



**CSA S474:04**  
National Standard of Canada  
*(reaffirmed 2019)*



## Concrete structures



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## **CAN/CSA-S474-04**

### **July 2007**

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**Title:** *Concrete structures* — originally published August 2004

**Revisions issued:** Update No. 1 — July 2005

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The following revisions have been formally approved and are marked by the symbol delta ( $\Delta$ ) in the margin on the attached replacement pages:

<b>Revised</b>	Clause 8.3.2
<b>New</b>	None
<b>Deleted</b>	None

CAN/CSA-S474-04 originally consisted of **60 pages** (x preliminary and 50 text), each dated **August 2004**. It now consists of the following pages:

<b>August 2004</b>	iii–x, 1–22, and 25–50
<b>July 2005</b>	Cover, National Standard of Canada text, title page, and copyright page
<b>July 2007</b>	23 and 24

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### 8.2.2

The element stiffness used in the elastic analysis may be based on the secant modulus of the concrete and the entire concrete cross-section, ignoring the reinforcement. In lieu of these gross stiffness values, procedures involving reductions in local stiffness to account for the influence of cracking may be used.

### 8.2.3

The sectional deformations throughout the structure that are caused by imposed deformations may be assumed to have the values determined from an elastic analysis. The resulting sectional forces caused by imposed deformations can be determined by multiplying the sectional deformations by the appropriate secant sectional stiffness.

### 8.2.4

For structural elements exposed to direct water pressure on the concrete surface, the influence of water pressure penetrating a crack on the magnitude of the sectional forces shall be taken into account. In lieu of determining the depth of penetration, the section may be checked for the two limiting cases of no penetration and full penetration.

### 8.2.5

For structures or portions of structures where second-order effects are significant, the influence of displacements and geometric imperfections shall be accounted for when sectional forces are determined. The stiffnesses used in the analyses should reflect the distributions of stiffnesses anticipated under the load combinations corresponding to the limit states in question.

## 8.3 Determination of factored sectional resistances

### 8.3.1

The factored sectional resistances shall be calculated using the factored material stress-strain relationships shown in Figure 8.1.

### Δ 8.3.2

The factored sectional resistances of elements that can be regarded as beams, columns, ties, or struts shall be determined using the procedures described in CSA A23.3. However, elements loaded by direct water pressure on the concrete surface shall be designed for the full shear force at the face of the support.

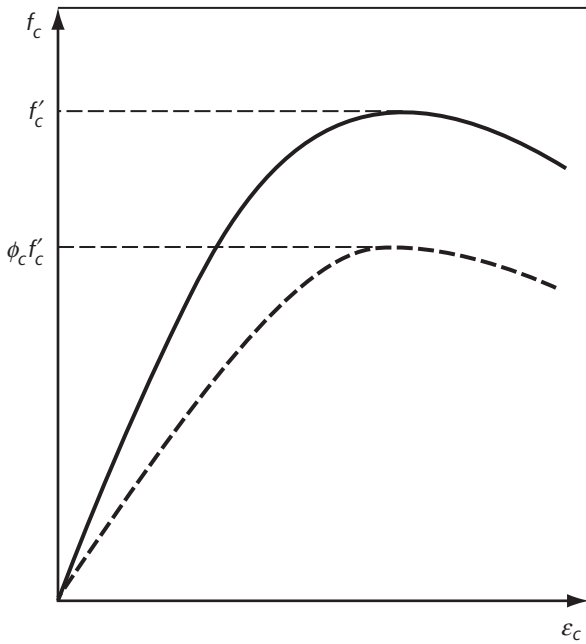
### 8.3.3

The factored sectional resistances of slab or shell elements subjected to the sectional forces shown in Figure 8.2 may be determined using the procedures described below:

