Users' work area as entry point for selecting fall arrest systems

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Abstract: When working at heights, fall protection is generally provided by a fall arrest system FAS. The FAS is made of a full body harness, an energy absorber, a lanyard, a connecting subsystem and an anchor. The combination of components could be complex. Several guides and standards are directed at managers, explain too generic principles and are listing mostly limitations. Our proposal is a positive selection procedure starting with the work area in which the fall arrest system should protect the worker without interfering with the tasks. Several combinations of equipment are proposed. Then their limitations could assess by a competent person. The proposed table is a complement to a guide or standard such as the CSA Z259.17.
Keywords: Works at height, fall arrest system, selection, work space

1. Context

Working at heights requires fall protection, mostly provided by a fall arrest system FAS. The FAS is made of a full body harness, a connecting subsystem with mandatory energy absorption, and an anchorage. Its main performance requirements are arresting the fall, arresting before any obstacle is hit, and maintaining the arrest force lower than the acceptable level. These requirements are achieved by the connecting subsystem. The connecting sub system is made of a mandatory component either the energy absorber or a self-retracting lanyard having an integrated energy absorbing mechanism; then optionally several components could be added to reach the anchorage. Theses combinations define the connecting sub system. The combinations are complex with conflicting properties such as strength and elongation. The absorption of energy requires elongation of the connecting subsystem which could means reaching the ground before the fall is arrested. Furthermore the fall arrest system shall not interfere with the tasks and thus allows free movements of the user over a volume or a surface. That volume or surface is named the work area.

To select the right system, some standards and guides exist. Two standards are cited: the ANSI/ASSE Z359.2-2007 and the CSA Z259.17-xx. The ANSI/ASSE Z359.2 is very generic and gives management principles; its usefulness is very limited for fall protection specialists and does not exist for users at the work site. The CSA Z259.17 is oriented for competent persons, those having knowledge and training in fall protection; its content is more a check list of "what to do" and many "what not to do". The "what not to do"s lead to confusion and leave the users at the work site without a selection process. Several guides are published. Four of them are analyzed; they are written by the 1) European commission, by 2) INRS-France, by 3) Laine et al and by 4) OPPBTP-France. The 1st one is the most comprehensive; the hierarchy of prevention is explained and several examples of fall hazard elimination are given. The individual fall arrest system is briefly described. Similar comments are made for the 2nd and the 3rd guides. The 4th one is limited. The 3 first guides are excellent but lack a detailed procedure to identify combinations of components to create viable fall arrest systems.

Lortie in Gilbert, Lortie and Thiry, had identified clearly that the real issue in fall protection is the availability of an anchorage. The success of the horizontal lifelines during the construction of a large car painting plant in Quebec demonstrated the usefulness of an anchorage that allows mobility (Arteau and Lan). Desjardins and Arteau presented criteria for the selection of PPE among which the lack of interference with the tasks is identified. The users know: their tasks, the site (the geometry), their displacements in that site to achieve their tasks, and their exposition to fall hazards as a consequence of their displacements.

2. The proposed approach

The proposed approach modifies the classification of fall protection systems presented by Sulowski. Our entry point is the users' displacements. The displacements define the geometry: a line, a plane or a volume, vertical, inclined or horizontal. From the geometry, several combinations of components are proposed. Criteria or warning are added to orient toward the key factors and at the end, to the specific clauses of technical standard such as CSA Z259.17.

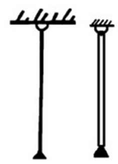
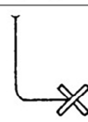
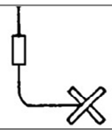
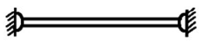
The selection strategy is described by a series of questions:

Q1 What is the work space? Line, plane or volume?
Q2 Is the work requiring movements or immobile?
Q3 Is horizontal, vertical or inclined?
Q4 The total mass (worker's mass plus tools) to select E4 or E6 energy absorber.
Q5 The free fall distance?
Q6 The stopping distance?
Q7 The clearance?
Q8 Any obstacle between the worker and his anchoring point, obstacle that could damage the fall arrest system?
Q9 Do you have a plan for a fast rescue if a fall occurs?

Q1, Q2 and Q3 are entries for Table 2; they lead to the selection of one or more systems. Q4 allows for the selection of the proper energy absorber. Then Q5, Q6 and Q7 are information required by competent persons to answer the questions of standard as CSA Z259.17. If the system is simple, the competent person could select the correct system. If the system is more complex, an engineer shall calculate the total fall distance and the clearance. Finally the manager shall set and demonstrate a rescue procedure.

Table 1 presents the component symbols and Table 2, several fall arrest systems for each work area.

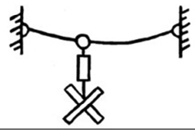
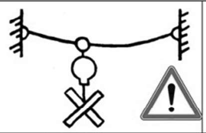
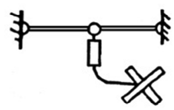
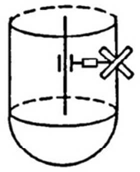
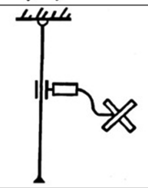
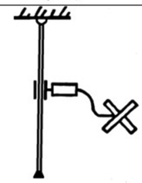
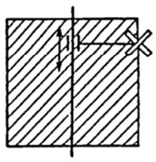
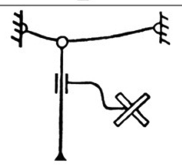
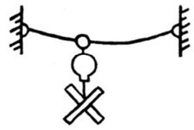
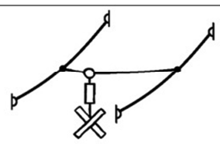
Table 1: *Fall arrest component symbols (photos omitted).*

Name	Symbol	Name	Symbol	Name	Symbol	Name	Symbol
Harness		Energy absorber		Fall arrester		Vertical lifeline, Vertical Rail	
Lanyard		Lanyard with integral energy absorber		Self retracting lanyard			
Horizontal lifeline			Horizontal rail			Anchoring point (Anchorage)	

3. Discussion

The selection procedure starts with the mobility needs of the workers. One or more systems are proposed. Their technical limitations could be assessed by a competent person. The proposed tables are a complement to standard such as the CSA Z259.17.

Table 2: *Some typical generic fall arrest systems.*

Work area		Proposed fall arrest systems			
Name	**Schematic**				
Narrow horizontal surface					
Vertical cylinder					
Large vertical surface					
Large horizontal surface					

4. Literature

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