

ROOF ANCHORS

BACKGROUND

The Government of Alberta owns, operates and maintains a large number of buildings. Many buildings have roof anchor points to tie off scaffolding or swing stages and other anchor points for fall protection of workers.

The requirements of the Occupational Health and Safety Code are very specific with respect to design of life safety tie-offs. The OHS Code is silent with respect to requirements for inspection and maintenance of roof anchors. The OHS Code defers to the anchor manufacturer, or the professional engineer who certified the anchor for use, for recommendations regarding anchor inspection and maintenance. Section 12(d) of the OHS Code requires that equipment (such as fall protection anchors) be inspected and maintained according to the manufacturer's specifications or the specifications of a professional engineer.

INTRODUCTION

The umbrella statute is the Occupational Health and Safety Act. The Act refers to the Occupational Health and Safety Regulation that came into force on March 31, 2003 and the Occupational Health and Safety Code that came into force on April 30, 2004.

The OHS Code has adopted numerous standards relevant to fall protection. The requirements of these adopted standards therefore become mandatory.

The following Canadian Standards have been adopted by the Occupational Health and Safety Code:

- 1) CAN/CSA-Z259.1-98 *Fall Arrestors, Vertical Lifelines and Rails*
- 2) CAN/CSA-Z271-98 *Safety Code for Suspended Elevating Platforms*

CSA Standard Z91-02 *Health and Safety Code for Suspended Equipment Operations* is not listed as being adopted by the OHS Code therefore the requirements of Z91-02 are not a mandatory part of the OHS Code at this time. However, both CSA standards Z271 and Z91 are referenced in section 4.1.6.14 of the Alberta Building Code. This section makes the requirements of the two standards

mandatory on a building that is more than 12 metres in height. Of course, the building must have windows, otherwise anchors are not required since no window cleaning activities will take place.

The purpose of this technical bulletin is to highlight and summarize certain relevant and important requirements of the OHS Code with respect to fall protection. The reader is encouraged to review Part 9 – Fall Protection of the OHS Code along with the OHS Code Explanation Guide for this section, to obtain a full and comprehensive understanding of the responsibilities of owners. Technical Bulletin No. 35 also provides information on Fall Protection.

FALL ARREST REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY CODE:

A fall protection system is required if a worker may fall 3 metres or more, or if falling a lesser distance involves a risk of injury greater than the risk of injury from the impact on a flat surface. A fall protection system can consist of a personal fall arrest system, a travel restraint system, a safety net or a control zone preventing access to the edge of a roof. The following are the OHS Code requirements for fall arrest anchors as taken from Part 9 of the OHS Code.

FALL ARREST ANCHORS

154 (1) *An employer must ensure that anchor points to which a personal fall arrest system is attached have an ultimate load capacity of at least 22.2 kilonewtons per worker attached, in any direction in which the load may be applied.*

(2) *Subsection (1) does not apply to anchor points installed before April 30, 2004.*

(3) *Subsection (1) does not apply to the anchor points or horizontal lifeline systems that must meet the requirements of section 157(1)(e).*

(4) *If the structure to which the anchor point is attached is not capable of withstanding a 22.2 kilonewtons force without damage, the employer may use an anchor point designed, installed and used as part of a fall protection system that is capable of withstanding twice the maximum arresting force that the anchor point is subjected to.*

(5) *The employer must ensure that the anchor point described in subsection (4) is designed, installed and used*

- (a) *in accordance with the manufacturer's specification, or*
- (b) *specifications certified by a professional engineer.*

(6) *An employer must ensure that anchor points to which a personal fall arrest system is attached are not part of an anchor used to support or suspend a platform.*

These requirements apply to anchors used in personal fall arrest systems. Anchors used with horizontal lifeline systems may require far greater strengths. Because of their technical complexity, permanent horizontal lifeline systems should be purchased as a manufactured product or designed by a professional engineer familiar with such systems. The engineer should, at a minimum, be designing the system using CSA standard Z259.13-04, *Flexible horizontal lifeline systems*. This standard had not yet been published at the time that the OHS Code was published in 2003, but it is very likely that an upcoming amendment of the OHS Code will refer to this standard. The following is additional material on personal fall arrest systems as taken from the OHS Code Explanation Guide.

Anchor points used for attachment of personal fall arrest systems must be capable of

- (a) *supporting a load of at least 22.2 kilonewtons (5000 pounds-force) per worker attached, in any direction required to resist a fall, or*
- (b) *if the structure to which the anchor point is attached is not capable of withstanding this 22.2 kilonewtons force without damage, then a lower strength is acceptable as long as the system maintains a safety factor of 2 i.e. capable of withstanding twice the maximum dynamic arresting force per attached worker.*

The safety factor approach is particularly useful in cases where workers must be protected from falling but the structure on or from which they are working cannot accommodate anchors with a 22.2 kilonewton ultimate load capacity. When the 2:1 safety factor is

applied using the maximum arresting force limit of 8 kilonewtons (1800 pounds-force) required by subsection 150(3), the required strength of the anchor decreases to 16 kilonewtons (3600 pounds-force).

