Integration of safe work process at the design stage: Access at height for safety and productivity

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Abstract: After their construction, buildings and structures will need maintenance. Statistics of occupational accidents demonstrate that many severe accidents occur during maintenance operations. Therefore a human-oriented design shall integrated maintenance issues. The design of work process and facilities integrate the elimination of hazards as well economical aspects. As example, equipment for the maintenance of a building is used; two solutions are compared. The permanent installation of rails is the best solution considering all factors including safety, ergonomics and economics. This approach shows that the best solutions eliminates or isolates the hazardous phenomena, reducing occupational safety and health risks and costs, and increase the productivity and the quality of the work. Occupational safety and health is only one of the sides of work and therefore the real solution of an OSH problem is done when the work is designed correctly from the beginning.
Keywords: Safe design, risk assessment, fall from height, economics.

1. Introduction

After their construction, buildings and structures will need maintenance. Unfortunately means to safely achieve maintenance operations are not present because they were ignored or neglected at the design stage. This is true in North-America. Since April 1995 in France and probably in the European Union, it is mandatory for the group in charge of the design and the construction to transmit the maintenance manual to the users of the building one month after its completion (INRS ED773). In North America, the demonstration for a mandatory maintenance manual is still to be done. In Europe, more examples with detailed approach are still useful. Statistics of occupational accidents demonstrate that many severe accidents occur during maintenance operations. Durable development includes the preservation of the human life which includes its physical and psychological integrity. Therefore a human-oriented design shall integrated maintenance issues (INRS ED950; Arteau 1997). Unfortunately occupational health and safety OSH issues are often perceived as additional costs by the companies. This perception is true if OSH is limited to personal protective equipment PPE and corrections after the case or the construction is completed. PPE do not modify the work process which keeps the same dysfunctions and the same hazards; PPE reduce the severity of the damage. Corrections after the case are expensive and often do not address the hazardous phenomena itself. The cost of safety is higher when done after the construction and that the ease of safety is greater done at the design stage with a lower cost (NOHSC). Occupational safety hazards are corrected totally and more economically by the use of equipment that

addresses the hazards at the source and by corrective measures integrated at the design stage. Maintenance operations need often access at height which will be used as illustrative case.

2. Methods

The article is based on several examples of the design of work process and facilities where the hazards as well economical aspects where integrated. The analysis is based on the methodology of risk assessment published by the CRAMIF (CRAMIF DTE127 and 167) to which is added the economical approach of work facility design published by INRS (INRS ED847). Supplementary criteria are considered as esthetical aspects.

3. Results: a large departmental store with a 200m facade

A large departmental store built in 1920s was renovated in Montreal in 1998-1999. The new owner added a cinema at the top which means the addition of several floors to the building (see figure 1).

Figure 1: Renovated building with a stylized cornice

The architects suggest a cornice at the top as stylized reproduction of the traditional architecture around the renovated building (see figure 2); the owner rejected the idea because at it was too expensive.

Figure 2: Exiting traditional cornices

Instead, the owner proposed a permanent window washing suspended scaffold system. The architect and the owner agreed for an anchoring system integrated in the cornice (Sabourin 2000). Anchorage planning facilitates the work and the use of fall arrest equipment during both the construction and use of the building. Rails hidden in the eaves reproduce the architecture of buildings from the early 20th century; they serve as anchorages for flying scaffolds and for fall arrest systems while being aesthetic (see figure 3).

Figure 3: Rail and suspended scaffold

What were the alternatives? What are their costs? What are the dangerous phenomena associated with each? The information was given by the designer, manufacturer and installer of the permanent rail (Gagnon). The tasks performed around the facade of the building are numerous and exceed the window washing. The facade maintenance include: window cleaning (3 to 4 times per year because this is a commercial building), weather-stripping replacement; masonry, light replacement, advertising signs, decorations (Christmas, Easter, etc). Eight interventions per year were estimated. Two alternatives were considered; both use a suspended scaffold; they differ by the anchoring system.

The first alternative is the use of temporary beams and counterweights. This alternative requires the design and installation of 35 permanent anchors on the roof at a cost of 42 000 cdn dollars; the anchors are mandatory for the individual fall arrest system (harness, energy absorber, fall arrester, vertical rope, and anchor). The annual reimbursement is 5439 cdn dollars. The alternative involves: rental of the scaffold, the beams and the counterweights (1000 cdn dollars), transportation on the roof ((4h up + 4h down) × 2 workers), moving the beams and counterweights every 6 m (2h × 2 workers × 35 times) for a total cost of 10 400 cdn dollars for each installation (see Table 1). Eight times per year make 83 200 cdn dollars. The second alternative uses a permanent rail integrated to a decorative cornice. This alternative requires the design, manufacturing and installation of 35 permanent anchors on the roof and the rail at a cost of 90 000 cdn dollars. The annual reimbursement is 11 655 cdn dollars. The suspended scaffold is supplied with the system. The scaffold is to be installed on the rail and uninstalled (2h × 2 persons) for a cost of 240 cdn dollars. Eight times per year makes 1920 cdn dollars (see Table 1).

Table 1 summarizes and compares the costs. The total of capital reimbursement and operation costs is 89 139 cdn dollars for the temporary solution and 14 575 cdn dollars for the permanent rail per year.

Table 1 Cost comparison between temporary installation and permanent rail

		Temporary		Permanent rail	
Engineering, manufacturing, construction		42 000		90 000	
	10 years at 5% interest rate = per year		5 439		11 655
Yearly inspection			500		1 000
For each installation 8 times a year					
	Rental cost	1 000		0	
	counterweights on the roof (4h)+ reverse (4h)	1 000		240	
	counterweights at every 6 m 2 hours X 2 persons Facade 200 m / 6m = 35 times	8 400		0	
	For each installation	10 400		240	
Total installation 8 times a year: X 8 =			83 200		1 920
Total per year			89 139		14 575
Note: All prices in 1999 Canadian dollars.					

The major dangerous phenomena are the fall from height and the manual transportation of beams and counterweights (ergonomic danger). The fall from height hazard remains theoretically the same but the stability of temporary support beams is questionable and lower than the permanent rail; the probability of scaffold system fai-

lure is reduced. With the permanent rail, the transportation of beams and counterweights disappear. The permanent rail system is safer, ergonomically better, less expensive and reduced work constraint and physical cost for the worker. It is also integrated to the architecture of adjacent buildings.

4. Conclusion

The best solutions eliminate or isolate the hazardous phenomena, reducing occupational safety and health risks and costs, and increase the productivity and the quality of the work. These examples demonstrate that occupational safety and health is only one of the sides of work and therefore the real solution of an OSH problem is done when the work is designed correctly from the beginning. Also a systemic approach considers all variables; these variables could be a source of danger, generate costs and consequences on the productivity. When a methodology addresses all variables, the benefits of a safe design can be demonstrate and the point of view of all concerned persons could find its answer. A final conclusion: eliminating the hazard at the source at the design stage or by major upgrading reduce the long term operation costs by improving productivity and reducing future insurance costs. . This global approach presents arguments and points of view understandable by all persons or groups of interest related to the work activity.

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