subpart for an employee, and shall comply with all other pertinent requirements of this subpart before that employee begins the work that necessitates the fall protection.

1926.502(b) "Guardrail systems." Guardrail systems and their use shall comply with the following provisions:

1926.502(b)(1) Top edge height of top rails, or equivalent guardrail system members, shall be 42 inches (1.1 m) plus or minus 3 inches (8 cm) above the walking/working level. When conditions warrant, the height of the top edge may exceed the 45-inch height, provided the guardrail system meets all other criteria of this paragraph.

Note: When employees are using stilts, the top edge height of the top rail, or equivalent member, shall be increased an amount equal to the height of the stilts.

1926.502(b)(2) Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members shall be installed between the top edge of the guardrail system and the walking/working surface when there is no wall or parapet wall at least 21 inches (53 cm) high.

1926.502(b)(2)(i) Midrails, when used, shall be installed at a height midway between the top edge of the guardrail system and the walking/working level.

1926.502(b)(2)(ii) Screens and mesh, when used, shall extend from the top rail to the walking/working level and along the entire opening between top rail supports.

1926.502(b)(2)(iii) Intermediate members (such as balusters), when used between posts, shall be not more than 19 inches (48 cm) apart.

1926.502(b)(2)(iv) Other structural members (such as additional midrails and architectural panels) shall be installed such that there are no openings in the guardrail system that are more than 19 inches (0.5 m) wide.

1926.502(b)(3) Guardrail systems shall be capable of withstanding, without failure, a force of at least 200 pounds (890 N) applied within 2 inches (5.1 cm) of the top edge, in any outward or downward direction, at any point along the top edge.

1926.502(b)(4) When the 200 pound (890 N) test load specified in paragraph (b)(3) of this section is applied in a downward direction, the top edge of the guardrail shall not deflect to a height less than 39 inches (1.0 m) above the walking/working level. Guardrail system components selected and constructed in accordance with the Appendix B to subpart M of this part will be deemed to meet this requirement.

1926.502(b)(5) Midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding, without failure, a force of at least 150 pounds (666 N) applied in any downward or outward direction at any point along the midrail or other member.

1926.502(b)(6) Guardrail systems shall be so surfaced as to prevent injury to an employee from punctures or lacerations, and to prevent snagging of clothing.

1926.502(b)(7) The ends of all top rails and midrails shall not overhang the terminal posts, except where such overhang does not constitute a projection hazard.

1926.502(b)(8) Steel banding and plastic banding shall not be used as top rails or midrails.

1926.502(b)(9) Top rails and midrails shall be at least one-quarter inch (0.6 cm) nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for top rails, it shall be flagged at not more than 6-foot intervals with high-visibility material.

1926.502(b)(10) When guardrail systems are used at hoisting areas, a chain, gate or removable guardrail section shall be placed across the access opening between guardrail sections when hoisting operations are not taking place.

1926.502(b)(11) When guardrail systems are used at holes, they shall be erected on all unprotected sides or edges of the hole.

1926.502(b)(12) When guardrail systems are used around holes used for the passage of materials, the hole shall have not more than two sides provided with removable guardrail sections to allow the passage of materials. When the hole is not in use, it shall be closed over with a cover, or a guardrail system shall be provided along all unprotected sides or edges.

1926.502(b)(13) When guardrail systems are used around holes which are used as points of access (such as ladderways), they shall be provided with a gate, or be so offset that a person cannot walk directly into the hole.

1926.502(b)(14) Guardrail systems used on ramps and runways shall be erected along each unprotected side or edge.

1926.502(b)(15) Manila, plastic or synthetic rope being used for top rails or midrails shall be inspected as frequently as necessary to ensure that it continues to meet the strength requirements of paragraph (b)(3) of this section.

1926.502(c) "Safety net systems." Safety net systems and their use shall comply with the following provisions:

1926.502(c)(1) Safety nets shall be installed as close as practicable under the walking/working surface on which employees are working, but in no case more than 30 feet (9.1 m) below such level. When nets are used on bridges, the potential fall area from the walking/working surface to the net shall be unobstructed.

