SOUTH AFRICAN NATIONAL STANDARD

Basis of structural design and actions for buildings and industrial structures

Part 1: Basis of structural design
Table of changes

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<th>Change No.</th>
<th>Date</th>
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<td>Amdt 1</td>
<td>2011</td>
<td>Amended to update the scope, to delete the definitions of &quot;acceptable&quot; and &quot;competent person&quot;, to modify the general prerequisites, to correct a value in the table on the partial factors for actions for the ultimate limit state, to add a reference to annex B in the note to 7.4.2.2(a), and to add a cross reference to 7.4.3.2.</td>
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Acknowledgement

The SABS Standards Division wishes to acknowledge the valuable assistance derived from the South African Institution of Civil Engineering (SAICE).

Foreword

This South African standard was approved by National Committee SABS SC 59I, *Construction standards – Basis for the design of structures*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in October 2011.

This document supersedes SANS 10160-1:2010 (edition 1).

A vertical line in the margin shows where the text has been technically modified by amendment No. 1.

The SANS 10160 series consists of the following eight parts, under the general title *Basis of structural design and actions for buildings and industrial structures*:

**Part 1:** Basis of structural design.

**Part 2:** Self-weight and imposed loads.

**Part 3:** Wind actions.

**Part 4:** Seismic actions and general requirements for buildings.

**Part 5:** Basis for geotechnical design and actions.

**Part 6:** Actions induced by cranes and machinery.

**Part 7:** Thermal actions.

**Part 8:** Actions during execution.

Annexes A, B, C, D and E are for information only.
Background

With the revision of SABS 0160, its scope has generally been maintained in terms of the structures provided for, design procedures to be applied and the associated levels of reliability, as well as the actions to be considered. Similarly, the materials-based structural design standards which are intended to be applied in conjunction with SANS 10160 have generally been maintained. Deviations in scope and contents from that of SABS 0160 derive mainly from the incorporation of improved, additional models and procedures that are in the main implemented internationally.

The general basis of structural design utilises the limit states based partial factor procedures to achieve appropriate levels of reliability for the design of safe and sound structures. The requirements include not only the treatment of actions and their combinations and effects on structures, but also the material-independent requirements for structural resistance. Changes from the general requirements stipulated in SABS 0160 result mainly from extensions of the design situations and the related limit states which are required to be considered. Although this appears to increase the complication of the design procedures, it really clarifies the requirements. The extended basis of design should improve the consistency of the reliability of structural performance, improve the reliability where necessary and also remove some unwarranted conservatism.

The provisions of SANS 10160 update the procedures for the treatment of actions as stipulated in SABS 0160 by presenting revised and extended requirements, load models and the determination of appropriate values for the actions. The revised procedures apply to self-weight and imposed loads, wind actions, seismic actions and earthquake resistance as well as crane induced actions.

An important addition to the scope of SANS 10160 is to provide for the following:

a) Geotechnical design and actions for situations within the scope of buildings and similar industrial structures.

b) Other additions include the following:

1) actions induced by stationary rotating machinery are added to the provisions for crane induced actions;

2) new provisions for thermal actions include information on local climatic conditions, as specified in the TMH 7 requirements for bridge design; and

3) requirements and actions on the structure during execution are also added, which represent the situations to which a structure is exposed during construction, prefabrication, erection or reconstruction. These requirements should ensure that proper attention is given to the assignment of responsibilities for the performance of the structure not only ultimately during its use, but also during its execution.

Relationship with Eurocodes

Although SABS 0160 served as basis and reference for the scope and reference levels of reliability and ISO standards, in particular SANS 2394, SANS 10160 is primarily based on appropriate parts of the Eurocodes.
Advances were made in the Eurocodes in the treatment of a comprehensive set of structures and structural materials within a consistent reliability framework and providing for an elaborate set of actions related to the function of the civil engineering works and environmental exposure, whilst allowing levels of safety to be set nationally. The comprehensive treatment of the design of civil engineering works in Eurocode results in harmonization and consistency between its various parts. Equivalent unification is therefore also achieved by reference to the respective Eurocode parts of the various procedures which are incorporated into SANS 10160.