A fall arrest system using a shock absorber approved to CSA Standard CAN/CSA-Z259.11-M92 (R1998) Shock Absorbers for Personal Fall Arrest Systems, that limits the worker's weight to 100 kilograms (including tools and personal accessories), and restricts the free fall distance to less than 1.8 metres, is capable of limiting the arresting force to 4 kilonewtons (900 pounds-force). The resulting required anchor strength decreases further to 8 kilonewtons (1800 pounds-force).

Users of this approach must realize that using shock absorber arrest force performance to set anchor strength has several important limitations:

- (1) *the 100 kilogram weight limit can easily be exceeded if a large worker is required to wear personal protective equipment, a tool belt, and carry equipment, additional tools or supplies;*
- (2) *the free fall limit distance of 2 metres may not always be practicably achieved. Workers often use lanyards having a length of 1.8 metres. Connected to an appropriate anchor located above, standing shoulder height, the 2 metre limit can be met. However, if the lanyard is attached at a lower level, the 1.8 metre free fall distance against which the lanyard's performance was verified is exceeded. The lanyard may be unable to limit the fall arrest force to 4 kilonewtons; and*
- (3) *fall arrest equipment is used under a variety of environmental conditions. When wet, or frozen after being wet, a shock absorber's maximum arresting force increases. CSA Standard Z259.11 allows the maximum arresting force of a shock absorber under these conditions to increase to 6 kilonewtons (1350 pounds-force). This needs to be taken into consideration as a limited factor if there is a chance that the shock absorber will get wet or freeze after being wet. The resulting required anchor strength would be 12 kilonewton (2700 pounds-force).*

Having all anchors comply with the 22.2 kilonewtons per attached worker option is the preferred choice as it provides a greater factor of safety than the second

option and there is no confusion as to the strength of the anchor. The second option requires the anchor point to be “designed, installed and used as part of a fall arrest system”, requiring that the anchor point be part of an engineered system.

For compliance purposes, an employer using the 2:1 safety factor option must be able to demonstrate that the safety factor approach

- (a) is being used in accordance with the manufacturer’s specifications if a commercially available system is used, or
- (b) has been certified by a professional engineer.

If there is an anchor plate with multiple attachment points designed to support combinations of suspension lines, tie-back lines and lifelines it must be certified as acceptable in writing by a professional engineer.

REQUIREMENTS OF CSA Z271-98 SAFETY CODE FOR SUSPENDED ELEVATION PLATFORMS:

This standard specifies the required strength of lifeline and tie-back anchors. Anchor systems shall be designed to resist an ultimate load, applied in any direction of 22.2 kilonewtons (5000 pounds) without fracture and/or pullout. Alternatively the anchor can be designed for a load of 11.1 kilonewtons (2500 pounds) without permanent deformation, if the anchors are load tested after installation.

The anchoring systems shall be made of stainless steel, aluminium or hot-dipped galvanized steel. The bolts and hardware must be stainless steel. There are specific requirements for the location of lifeline and tie-back anchors. They must be located with no more than a 3 metre (10 foot) offset from the point of suspension, nor can the angle created by the offset exceed 25°.

REQUIREMENTS OF CSA Z91-02 HEALTH AND SAFETY CODE FOR SUSPENDED EQUIPMENT OPERATIONS:

This is a companion standard to CSA Z271-98 *Safety Code for Suspended Elevating Platforms*. It is not referenced in the OHS Code. The standard is onerous with a requirement that a professional engineer

complete inspections of structural components annually. In the interest of worker safety there are some clauses that should be adhered to, and these requirements as modified are listed as follows.

New anchor systems should be inspected and tested by the professional engineer responsible for the design prior to being placed into service.

Persons skilled in identifying signs of damage or deterioration should inspect existing anchor systems annually. The standard requires that a professional engineer complete these inspections, however a technologist should be able to complete an initial assessment. The inspection should include:

- (a) a review of the design drawings to ensure compliance with current regulations, standards, and engineering standards.
- (b) an assessment of the system to ensure compliance with the engineered drawings;
- (c) an inspection of all exposed, visible, and accessible components of the system for signs of distress or corrosion and
- (d) an inspection of all adhesive and expansion fasteners.

If there is any sign of distress a professional engineer should be engaged to prepare a report with recommendations for repair or alteration.

Systems incorporating adhesive or expansion fasteners should have 100% of the anchors load tested every five years. The load testing should be witnessed by a professional engineer or his representative.

Load testing can be accomplished by loading two anchors off of each other using a come-along and a load cell.

REFERENCES

The OHS Code Explanation Guide for Part 9 – Fall Protection, can be found at the following website:

http://www3.gov.ab.ca/hre/whs/law/pdf/ohsc_p9.pdf

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