1926.502(c)(2) Safety nets shall extend outward from the outermost projection of the work surface as follows:

| Vertical distance from working level to horizontal plane of net | Minimum required horizontal distance of outer edge of net from the edge of the working surface |
|---|--|
| Up to 5 feet | 8 feet. |
| More than 5 feet up to 10 feet | 10 feet. |
| More than 10 feet | 13 feet. |

1926.502(c)(3) Safety nets shall be installed with sufficient clearance under them to prevent contact with the surface or structures below when subjected to an impact force equal to the drop test specified in paragraph (c)(4) of this section.

1926.502(c)(4) Safety nets and their installations shall be capable of absorbing an impact force equal to that produced by the drop test specified in paragraph (c)(4)(i) of this section.

1926.502(c)(4)(i) Except as provided in paragraph (c)(4)(ii) of this section, safety nets and safety net installations shall be drop-tested at the jobsite after initial installation and before being used as a fall protection system, whenever relocated, after major repair, and at 6-month intervals if left in one place. The drop-test shall consist of a 400 pound (180 kg) bag of sand 30 + or - 2 inches (76 + or - 5 cm) in diameter dropped into the net from the highest walking/working surface at which employees are exposed to fall hazards, but not from less than 42 inches (1.1 m) above that level.

1926.502(c)(4)(ii) When the employer can demonstrate that it is unreasonable to perform the drop-test required by paragraph (c)(4)(i) of this section, the employer (or a designated competent person) shall certify that the net and net installation is in compliance with the provisions of paragraphs (c)(3) and (c)(4)(i) of this section by preparing a certification record prior to the net being used as a fall protection system. The certification record must include an identification of the net and net installation for which the certification record is being prepared; the date that it was determined that the identified net and net installation were in compliance with paragraph (c)(3) of this section and the signature of the person making the determination and certification. The most recent certification record for each net and net installation shall be available at the jobsite for inspection.

1926.502(c)(5) Defective nets shall not be used. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration. Defective components shall be removed from service. Safety nets shall also be inspected after any occurrence which could affect the integrity of the safety net system.

1926.502(c)(6) Materials, scrap pieces, equipment, and tools which have fallen into the safety net shall be removed as soon as possible from the net and at least before the next work shift.

1926.502(c)(7) The maximum size of each safety net mesh opening shall not exceed 36 square inches (230 cm) nor be longer than 6 inches (15 cm) on any side, and the opening, measured center-to-center of mesh ropes or webbing, shall not be longer than 6 inches (15 cm). All mesh crossings shall be secured to prevent enlargement of the mesh opening.

1926.502(c)(8) Each safety net (or section of it) shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds (22.2 kN).

1926.502(c)(9) Connections between safety net panels shall be as strong as integral net components and shall be spaced not more than 6 inches (15 cm) apart.

1926.502(d) "Personal fall arrest systems." Personal fall arrest systems and their use shall comply with the provisions set forth below. Effective January 1, 1998, body belts are not acceptable as part of a personal fall arrest system. Note: The use of a body belt in a positioning device system is acceptable and is regulated under paragraph (e) of this section.

1926.502(d)(1) Connectors shall be drop forged, pressed or formed steel, or made of equivalent materials.

1926.502(d)(2) Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system.

1926.502(d)(3) Dee-rings and snaphooks shall have a minimum tensile strength of 5,000 pounds (22.2 kN).

1926.502(d)(4) Dee-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or taking permanent deformation.

1926.502(d)(5) Snaphooks shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snaphook by depression of the snaphook keeper by the connected member, or shall be a locking type snaphook designed and used to prevent disengagement of the snaphook by the contact of the snaphook keeper by the connected member. Effective January 1, 1998, only locking type snaphooks shall be used.

1926.502(d)(6) Unless the snaphook is a locking type and designed for the following connections, snaphooks shall not be engaged:

1926.502(d)(6)(i) directly to webbing, rope or wire rope;

1926.502(d)(6)(ii) to each other;

1926.502(d)(6)(iii) to a dee-ring to which another snaphook or other connector is attached;

1926.502(d)(6)(iv) to a horizontal lifeline; or

1926.502(d)(6)(v) to any object which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.

1926.502(d)(7) On suspended scaffolds or similar work platforms with horizontal lifelines which may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.

1926.502(d)(8) Horizontal lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two.

1926.502(d)(9) Lanyards and vertical lifelines shall have a minimum breaking strength of 5,000 pounds (22.2 kN).

1926.502(d)(10)

1926.502(d)(10)(i) Except as provided in paragraph (d)(10)(ii) of this section, when vertical lifelines are used, each employee shall be attached to a separate lifeline.