Adjustments for local environmental conditions, present levels of reliability and a limited degree of providing for existing practice and preferences in SANS 10160 are similar to the adjustments allowed for Eurocode member states through the Nationally Determined Parameters. SANS 10160 however, deviates substantially from Eurocode practice through the compilation of the eight part standard series into a single document. A conscious effort was made to achieve as compact and effective a layout of the relevant material. However, since such a formulation and format can be considered as a harmonised scaling down of Eurocode, the benefits from the consistent and unified Eurocode procedures are maintained.

An important practical implication of the high degree of consistency that has been maintained between this standard and the relevant Eurocode parts is that Eurocode procedures can be applied in design for situations which are outside the scope of this standard. Guidance to this effect is given in the relevant parts of SANS 10160. Specialist input will generally be required for these situations.

The reference in a part of the SANS 10160 series to the Eurocodes also implies a recommendation that the future revision of materials-based structural design standards, or the introduction of new standards which are not presently available, also refer to the Eurocodes. Such development will improve the consistency between SANS 10160 and all other South African structural design standards. By sharing a common basis of design, the lack of consistency between the present materials-based structural design standards will also improve. Such development would also enhance harmonization of South African standards with international practice.

Outline of parts

An outline and summary of the most important features of the eight parts of SANS 10160 are given below. An indication is also given of changes from SABS 0160, where relevant. Additional information on the considerations and motivations for changes and the introduction of new procedures is provided in the publication, Background to SANS 10160 (see bibliography).

- **SANS 10160-1: Basis of structural design**, serves as a general standard to specify procedures for determining actions on structures and structural resistance in accordance with the partial factor limit states design approach. The requirements and procedures are formulated to achieve acceptable levels of safety, serviceability and durability of structures within the scope of the application of the SANS 10160 series.

  Procedures for the basis of structural design include requirements for the specified minimum values for actions on structures presented in parts 2 to 8 of SANS 10160, the determination of design values for the effects of combined actions on the structure under a sufficiently severe and varied set of limit states, and general requirements for sufficient structural resistance reliability to which the related materials-based structural design standards should comply.
Provisions are introduced for taking situations and associated actions into account which are not expected during design life, but with such severe consequences that the risks of such situations need to be considered. A proper basis for improved specifications of robustness requirements is also presented.

Improved specification of procedures for design assisted by testing is obtained by requiring an equivalent level of reliability to that achieved by the procedures of SANS 10160. Guidance is given on testing procedures and the statistical treatment of the results required for compliance.

- **SANS 10160-2: Self-weight and imposed loads**, presents procedures for the treatment of self-weight and imposed loads on buildings. Procedures are given for determining self-weight of structural and non-structural materials as permanent loads, including recommended values of material densities. Minimum characteristic values for imposed loads as variable actions are given for loads on floors as a function of the occupancy, an extended range of imposed loads for industrial use of buildings, imposed roof loads, horizontal loads on parapets, railings, balustrades and partitions.

- **SANS 10160-3: Wind actions**, covers procedures for the determination of actions on land-based structures due to natural winds. The scope of application is limited to the general type buildings and industrial structures (in line with the SANS 10160 series) and is restricted to structures in which wind actions can be treated as quasi-static.

The wind climate given in SANS 10160 is effectively maintained, but its presentation is modified. The basic wind speed is based on an equivalent 10 min average value. The values of the basic wind speed are selected to be equivalent to the 3 s gust wind speeds used in the SANS 10160. The wind map is nominally updated. Terrain categories are modified to present a more even distribution of wind exposure conditions. The wide-ranging additional information on pressure and force coefficients represents a substantial update of the procedures for wind actions on structures.

- **SANS 10160-4: Seismic actions and general requirements for buildings**, covers earthquake actions on buildings and provides strategies and rules for the design of buildings subject to earthquake actions. Provisions for actions on structures exposed to earthquakes are revised and updated. The specification of seismic design of standard structures is extended, but procedures are restricted to situations where principles of proper layout and detailing are complied with.

- **SANS 10160-5: Basis for geotechnical design and actions**, represents an extension of the scope of SANS 10160 to set out the basis for geotechnical design and gives guidance on the determination of geotechnical actions on buildings and industrial structures, including vertical earth loading, earth pressure, ground water and free water pressure, as well as actions caused by ground movement. Procedures are given for determining representative values for geotechnical actions. The design of geotechnical structures such as slopes, embankments or free-standing retaining structures is not covered in SANS 10160-5.