

**Zeitschrift:** IABSE reports = Rapports AIPC = IVBH Berichte  
**Band:** 83 (1999)

**Artikel:** Learning from Canadian experience with concrete building structures  
**Autor:** Halsall, Robert / Buckley, Michael  
**DOI:** <https://doi.org/10.5169/seals-62912>

### **Nutzungsbedingungen**

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. [Mehr erfahren](#)

### **Conditions d'utilisation**

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. [En savoir plus](#)

### **Terms of use**

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. [Find out more](#)

**Download PDF:** 01.04.2026

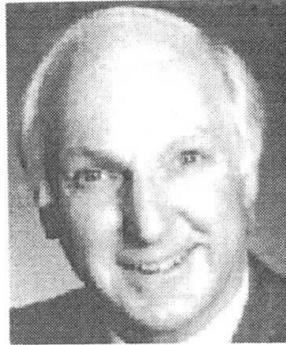
**ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>**



## Learning from Canadian Experience with Concrete Building Structures

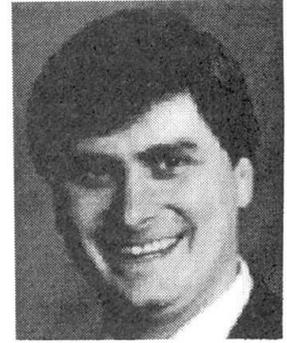
**Robert HALSALL**  
Chairman  
Halsall Associates Ltd.  
Toronto, ON, Canada

Robert Halsall received his civil engineering degree from the University of Glasgow



**Michael BUCKLEY**  
Vice President  
Halsall Associates Ltd.  
Toronto, ON, Canada

Michael Buckley received his civil engineering degrees from the Universities of Alberta & Toronto



### Summary

The paper is a sequel to a presentation to IABSE by Halsall in 1987 in Lisbon. The paper discusses types and extents of problems found in exposed parking structures and in enclosed buildings which are not exposed to de-icing salts. Structures investigated include those reinforced with plain and epoxy-coated bars and with various types of unbonded post-tensioning systems. There is discussion of methods of investigation, analysis and repair. The design of a new 4,000 car parking structure incorporating lessons learned is described.

**Keywords:** corrosion, epoxy-coating, unbonded tendons, investigations, repair, parking structure design.

### 1. Introduction

This paper reviews some of our experience in the investigation and repair of concrete structures since 1987. It will discuss the types and frequencies of the most common problems, and some recently developed techniques of investigation. In the last 10 years, we have been engaged in the investigation of over 500 buildings. About 300 involved damage due to corrosion of bar reinforcement, and 21 have involved stressed tendons. Due to the severe winters, and widespread use of de-icing salt on Canadian roads, parking structures often experience extreme temperature ranges and exposure to chloride contaminated water. Consequently, parking structures are found to develop problems more widely than any other category of building.

### 2. Parking Structures

Since 1987 Halsall has investigated, and usually repaired, over 3 million m<sup>5</sup> of parking structures. The paper will discuss some of our experiences concerning:

- ✦ methods of diagnosis
- ✦ methods of repair
- ✦ some unsatisfactory performance of previous attempts at repair



- design and detailing of parking structures in the light of these experiences, illustrated particularly in the example of a 4000 car parking structure, partly below ground and partly above ground, using beams and slabs post-tensioned with unbounded tendons.

### **3. Other Post-Tensioned Buildings**

Several failures have been investigated of P/T tendons in enclosed buildings not exposed to de-icing salts.

The paper will discuss some diagnostic methods, some remediation methods, including tendon replacement and an acoustic monitoring procedure to identify wire failures in real time.

### **4. General**

The importance will be stressed of understanding the whole structure, from both structural analysis and materials point of view. There will be some discussion of the problem of how to ensure that stress distribution in a repaired structure does not deviate unsafely, from that intended in the original design.