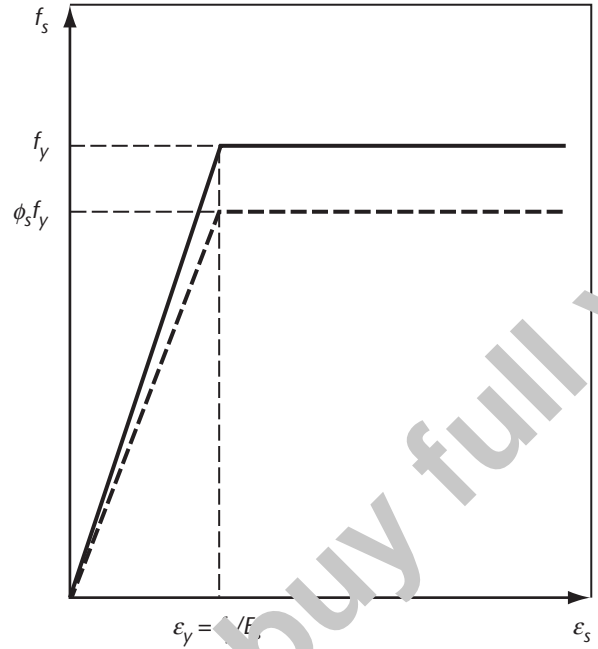
- It may be assumed that the in-plane concrete strains,  $\epsilon_{xx}$ ,  $\epsilon_{yy}$ , and  $\epsilon_{xy}$ , vary linearly over the thickness of the element.
- It may be assumed that the strain in a reinforcing bar is equal to the strain in a fibre of concrete adjacent to and parallel to the bar.
- It may be assumed that the strain in a prestressing tendon is equal to the strain in the adjacent concrete fibre plus the difference in strain between the tendon and the adjacent concrete fibre. This difference in strain can be determined from specifics of the prestressing operation and may be assumed to remain constant throughout the life of the structure.
- The stress in reinforcement may be determined from the calculated strain by using the factored uniaxial stress-strain relationship appropriate for the reinforcement.
- The principal stresses in the concrete may be calculated from the principal strains by using the factored multiaxial stress-strain relationships of concrete.

#### Notes:

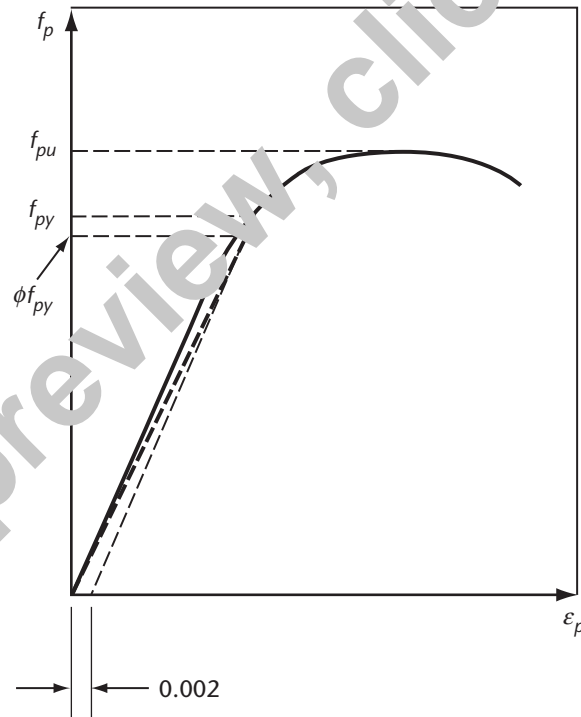
- The factored sectional resistances are the highest values of the sectional forces for which a valid strain state can be found.
- A valid strain state is one in which the stress resultants found by integrating the resulting stresses over the section faces balance the applied sectional forces.



**Concrete**



**Reinforcing bars**



**Prestressing tendons**

**Figure 8.1**  
**Factored material stress-strain relationships**  
 (See Clause 8.3.1.)

# **Update No. 1**

## **S474-04**

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<b>Revised</b>	Outside front cover and title page
<b>New</b>	National Standards of Canada text
<b>Deleted</b>	None

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# Preface

This is the third edition of CSA S474, *Concrete structures*. It supersedes the second edition, published in 1994, and the preliminary edition, published in 1989.