1926.502(d)(10)(ii) During the construction of elevator shafts, two employees may be attached to the same lifeline in the hoistway, provided both employees are working atop a false car that is equipped with guardrails; the strength of the lifeline is 10,000 pounds [5,000 pounds per employee attached] (44.4 kN); and all other criteria specified in this paragraph for lifelines have been met.

1926.502(d)(11) Lifelines shall be protected against being cut or abraded.

1926.502(d)(12) Self-retracting lifelines and lanyards which automatically limit free fall distance to 2 feet (0.61 m) or less shall be capable of sustaining a minimum tensile load of 3,000 pounds (13.3 kN) applied to the device with the lifeline or lanyard in the fully extended position.

1926.502(d)(13) Self-retracting lifelines and lanyards which do not limit free fall distance to 2 feet (0.61 m) or less, ripstitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kN) applied to the device with the lifeline or lanyard in the fully extended position.

1926.502(d)(14) Ropes and straps (webbing) used in lanyards, lifelines, and strength components of body belts and body harnesses shall be made from synthetic fibers.

1926.502(d)(15) Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds (22.2 kN) per employee attached, or shall be designed, installed, and used as follows:

1926.502(d)(15)(i) as part of a complete personal fall arrest system which maintains a safety factor of at least two; and **1926.502(d)(15)(ii)** under the supervision of a qualified person.

1926.502(d)(16) Personal fall arrest systems, when stopping a fall, shall:

1926.502(d)(16)(i) limit maximum arresting force on an employee to 900 pounds (4 kN) when used with a body belt;

1926.502(d)(16)(ii) limit maximum arresting force on an employee to 1,800 pounds (8 kN) when used with a body harness;

1926.502(d)(16)(iii) be rigged such that an employee can neither free fall more than 6 feet (1.8 m), nor contact any lower level;

1926.502(d)(16)(iv) bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 m); and,

1926.502(d)(16)(v) have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet (1.8 m), or the free fall distance permitted by the system, whichever is less.

Note: If the personal fall arrest system meets the criteria and protocols contained in Appendix C to subpart M, and if the system is being used by an employee having a combined person and tool weight of less than 310 pounds (140 kg), the system will be considered to be in compliance with the provisions of paragraph (d)(16) of this section. If the system is used by an employee having a combined tool and body weight of 310 pounds (140 kg) or more, then the employer must appropriately modify the criteria and protocols of the Appendix to provide proper protection for such heavier weights, or the system will not be deemed to be in compliance with the requirements of paragraph (d)(16) of this section.

1926.502(d)(17) The attachment point of the body belt shall be located in the center of the wearer's back. The attachment point of the body harness shall be located in the center of the wearer's back near shoulder level, or above the wearer's head.

1926.502(d)(18) Body belts, harnesses, and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.

1926.502(d)(19) Personal fall arrest systems and components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until inspected and determined by a competent person to be undamaged and suitable for reuse.

1926.502(d)(20) The employer shall provide for prompt rescue of employees in the event of a fall or shall assure that employees are able to rescue themselves.

1926.502(d)(21) Personal fall arrest systems shall be inspected prior to each use for wear, damage and other deterioration, and defective components shall be removed from service.

1926.502(d)(22) Body belts shall be at least one and five-eighths (1 5/8) inches (4.1 cm) wide.

1926.502(d)(23) Personal fall arrest systems shall not be attached to guardrail systems, nor shall they be attached to hoists except as specified in other subparts of this Part.

1926.502(d)(24) When a personal fall arrest system is used at hoist areas, it shall be rigged to allow the movement of the employee only as far as the edge of the walking/working surface.

1926.502(e) "Positioning device systems." Positioning device systems and their use shall conform to the following provisions:

1926.502(e)(1) Positioning devices shall be rigged such that an employee cannot free fall more than 2 feet (.6m).

1926.502(e)(2) Positioning devices shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds (13.3 kN), whichever is greater.

1926.502(e)(3) Connectors shall be drop forged, pressed or formed steel, or made of equivalent materials.

1926.502(e)(4) Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of this system.

1926.502(e)(5) Connecting assemblies shall have a minimum tensile strength of 5,000 pounds (22.2 kN)

1926.502(e)(6) Dee-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or taking permanent deformation.

