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Number and title:
SANS 10160-8: BASIS OF STRUCTURAL DESIGN AND ACTIONS FOR BUILDINGS AND INDUSTRIAL STRUCTURES — PART 8: ACTIONS DURING EXECUTION

Remarks:

PLEASE NOTE:

- **The technical committee, SABS SC 59I responsible for the preparation of this standard has reached consensus that the attached document should become a South African standard. It is now made available by way of public enquiry to all interested and affected parties for public comment, and to the technical committee members for record purposes. Any comments should be sent by the indicated closing date, either by mail, or by fax, or by e-mail to**

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  Any comment on the draft must contain in its heading the number of the clause/subclause to which it refers. A comment shall be well motivated and, where applicable, contain the proposed amended text.

- **The public enquiry stage will be repeated if the technical committee agrees to significant technical changes to the document as a result of public comment. Less urgent technical comments will be considered at the time of the next amendment.**

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Edition 1

SOUTH AFRICAN NATIONAL STANDARD

Basis of structural design and actions for buildings and industrial structures

Part 8: Actions during execution

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Table of changes

Change No.	Date	Scope

Foreword

This South African standard was approved by National Committee SABS SC 59I, *Construction standards – Bases 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 supersedes SABS 0160:1989 (edition 2).

This document was published in xxxx 2009.

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 of geotechnical design and actions*

Part-6, *Actions induced by cranes and machinery*

Part-7, *Thermal actions*

Part-8, *Actions during execution*

Contents

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Basis of structural design and actions for buildings and industrial structures

Part-8:
Actions during execution

1 Scope

1.1 This part of the SANS 10160 Series falls within the general scope of application as given in SANS 10160-1 clause 1.1.

1.2 The requirements specified in SANS 10160-2 shall be applied in conjunction with the requirements specified in the following parts of the SANS 10160 Series :

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 of geotechnical design and actions*

Part 6 : *Actions induced by cranes and machinery*

Part 7, *Thermal actions*

1.3 This standard provides principles and general rules for the determination of actions which should be taken into account during execution of buildings and industrial structures.

NOTE 1 : It may be used as guidance for the determination of actions to be taken into account for different types of construction works, including structural alterations such as refurbishment and partial or full demolition. See Annex A

NOTE 2 : Rules concerning safety of people in and around the construction site are out of the scope of this standard. Such rules may be defined for the individual project in terms of the Occupational Health and Safety Act.

NOTE 3 : This standard provides principles and general rules for the determination of actions which should be taken into account during execution of buildings and industrial structures. The allocation of responsibilities during the construction process must be defined in appropriate documents for each individual project and are generally based on the responsibilities as assigned in appointments and contracts.

1.4 It gives rules for the determination of actions which may be used for the design of auxiliary construction works needed for the execution of buildings and industrial structures.

1.5 Design rules for auxiliary construction works are not covered and shall be defined in the appropriate documents.

NOTE : These design rules for auxiliary construction works may be defined for the individual project. Guidance may be found in European standards. For example, design rules for formworks and falseworks are given in EN 12812.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

SANS 10100-1 *The structural use of concrete Part 1: Design*

SANS 10137 *The installation of glazing in buildings*

SANS 10160-1 *Basis of structural design and actions for buildings and industrial structures Basis of structural design*

SANS 10160-2 *Basis of structural design and actions for buildings and industrial structures* – Part 2: Self-weight and imposed loads

SANS 10160-3 *Basis of structural design and actions for buildings and industrial structures- Part 3: Wind actions*

SANS 10160-4 *Basis of structural design and actions for buildings and industrial structures – Part 4: Seismic actions and general requirements for buildings*

SANS 10160-5 *Basis of structural design and actions for buildings and industrial structures – Part 5: Basis for geotechnical design and actions*

SANS 10160-6, *Basis of structural design and actions for buildings and industrial structures* – Part-6, *Actions induced by cranes and machinery*

SANS 10160-7 *Basis of structural design and actions for buildings and industrial structures – Thermal actions*

SANS 10162-1 *The structural use of steel Part 1: Limit-state design of hot-rolled steelwork*

SANS 10162-2 *The structural use of steel Part 2: Limit-states design of cold-formed steelwork*

SANS 10162-4 *Structural use of steel Part 4: The design of cold-formed stainless steel structural members*

SANS 10163-1 *The structural use of timber Part 1: Limit-states design*

SANS 10164-2 *The structural use of masonry Part 2: Structural design and requirements for reinforced and pre-stressed masonry*

ISO 3898

3 Definitions and symbols

For the purpose of this document the definitions and symbols given in SANS 10160-1 and the following apply.