This Standard is the fourth of five CSA Standards that form the *Code for the design, construction, and installation of offshore structures*. The others are

- (a) CSA S471, *General requirements, design criteria, the environment, and loads*;
- (b) CAN/CSA-S472, *Foundations*;
- (c) CSA S473, *Steel structures*; and
- (d) CAN/CSA-S475, *Sea Operations*.

The Code was developed in the 1980s and 1990s at the request of petroleum industry and regulatory authorities, which recognized that hydrocarbon production structures would likely become common in Canada's offshore regions. In 1984, CSA formed a special Executive Management Committee to establish a program for developing offshore engineering standards. This evolved into the Strategic Steering Committee on Offshore Structures and the Technical Committees responsible for producing the Code's five Standards. The Standards were developed with the participation of representatives from government, regulatory authorities, industry, classification societies, universities, and research and other institutions.

The current edition of this Standard incorporates the results of expert review and comment since the publication of the second edition. Although this Standard specifies minimum requirements for the design of offshore structures, it is simply intended as a guide to current practice and is not meant to inhibit the development and application of new engineering concepts. The proper exercise of engineering judgment is essential to good design, and it is the designers who are ultimately responsible for the soundness of their structures; the provisions of this Standard do not diminish that responsibility in any way. Users of this Standard are also cautioned that it has been developed specifically for fixed offshore structures. Users who wish to apply its basic engineering principles to other types of offshore structures or applications should first consider whether an engineering reappraisal is required.

It is also important to be aware of other CSA Standards that bear on the design and construction of offshore concrete structures. Users of this Standard are advised to consult the other four Standards in the Code to ensure that significant details are not overlooked. For requirements governing concrete structures in general, they should consult two Standards currently under preparation and scheduled for publication in 2004, CSA A23.1-04/A23.2-04, *Concrete materials and methods of concrete construction/Methods of test and standard practices for concrete*, and CSA A23.3-04, *Design of concrete structures*.

This Standard was prepared by the Technical Committee on Steel and Concrete Structures, under the jurisdiction of the Strategic Steering Committee on Offshore Structures, and has been formally approved by the Technical Committee. It will be submitted to the Standards Council of Canada for approval as a National Standard of Canada.

August 2004

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# S474-04

## Concrete structures

### 1 Scope

#### 1.1

This Standard specifies material selection, design, and construction requirements for fixed concrete offshore structures. It is intended for use by engineers experienced in the design and construction of offshore structures.

#### 1.2

In CSA Standards, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the standard. Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material. Notes to tables and figures are considered part of the table or figure and may be written as requirements. Legends to equations and figures are considered requirements.

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### 2 Definitions, symbols, and reference publications

#### 2.1 Definitions

The following definitions apply in this Standard:

**Abrasion** — wearing away of the concrete surface due to the repeated actions of moving sea ice, water-borne particles, or both.

**Air entraining** — inclusion of air voids in the concrete matrix to provide freeze-thaw durability.

**Air-void parameters** — microscopically determined parameters that describe the size and distribution of the air void system in hardened concrete.

**Cementitious materials** — Portland cement, with or without supplementary cementitious materials, used as the binder in the making of concrete.

**Cracking strength of concrete** — the tensile stress at which significant cracks form in concrete.

**Curing compound** — a liquid that can be applied as a coating to the surface of newly placed concrete to retard water loss and, in the case of pigmented compounds, reflect heat, thereby providing an opportunity for the concrete to develop its properties in a favourable moisture (or moisture and temperature) environment.

**Design life** — the period from the commencement of the construction phase to the end of the decommissioning phase.

**Note:** *Design life is normally divided into five phases: construction, transportation, installation, operational, and decommissioning.*