1926.502(e)(7) Snaphooks shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snaphook by depression of the snaphook keeper by the connected member, or shall be a locking type snaphook designed and used to prevent disengagement of the snaphook by the contact of the snaphook keeper by the connected member. As of January 1, 1998, only locking type snaphooks shall be used.

1926.502(e)(8) Unless the snaphook is a locking type and designed for the following connections, snaphooks shall not be engaged:

1926.502(e)(8)(i) directly to webbing, rope or wire rope;

1926.502(e)(8)(ii) to each other;

1926.502(e)(8)(iii) to a dee-ring to which another snaphook or other connector is attached;

1926.502(e)(8)(iv) to a horizontal lifeline; or

1926.502(e)(8)(v) to any object which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.

1926.502(e)(9) Positioning device systems shall be inspected prior to each use for wear, damage, and other deterioration, and defective components shall be removed from service.

1926.502(e)(10) Body belts, harnesses, and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.

1926.502(f) "Warning line systems." Warning line systems [See 1926.501(b)(10)] and their use shall comply with the following provisions:

1926.502(f)(1) The warning line shall be erected around all sides of the roof work area.

1926.502(f)(1)(i) When mechanical equipment is not being used, the warning line shall be erected not less than 6 feet (1.8 m) from the roof edge.

1926.502(f)(1)(ii) When mechanical equipment is being used, the warning line shall be erected not less than 6 feet (1.8 m) from the roof edge which is parallel to the direction of mechanical equipment operation, and not less than 10 feet (3.1 m) from the roof edge which is perpendicular to the direction of mechanical equipment operation.

1926.502(f)(1)(iii) Points of access, materials handling areas, storage areas, and hoisting areas shall be connected to the work area by an access path formed by two warning lines.

1926.502(f)(1)(iv) When the path to a point of access is not in use, a rope, wire, chain, or other barricade, equivalent in strength and height to the warning line, shall be placed across the path at the point where the path intersects the warning line erected around the work area, or the path shall be offset such that a person cannot walk directly into the work area.

1926.502(f)(2) Warning lines shall consist of ropes, wires, or chains, and supporting stanchions erected as follows:

1926.502(f)(2)(i) The rope, wire, or chain shall be flagged at not more than 6-foot (1.8 m) intervals with high-visibility material;

1926.502(f)(2)(ii) The rope, wire, or chain shall be rigged and supported in such a way that its lowest point (including sag) is no less than 34 inches (.9 m) from the walking/working surface and its highest point is no more than 39 inches (1.0 m) from the walking/working surface;

1926.502(f)(2)(iii) After being erected, with the rope, wire, or chain attached, stanchions shall be capable of resisting, without tipping over, a force of at least 16 pounds (71 N) applied horizontally against the stanchion, 30 inches (.8 m) above the walking/working surface, perpendicular to the warning line, and in the direction of the floor, roof, or platform edge;

1926.502(f)(2)(iv) The rope, wire, or chain shall have a minimum tensile strength of 500 pounds (2.22 kN), and after being attached to the stanchions, shall be capable of supporting, without breaking, the loads applied to the stanchions as prescribed in paragraph (f)(2)(iii) of this section; and

1926.502(f)(2)(v) The line shall be attached at each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in adjacent sections before the stanchion tips over.

1926.502(f)(3) No employee shall be allowed in the area between a roof edge and a warning line unless the employee is performing roofing work in that area.

1926.502(f)(4) Mechanical equipment on roofs shall be used or stored only in areas where employees are protected by a warning line system, guardrail system, or personal fall arrest system.

1926.502(g) "Controlled access zones." Controlled access zones [See 1926.501(b)(9) and 1926.502(k)] and their use shall conform to the following provisions.

1926.502(g)(1) When used to control access to areas where leading edge and other operations are taking place the controlled access zone shall be defined by a control line or by any other means that restricts access.

1926.502(g)(1)(i) When control lines are used, they shall be erected not less than 6 feet (1.8 m) nor more than 25 feet (7.7 m) from the unprotected or leading edge, except when erecting precast concrete members.

1926.502(g)(1)(ii) When erecting precast concrete members, the control line shall be erected not less than 6 feet (1.8 m) nor more than 60 feet (18 m) or half the length of the member being erected, whichever is less, from the leading edge.

1926.502(g)(1)(iii) The control line shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge.

