INFORMATION REGARDING OLDER HYDRAULIC ELEVATORS

GENERAL ADVICE REGARDING BURIED HYDRAULIC ELEVATOR EQUIPMENT:

Who should read this?

Owners, or their representatives, of buildings with elevators.

What is the reason for this letter of advice?

A recent accident in Hamilton, Ontario, raises new questions about the safety of older-vintage, buried hydraulic elevator cylinders. The risk is that elevators equipped with such cylinders could fall and seriously injure passengers. As a consequence of this accident, we predict that property owners will see an increase in unsolicited proposals of service from elevator contractors to address this problem. These proposals must be considered carefully from both a cost and liability/safety standpoint.

Specifically, what types of elevators are at risk?

Elevators equipped with single-bulkhead, buried hydraulic cylinders present the greatest risk. Such elevators can usually be identified by the following criteria:

1. The elevator is hydraulic-type and not traction (roped, cabled) design;
2. Some or all of the elevator cylinder is buried under the ground;
3. The elevator was installed pre 1980 and its cylinder has not been subsequently replaced.

Discussion:

A large number of the elevators existing in Ontario are of in-ground cylinder design and are of an age that they are not equipped with a second bulkhead on the cylinder bottom. This second bulkhead is a CSA B44 Safety Code requirement on newer elevators and is meant to prevent catastrophic oil pressure loss in the elevator system should the main bulkhead fail by corrosion or by other mechanisms. The second bulkhead, also called a safety bulkhead, is manufactured with a pre-existing hole which would leak oil in a controlled and detectable manner, should the primary bulkhead fail.

Catastrophic failure of a single-bulkhead cylinder could be conceptualized as a can of shaving cream left standing in water. Ultimately after the bottom of the can has been weakened by corrosion, the pressure of the can contents could “blow” it off. Similarly in the case of an elevator, corrosion could lead to failure at the bottom of the hydraulic cylinder. Consequentially the elevator cab, which had been previously suspended by a column of pressurized oil in its supporting cylinder, would then free-fall.

In Thunder Bay, Ontario, in 1990, the catastrophic failure of a single bulkhead, in-ground cylinder did in fact cause an elevator to free-fall. Although thousands of hydraulic elevators are in existence, until recently this incident was the only widely known occurrence of catastrophic cylinder failure in Canada leading to passenger injury, or death in this case.

Multiple deaths have, however, been experienced in the U.S.A. due to single-bulkhead cylinder failures. One such incident occurred in Ohio in 1994, leading to two deaths and several serious injuries. Extensive media coverage greatly raised the profile of the issue in the U.S.A.

Very recently, another incident of uncontrolled elevator down-speeding occurred with an in-ground cylinder elevator at the campus of a university in Hamilton, Ontario. Although the cylinder had not been fully analyzed at the time of the writing of this letter (January 1999) it seems certain that the incident was caused by catastrophic failure of the elevator's buried cylinder. As a precaution, a second elevator's cylinder at the campus was removed and inspected. Significantly, this second cylinder also showed considerable deterioration by corrosion at the bulkhead weld.

It should be noted that there have been many more failures of buried hydraulic cylinders by *slow oil leak*, as opposed to catastrophic failure. Slow leaks often occur as small rust holes on the side of the hydraulic cylinder. These leaks are usually detected by the elevator service personnel when there is otherwise unexplained oil loss in the elevator system. Slow-oil-leak failures, unlike catastrophic failures, do not present an imminent safety hazard. However, general opinion within the elevator industry is that occurrences of slow-oil-leak failure are more common at present than ever before. If true, it is reasonable to assume that occurrences of catastrophic failure will also increase. There are no studies on the subject that confirm this, or that definitively establish the conditions that make certain elevators pre-disposed to failure.

At present, provincial regulations do not require the retroactive replacement of single-bulkhead elevator cylinders in Ontario. This is presumably based on the relatively high cost of cylinder replacement, combined with the apparently remote chance of cylinder failure.

In light of the Hamilton incident, however, we strongly advise all property-owners to take stock of their elevator inventory and to identify those likely to be of single-bulkhead design. Once done, a list of suspect elevators should be forwarded to the elevator manufacturer as well as the maintenance contractor for their confirmation of the cylinder design. Note that some manufacturers began utilizing double-bulkhead cylinder designs in advance of the CSA Code requirement to do so. Once single bulkhead installations are positively identified, we recommend that at least one of the approaches listed herein be employed.

APPROACH A:

While no physical changes to the equipment would be undertaken, periodic leak tests on the hydraulic system would be performed to hopefully detect leaks earlier than they would otherwise be noticed. While elevator maintenance contractors are already undertaking a basic test annually as part of provincially-mandated work, the frequency of the test could be increased, the test made more stringent and the method of reporting this and additions of oil to the system made more rigorous.

Advantages of this approach are that no capital costs would be required, beyond possible extra fees to the elevator service contractor. Careful documentation and attention to this testing would demonstrate a degree of "due diligence" beyond that presently required by the elevator safety authority in Ontario.

A disadvantage of this approach is that there would be no guarantee that leak-testing would detect the kind of catastrophic failure that is to be avoided. In fact, the elevator in the Thunder Bay incident described previously apparently did exhibit unexplained oil loss and was then subject to, and passed, a leak-test in advance of the accident.[1]

APPROACH B:

The in-ground cylinder would be left as is but a back-up safety system would be installed. A relatively new device is available which is meant to detect and then arrest uncontrolled down-speeding of a hydraulic elevator. This device costs approximately $15,000 - $25,000 installed, per elevator.

An advantage of this device is that elevator free-fall should be prevented whether caused by catastrophic failure of the cylinder, or by other cause such as valve failure. An old elevator so-equipped should be even safer than modern double-bulkhead, PVC-encapsulated cylinder elevators.

A disadvantage of this device is that it is a new product. Relatively few installations exist in Ontario - none in the Ottawa area. Furthermore, the device would not inhibit cylinder corrosion, only prevent catastrophic results. Accordingly, it is possible that building owners could equip elevators with the device and still be required to bear the cost of replacing elevator cylinders shortly afterwards.

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[1] In that case, conceivably, the perimeter weld around the cylinder bottom corroded allowing the bulkhead to shift. Oil then leaked out slowly and the leak was noticed by the elevator contractor. However, the bulkhead shifted again, plugging the leak. At this point the elevator passed a leak-test and was restored to passenger use. Subsequently, the bulkhead dropped out of position entirely, leading to uncontrolled descent of the elevator with passengers aboard.

APPROACH C:
The existing in-ground cylinder would be removed, and a new double-bulkhead PVC-encapsulated cylinder would be installed. This work would likely cost $15,000 - $40,000 per elevator.

Advantages of this approach are that catastrophic failure would likely be avoided by both the extra degree of corrosion protection and the safety bulkhead. The buried portion of the elevator hydraulic system would comply with present-day Code.

Disadvantages of this approach are the high cost involved and the lengthy downtime of the elevator while the work would be undertaken.

In our opinion, the appropriate approach would vary according to risk tolerance factors and long term plans for the elevator in question. Replacement of cylinders can be more cost-feasible when done in conjunction with an overall elevator modernization.

Should you have any questions regarding this information, or if we can assist you with this matter, please do not hesitate to contact a consultant at the address or telephone number of this letterhead.

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