3.1 Definitions

3.1.1
auxiliary construction works
any works associated with the construction processes that are not required after use when the related execution activities are completed and they can be removed (for example, falsework, scaffolding, propping systems, cofferdams and temporary bracing systems)

3.1.2
construction load
load that can be present due to execution activities, but is not present when the execution activities are completed

3.2 Symbols

NOTE The notation used is based on ISO 3898.

3.2.1 Latin upper case letters

F_{hn} nominal horizontal forces

F_{w} wind forces

Q_{c} construction load (variable action)

Q_{ca} construction load due to personnel and hand tools

Q_{cb} construction load due to storage of movable items

Q_{cc} construction load due to non-permanent equipment

Q_{cd} construction load due to movable heavy machinery and equipment

Q_{ce} construction load due to accumulation of waste

Q_{cf} loads from parts of a structure in temporary states

Q_{wa} actions due to water, including ground water

3.2.1 Latin lower case letters

q_{ca} uniformly distributed construction load due to personnel and hand tools

q_{cb} uniformly distributed construction load due to storage of movable items

q_{cc} uniformly distributed construction load due to non-permanent equipment

q_{cd} uniformly distributed construction load due to movable heavy machinery and equipment

4 Basic requirements for execution

4.1 The structure shall be executed to the extent necessary to comply with the assumptions of the design rules for the completed structure during all the stages of execution, taking account of construction and other actions on the in-complete structure. (See Clause 4.2 SANS 10160-1).

4.2 The structure shall be executed in such a way that the partially completed structure will sustain all actions, including construction loads, during the different stages of execution.

4.3 Provision shall be made for the necessary structural integrity and robustness of the partially completed structure during the different stages of execution. (See SANS 10160-1).

5 Classification of actions

5.1 General

Actions during execution shall be classified in accordance with SANS 10160-1, and may include construction loads and those that are not construction loads.

5.2 Classification of actions (other than construction loads) occurring during execution

In addition to construction loads (see 5.3 and 7.9) all actions that could act on the structure during execution, shall be considered.

NOTE Tables 1 and 2 illustrate possible classifications.

Table 1 — Classification of actions (other than construction loads) during execution stages

1	2	3	4	5	6	7
Clause	**Action**	**Classification**				**Remarks**
		Variation in time	**Origin**	**Spatial Variation**	**Nature (static or dynamic)**	
7.2	Self weight	Permanent	Direct	Free	Static	Free during transportation or storage if dropped
7.3	Soil movement	Permanent or variable	Indirect	Free	Static	
7.3	Earth pressure	Permanent or variable	Direct	Free	Static	
7.4	Pre-stressing	Permanent or variable	Direct	Fixed	Static	Variable for local design (e.g. anchorage)
7.5	Pre-deformations	Permanent or variable	Indirect	Free	Static	
7.6	Temperature	Variable	Indirect	Free	Static	
7.6	Shrinkage and hydration effects	Variable or accidental	Indirect	Free	Static	
7.7	Initial imperfections	Variable	Indirect	Fixed	Static	Influence on stability of the structure
7.8	Wind actions	Variable or accidental	Direct	Fixed or free	Static or dynamic	Treated as pseudo-static
7.9	Actions due to water	Permanent, variable or accidental	Direct	Fixed or free	Static	Permanent or variable according to project specifications.
7.11	Accidental	Accidental	Direct or Indirect	Free	Static or dynamic	
7.12	Seismic	Accidental	Direct	Free	Dynamic	Treated as pseudo-static

5.3 Classification of Construction loads

5.3.1 Construction loads (see 7.9) should be classified as variable actions (Q_c).

NOTE 1 Table 2 gives a classification of construction loads.