1926.502(g)(1)(iv) The control line shall be connected on each side to a guardrail system or wall.

1926.502(g)(2) When used to control access to areas where overhand bricklaying and related work are taking place:

1926.502(g)(2)(i) The controlled access zone shall be defined by a control line erected not less than 10 feet (3.1 m) nor more than 15 feet (4.5 m) from the working edge.

1926.502(g)(2)(ii) The control line shall extend for a distance sufficient for the controlled access zone to enclose all employees performing overhand bricklaying and related work at the working edge and shall be approximately parallel to the working edge.

1926.502(g)(2)(iii) Additional control lines shall be erected at each end to enclose the controlled access zone.

1926.502(g)(2)(iv) Only employees engaged in overhand bricklaying or related work shall be permitted in the controlled access zone.

1926.502(g)(3) Control lines shall consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions as follows:

1926.502(g)(3)(i) Each line shall be flagged or otherwise clearly marked at not more than 6-foot (1.8 m) intervals with high-visibility material.

1926.502(g)(3)(ii) Each line shall be rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches (1 m) from the walking/working surface and its highest point is not more than 45 inches (1.3 m) [50 inches (1.3 m) when overhand bricklaying operations are being performed] from the walking/working surface.

1926.502(g)(3)(iii) Each line shall have a minimum breaking strength of 200 pounds (.88 kN).

1926.502(g)(4) On floors and roofs where guardrail systems are not in place prior to the beginning of overhand bricklaying operations, controlled access zones shall be enlarged, as necessary, to enclose all points of access, material handling areas, and storage areas.

1926.502(g)(5) On floors and roofs where guardrail systems are in place, but need to be removed to allow overhand bricklaying work or leading edge work to take place, only that portion of the guardrail necessary to accomplish that day's work shall be removed.

1926.502(h) "Safety monitoring systems." Safety monitoring systems [See 1926.501(b)(10) and 1926.502(k)] and their use shall comply with the following provisions:

1926.502(h)(1) The employer shall designate a competent person to monitor the safety of other employees and the employer shall ensure that the safety monitor complies with the following requirements:

1926.502(h)(1)(i) The safety monitor shall be competent to recognize fall hazards;

1926.502(h)(1)(ii) The safety monitor shall warn the employee when it appears that the employee is unaware of a fall hazard or is acting in an unsafe manner;

1926.502(h)(1)(iii) The safety monitor shall be on the same walking/working surface and within visual sighting distance of the employee being monitored;

1926.502(h)(1)(iv) The safety monitor shall be close enough to communicate orally with the employee; and

1926.502(h)(1)(v) The safety monitor shall not have other responsibilities which could take the monitor's attention from the monitoring function.

1926.502(h)(2) Mechanical equipment shall not be used or stored in areas where safety monitoring systems are being used to monitor employees engaged in roofing operations on low-slope roofs.

1926.502(h)(3) No employee, other than an employee engaged in roofing work [on low-sloped roofs] or an employee covered by a fall protection plan, shall be allowed in an area where an employee is being protected by a safety monitoring system.

1926.502(h)(4) Each employee working in a controlled access zone shall be directed to comply promptly with fall hazard warnings from safety monitors.

1926.502(i) "Covers." Covers for holes in floors, roofs, and other walking/working surfaces shall meet the following requirements:

1926.502(i)(1) Covers located in roadways and vehicular aisles shall be capable of supporting, without failure, at least twice the maximum axle load of the largest vehicle expected to cross over the cover.

1926.502(i)(2) All other covers shall be capable of supporting, without failure, at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time.

1926.502(i)(3) All covers shall be secured when installed so as to prevent accidental displacement by the wind, equipment, or employees.

1926.502(i)(4) All covers shall be color coded or they shall be marked with the word "HOLE" or "COVER" to provide warning of the hazard.

Note: This provision does not apply to cast iron manhole covers or steel grates used on streets or roadways.

1926.502(j) "Protection from falling objects." Falling object protection shall comply with the following provisions:

1926.502(j)(1) Toeboards, when used as falling object protection, shall be erected along the edge of the overhead walking/working surface for a distance sufficient to protect employees below.

1926.502(j)(2) Toeboards shall be capable of withstanding, without failure, a force of at least 50 pounds (222 N) applied in any downward or outward direction at any point along the toeboard.

1926.502(j)(3) Toeboards shall be a minimum of 3 1/2 inches (9 cm) in vertical height from their top edge to the level of the walking/working surface. They shall have not more than 1/4 inch (0.6 cm) clearance above the walking/working surface. They shall be solid or have openings not over 1 inch (2.5 cm) in greatest dimension.

1926.502(j)(4) Where tools, equipment, or materials are piled higher than the top edge of a toeboard, paneling or screening shall be erected from the walking/working surface or toeboard to the top of a guardrail system's top rail or midrail, for a distance sufficient to protect employees below.

1926.502(j)(5) Guardrail systems, when used as falling object protection, shall have all openings small enough to prevent passage of potential falling objects.

1926.502(j)(6) During the performance of overhand bricklaying and related work:

1926.502(j)(6)(i) No materials or equipment except masonry and mortar shall be stored within 4 feet (1.2 m) of the working edge.

1926.502(j)(6)(ii) Excess mortar, broken or scattered masonry units, and all other materials and debris shall be kept clear from the work area by removal at regular intervals.

1926.502(j)(7) During the performance of roofing work:

1926.502(j)(7)(i) Materials and equipment shall not be stored within 6 feet (1.8 m) of a roof edge unless guardrails are erected at the edge.

1926.502(j)(7)(ii) Materials which are piled, grouped, or stacked near a roof edge shall be stable and self-supporting.

1926.502(j)(8) Canopies, when used as falling object protection, shall be strong enough to prevent collapse and to prevent penetration by any objects which may fall onto the canopy.

1926.502(k) "Fall protection plan." This option is available only to employees engaged in leading edge work, precast concrete erection work, or residential construction work (See 1926.501(b)(2), (b)(12), and (b)(13)) who can demonstrate that it is infeasible or it creates a greater hazard to use conventional fall protection equipment. The fall protection plan must conform to the following provisions.

1926.502(k)(1) The fall protection plan shall be prepared by a qualified person and developed specifically for the site where the leading edge work, precast concrete work, or residential construction work is being performed and the plan must be maintained up to date.

1926.502(k)(2) Any changes to the fall protection plan shall be approved by a qualified person.

1926.502(k)(3) A copy of the fall protection plan with all approved changes shall be maintained at the job site.

1926.502(k)(4) The implementation of the fall protection plan shall be under the supervision of a competent person.

1926.502(k)(5) The fall protection plan shall document the reasons why the use of conventional fall protection systems (guardrail systems, personal fall arrest systems, or safety nets systems) are infeasible or why their use would create a greater hazard.

1926.502(k)(6) The fall protection plan shall include a written discussion of other measures that will be taken to reduce or eliminate the fall hazard for workers who cannot be provided with protection from the conventional fall protection systems. For example, the employer shall discuss the extent to which scaffolds, ladders, or vehicle mounted work platforms can be used to provide a safer working surface and thereby reduce the hazard of falling.

1926.502(k)(7) The fall protection plan shall identify each location where conventional fall protection methods cannot be used. These locations shall then be classified as controlled access zones and the employer must comply with the criteria in paragraph (g) of this section.

1926.502(k)(8) Where no other alternative measure has been implemented, the employer shall implement a safety monitoring system in conformance with 1926.502(h).

1926.502(k)(9) The fall protection plan must include a statement which provides the name or other method of identification for each employee who is designated to work in controlled access zones. No other employees may enter controlled access zones.

1926.502(k)(10) In the event an employee falls, or some other related, serious incident occurs, (e.g., a near miss) the employer shall investigate the circumstances of the fall or other incident to determine if the fall protection plan needs to be changed (e.g. new practices, procedures, or training) and shall implement those changes to prevent similar types of falls or incidents.

29 CFR 1926.503 Training requirements. (construction industry)

The following training provisions supplement and clarify the requirements of 1926.21 regarding the hazards addressed in subpart M of this part.

1926.503(a) "Training Program."

1926.503(a)(1) The employer shall provide a training program for each employee who might be exposed to fall hazards. The program shall enable each employee to recognize the hazards of falling and shall train each employee in the procedures to be followed in order to minimize these hazards.