NOTE 2 Table 4 gives a full description and classification of construction loads

Table 2 — Classification of construction loads

1	2	3	4	5	6
Action	**Classification**				**Remarks**
	Variation in time	**Origin**	**Spatial variation**	**Nature (Static or dynamic)**	
Personnel and hand-tools	Variable	Direct	Free	Static	
Storage of movable items	Variable	Direct	Free	Static or dynamic	Dynamic in case of dropped loads
Non-permanent equipment	Variable	Direct	Fixed or free	Static or dynamic	
Movable heavy machinery and equipment	Variable	Direct	Free	Static or dynamic	
Accumulation of waste materials	Variable	Direct	Free	Static or dynamic	Can impose on e.g. vertical surfaces also
Loads from parts of structure in temporary states	Variable	Direct	Free	Static	Dynamic effects are excluded

NOTE 3 Construction loads, which are caused by cranes, equipment, auxiliary construction works or structures (or both) may be classified as fixed or free actions depending on the possible position(s) for use.

5.3.2 Where construction loads are classified as fixed, then tolerances for possible deviations from the theoretical position should be defined.

5.3.3 Where construction loads are classified as free, then the limits of the area where they may be moved or positioned should be determined.

NOTE In accordance with SANS 10160-1, control measures may have to be adopted to verify the conformity of the position and moving of construction loads with the design assumptions.

6 Design situations and limit states

6.1 Identification of design situations

6.1.1 Transient, accidental and seismic design situations shall be identified and taken into account

as appropriate for design for execution.

NOT For wind actions during storm conditions (for example, tornado or cyclone) the accidental design situation should apply.

6.1.2 Design situations should be selected as appropriate for the structure as a whole, the structural members, the partially completed structure, and also for auxiliary construction works and equipment.

6.1.3 The selected design situations shall take into account the conditions that apply from stage to stage during execution in accordance with SANS 10160-1.

6.1.4 The selected design situations, which shall include any revised design situation, shall be in accordance with the execution processes resulting from the design.

6.1.5 Any selected transient design situation shall be associated with a nominal duration equal to or greater than the anticipated duration of the stage of execution under consideration. The design situations shall take into account the likelihood for any corresponding return periods of variable actions (for example climatic actions).

NOTE 1 The assessment of characteristic values of variable actions during execution may be related to the return period. Recommended return periods of climatic actions are given in table 3, depending on the nominal duration of the relevant design situation.

NOTE 2 The minimum recommended wind velocity during execution for durations of up to 3 months is 20 m/s.

NOTE 3 Relationships between characteristic values and return period for wind and thermal actions are given in SANS 10160-3 and SANS 10160-7 respectively.

Table 3 — Recommended return periods for the assessment of the characteristic values of climatic actions

1	2
Duration of design situation	**Return period**
≤ 3 days	2 years [a]
> 3 months (but > 3 days)	5 years [b]
≤ 1 year (but > 3 months)	10 years
> 1 year	25 years

[a] A nominal duration of three days, to be chosen for short execution phases, corresponds to the extent in time of reliable meteorological predictions for the location of the site. This choice may be kept for a slightly longer execution phase if appropriate organizational measures are taken. The concept of mean return period is generally not appropriate for short term duration.

[b] For a nominal duration of up to three months actions may be determined taking into account appropriate seasonal and shorter term meteorological climatic variations.

6.1.6 Where an execution stage design prescribes limiting climatic conditions, or weather window, the characteristic climatic actions should be determined taking into account:

a) duration of the execution stage;

b) the reliability of meteorological predictions; and

c) time to organise protection measures.

6.1.7 Imperfections in the geometry of the structure and of structural members should be defined for the selected design situations during execution.

6.1.8 Where the structure or parts of it are subjected to accelerations that may give rise to dynamic or inertia effects, these effects should be taken into account.