1926.503(a)(2) The employer shall assure that each employee has been trained, as necessary, by a competent person qualified in the following areas:

1926.503(a)(2)(i) The nature of fall hazards in the work area;

1926.503(a)(2)(ii) The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used;

1926.503(a)(2)(iii) The use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, controlled access zones, and other protection to be used;

1926.503(a)(2)(iv) The role of each employee in the safety monitoring system when this system is used;

1926.503(a)(2)(v) The limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;

1926.503(a)(2)(vi) The correct procedures for the handling and storage of equipment and materials and the erection of overhead protection; and

1926.503(a)(2)(vii) The role of employees in fall protection plans;

1926.503(a)(2)(viii) The standards contained in this subpart.

1926.503(b) "Certification of training."

1926.503(b)(1) The employer shall verify compliance with paragraph (a) of this section by preparing a written certification record. The written certification record shall contain the name or other identity of the employee trained, the date(s) of the training, and the signature of the person who conducted the training or the signature of the employer. If the employer relies on training conducted by another employer or completed prior to the effective date of this section, the certification record shall indicate the date the employer determined the prior training was adequate rather than the date of actual training.

1926.503(b)(2) The latest training certification shall be maintained.

1926.503(c) "Retraining."

When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required by paragraph (a) of this section, the employer shall retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where:

1926.503(c)(1) Changes in the workplace render previous training obsolete; or

1926.503(c)(2) Changes in the types of fall protection systems or equipment to be used render previous training obsolete; or

1926.503(c)(3) Inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee has not retained the requisite understanding or skill.

Annex B (Informative) – Example Of An Orchestra Lift Safety Program

[This is simply an example. It is not offered as a model for an ideal program, but it shows how one organization has addressed the risks of an orchestra lift, what they chose as reasonable measures for safety.]

SYMPHONY HALL ORCHESTRA LIFT PROCEDURES and GUIDELINES

- 1) When the orchestra pit lift is below stage level a fall hazard exists.
- 2) The orchestra lift is to be operated only by qualified personnel knowledgeable in its operation, safety features, and these guidelines.
- 3) **NO ONE** is to enter or exit the lift while it is in motion.
- 4) **NO ONE** riding on the lift is to stand within 18" of the edge of the lift while the lift is in motion.
- 5) Persons at the trap room level waiting for the lift to descend shall stand back at least 6'.
- 6) Operator is to be on the lift at all times when the lift is in motion. The only normal exception is when the seat wagon is being installed or removed.
- 7) The lift shall be operated only with all wall panels in place. The only exception to this is during the installation or removal of the seat wagon.
- 8) Orchestra lift **SHALL NOT** be operated with any safety interlock or safety feature bypassed or defeated.
- 9) When the presence of an operator on the lift will interfere with the performance (or rehearsal) the remote operator must have constant visual contact with the entire lift. A minimum of one spotter in constant communication with the operator is required. Theatre Division technical staff will require additional spotters or safety measures as appropriate.
- 10) Equipment, scenery, props, and similar items are not to be placed, stored, or set both on the stage and on the lift. i.e. the same as the fire line.
- 11) **NO ONE** shall be permitted to approach within 6' of the opening, hang arms or legs over the edge of the opening, or sit on the edge of the opening, when the lift is below stage level.
- 12) When lift is down, the orchestra pit area is to be secured with safety cones.
- 13) When the lift is set as an orchestra pit, pit area is to be secured with safety cones except during performance.
- 14) Operating the lift under the influence of alcohol or drugs is prohibited. Persons found working under the influence of drugs or alcohol will be removed from the premises.

Annex C (Informative) – Example of a Plan for Installing an Apron Extension

[This is simply an example. It is not offered as a model for an ideal plan, but it shows how one TD might address the risks of installing portable platforms over an orchestra pit to extend the stage apron.]

Obvious hazards:

1. People installing the platforms could fall into the orchestra pit.
2. Platforms could fall on workers in the pit while they are working to install the platforms.
3. Other people on stage, not involved in installing the platforms, could fall into the pit or walk on the platforms before they are secure, causing them and the platforms to fall into the pit.

General remediation steps:

The work area will be separated from the rest of the stage by a portable barrier (saw horses, stanchions and rope, etc) that also has signs saying, "Keep out. Fall hazard." The barrier will not be less than 6' from the stage edge, but will probably have to be much further away to allow enough work space for installing the platforms. Saw horses will be set in the house aisles to block the aisles leading to the stage and will have the same signage.

The work site will be supervised at all times until the installation is complete. That is, someone will have to stay at the worksite while the other workers take breaks; everyone can't all leave for lunch or coffee together.