NOTE Significant accelerations may be excluded where possible movements are strictly controlled by appropriate devices.

6.1.9 Actions caused by water, including for example uplift due to groundwater, should be determined in conjunction with water levels corresponding to specified or identified design situations, where appropriate.

NOTE These actions may commonly be determined in the same manner as specified in (e) above.

6.1.10 Actions due to creep and shrinkage in concrete construction works should be determined on the basis of the expected dates and duration associated with the design situations, where relevant.

6.2 Ultimate limit states

6.2.1 Ultimate limit states shall be verified for all selected transient, accidental and seismic design situations as appropriate during execution in accordance with SANS 10160-1.

NOTE 1 The combinations of actions for accidental design situations can either include the accidental action explicitly or refer to a situation after an accidental event.

NOTE 2 Generally, accidental design situations refer to exceptional conditions applicable to the structure or its exposure, such as:
• impact;
• local failure and subsequent progressive collapse,
• fall of structural or non-structural parts,
and, in the case of buildings,
• abnormal concentrations of building equipment and/or building materials,
• water accumulation on steel roofs,

6.2.2 The verifications of the structure should take into account the appropriate geometry and resistance of the partially completed structure corresponding to the selected design situations.

6.2.3 For transient, accidental and seismic design situations the ultimate limit state verifications shall be based on combinations of actions applied with the partial factors for actions, γ_f, and the combination factors, ψ, specified in SANS 10160-1.

6.3 Serviceability limit states

6.3.1 The serviceability limit states for the selected design situations during execution shall be verified, as appropriate, in accordance with SANS 10160-1.

6.3.2 The criteria associated with the serviceability limit states during execution shall take into account the requirements for the completed structure.

6.3.3 Operations during execution which can cause excessive cracking and/or early deflections and which may adversely affect the durability, fitness for use or aesthetic appearance in the final stage (or both) shall be avoided.

6.3.4 Load effects due to shrinkage and temperature should be taken into account in the design and should be minimized by appropriate detailing.

6.3.5 The combinations of actions should be established in accordance with SANS 10160-1. In general, the relevant combinations of actions for transient design situations during execution are:

a) the irreversible or reversible combination, and

b) the quasi-permanent combination

6.3.6 Serviceability requirements for auxiliary construction works should be defined in order to avoid any unintentional deformations and displacements which affect the appearance or effective use of the structure or cause damage to finishes or non-structural members.

7 Representation of actions

7.1 General

7.1.1 Characteristic and other representative values of actions shall be determined in accordance with SANS 10160-1.

NOTE 1 The representative values of actions during execution may be different from those used in the design of the completed structure. Common actions during execution, specific construction loads and methods for establishing their values are given in this standard.

NOTE 2 The action effects may be minimised or eliminated by appropriate detailing, providing auxiliary construction works or by protection/safety devices.

7.1.2 Representative values of construction loads Q_c should be determined taking into account, including their variations in time.

7.1.3 Interaction effects between structures and parts of structures should be taken into account during execution. Such structures should include structures that form part of the auxiliary construction works.

7.1.4 When parts of a structure are braced or supported by other parts of a structure (for example by propping floor beams for concreting) the actions on these parts resulting from bracing or supporting shall be taken into account.

NOTE Depending on the construction procedures, the supporting parts of the structure may be subjected to loads greater than the imposed loads for which they are designed for the persistent design situation. Additionally, the supporting slabs may not have developed their full strength capacities.

7.1.5 Horizontal actions from friction effects should be determined and based on the use of appropriate values of friction coefficients.

NOTE Lower and upper bounds of friction coefficients may have to be taken into account. Friction coefficients may be defined for the individual project.

7.2 Actions on structural and non-structural members during handling

7.2.1 The self-weight of structural and non-structural members during handling should be determined in accordance with SANS 10160- 2.

7.2.2 Dynamic or inertia effects of self-weight during handling of structural and non-structural members should be taken into account.

7.2.3 Actions on structural and non-structural members due to support positions and conditions during hoisting, transporting or storage should be taken into account, and where appropriate, the actual support conditions and dynamic or inertia effects due to vertical and horizontal accelerations.