Workers in the pit will wear hard hats. Workers at the stage edge will wear work positioning harnesses attached to lanyards that will prevent them from going over the stage edge but will allow them to reach beyond the edge with their hands.

Work plan

Eight people shall be on the work crew: four in the pit, two on stage, and two in the front row of the house. Fewer than that will make handling the platforms difficult, increasing the probability that they will be dropped.

Equipment needed will include two 6' step ladders, at least two c-clamps, spirit levels, 1-1/4" screws, 2" screws, screwdrivers, and miscellaneous lengths of 1x3 for cross-bracing.

The leg units (our usual "tiger legs") will be stacked against the upstage pit wall, under the permanent apron edge. The 4x8 platforms will be stacked on stage, conveniently near the edge, but not in the way.

The first platform will be laid flat and slid out on the stage left side stage/hanamichi leading to the house. Then workers in the front row and workers kneeling on stage then will slide the first platform onstage out over the open pit about 16 inches.

Workers in the pit will attach a set of legs to the overhanging edge using c-clamps. A second set of legs will be moved by two workers into position to carry the off-stage edge of the platform, and then those workers will take shelter under the permanent apron lip to be out of the way.

Two workers in the pit—standing at the on-stage side of the platform, not under it—will move the legs toward the center of the house while the top workers slide the platform fully off the side stage. The two workers that had taken shelter will then put the second set of legs in place while the platform is held and steadied by the four workers above and the two other workers at the first set of legs. The legs then will be attached to the platform frame with 1-1/4" screws.

While the workers above steady the platform, the four workers below will ensure that the legs are plumb and will add 1x3 cross-bracing, screwing them in place with the 2" screws.

After the first platform is secure, the second platform will be slid out on it, and then slid sideways to have the first set of legs attached by workers in the pit.

The platform will then be slid further toward the center line until the offstage edge can be set down on top of the first set of legs for the first platform. The legs will be secured to the platform frame with 1-1/4" screws. The legs will be plumbed, and then braced with 1x3, as before.

The remainder of the platforms will be installed in a similar manner.

When the job is done, the barriers and signage for the project will be removed. The usual stage edge protection will be put in place, or an equivalent. The apron extension removes the hazard of falling into the orchestra pit, but creates a new hazard of falling into the first row of the audience. That is less serious, but still to be avoided.

Annex D (Informative) – Selected Building Code Requirements

BUILDING PERMITS

While stage, movie and television sets are not required to have building permits this does not exempt them from meeting the requirements of the building code.

2012 International Building Code Section “[A]105.2 Work exempt from permit. Exemptions from *permit* requirements of this code shall not be deemed to grant authorization for any work to be done in any manner in violation of the provisions of this code or any other laws or ordinances of this jurisdiction. Permits shall not be required for the following:

Building:

8. “Temporary motion picture, television and theater sets and scenery.”

Keep in mind that local requirements may be different as local jurisdictions are free to amend and/or change model codes such as the *International Building Code*. They may also adopt their own version of a building code independent of the model codes. Local jurisdictions also may continue to use old or obsolete model codes. Changes to a model code by the local jurisdiction are required by the code to be in a separate document or attachment.

While a permit is not required for temporary motion picture, television and theater sets and scenery, the exemption from the permit requirement does not grant an exemption from the requirements of the building code. Exemptions from specific portions of the building code would be contained within or next to the relevant code section. Other building codes, *NFPA 5000 Building Construction and Safety Code* being one of the most well-known, do not have specific language noting that the lack of a permit does not grant work to be done in violation of the code.

Understand that the usual interpretation would be that any work would be required to meet the applicable code requirement. Building officials, usually the building inspector or a person with some similar title, also referred to as the Authority Having Jurisdiction (AHJ), have a significant amount of leeway to determine what is covered under the code and if the work meets the requirements of the code. The building official also is able to determine that a particular item of work is not a temporary motion picture, television and theater set or scenery, and so any permit exemption would not apply.

The AHJ's interpretation can be appealed, but this is usually a time consuming process. As a practical matter, the AHJ's decision is the final authority on code interpretations. An appeal is only practical if there is sufficient time before the performance is to take place.

Sometimes an AHJ will offer alternatives to make the work code-compliant. It is acceptable to politely suggest a mutually acceptable solution to existing non-compliant work even if no alternatives to the existing work are suggested by the AHJ.