7.3 Geotechnical actions

7.3.1 The characteristic values of geotechnical parameters, soil and earth pressures, and limiting values for movements of foundations shall be determined in accordance with SANS 10160-5.

7.3.2 The soil movements for the foundations of the structure and of auxiliary construction works, for example temporary supports during execution, should be assessed from the results of geotechnical investigations. Such investigations should be carried out to give information on both absolute and relative values of movements, their time dependency and possible scatter.

NOTE Movements of auxiliary construction works may cause displacements and additional stresses.

7.3.3 The characteristic values of soil movements estimated on the basis of geotechnical investigations using statistical methods should be used as nominal values for imposed deformations of the structure.

NOTE It may be possible to adjust the calculated imposed deformations by considering the full soil-structure interaction.

7.4 Actions due to pre-stressing

7.4.1 Actions due to pre-stressing should be taken into account, including the effects of interactions between the structure and auxiliary construction works (for example falsework) where relevant.

NOTE Pre-stressing forces during execution may be determined according to the requirements of the relevant structural design standards.

7.4.2 Loads on the structure from stressing jacks during the pre-stressing activities should be classified as variable actions for the design of the anchor region.

7.4.3 Pre-stressing forces during the execution stage should be taken into account as permanent actions.

7.5 Pre-deformations

7.5.1 The treatment of the effects of pre-deformations shall be in conformity with the relevant structural design standards.

NOTE Pre-deformations can result from, for example, displacements of supports (such as loosening of ropes or cables, including hangers, and displacements of supports and bearings).

7.5.2 Action effects from execution processes should be taken into account, especially where pre-deformations are applied to a particular structure in order to generate action effects for improving its final behaviour, particularly for structural safety and serviceability requirements, for example pre-camber.

7.5.3 The action effects from pre-deformations should be checked against design criteria by measuring forces and deformations during execution, for example measuring forces and deformations during the pre-stressing process.

7.6 Temperature, shrinkage and hydration effects

7.6.1 The effects of temperature, shrinkage and hydration shall be taken into account in each construction phase, as appropriate.

NOTE For buildings, the actions due to temperature and shrinkage are not generally significant if appropriate detailing has been provided for the persistent design situation.

7.6.2 Climatic thermal actions should be determined according to SANS 10160-7.

7.6.3 Thermal actions due to hydration should be determined according to relevant structural design standards.

NOTE 1 Temperature can rise significantly in a massive concrete structure after casting, with consequent thermal effects.

NOTE 2 The extreme values of the minimum and maximum temperatures to be taken into account in the design may be changed according to seasonal variations.

7.6.4 Shrinkage effects of structural building materials should be determined according to relevant structural design standards.

7.6.5 Where relevant, second order effects should be taken into account and the effects of deformations from temperature and shrinkage should be combined with initial imperfections.

7.7 Imperfections and tolerances

The influence of initial imperfections on the stability of the incomplete structure during the different stages of execution should be taken into account. Initial imperfections which may deviate during execution from those of the completed structure should be taken into account.

NOTE The action effects of initial imperfections may be minimised or eliminated by temporary bracing or by providing auxiliary construction works.

7.8 Wind actions

7.8.1 The need for a wind dynamic response design procedure should be determined for the execution stages, taking into account the degree of completeness and stability of the structure.

7.8.2 Where a dynamic response procedure is not needed, the characteristic values of static wind actions forces F_W should be determined according to SANS 10160-3 for the appropriate return period.

7.8.3 For lifting and moving operations or other construction phases that are of short duration, the maximum acceptable wind speed for the operations should be specified.

7.8.4 The effects of wind induced vibrations such as vortex induced cross wind vibrations, galloping, flutter and rain-wind should be taken into account.

7.8.5 Wind actions on parts of the structure that are intended to be internal parts of the structure after its completion, such as walls, should be taken into account for execution processes.

NOTE In such cases, the external pressure coefficients c_{pe} for free-standing walls may have to be applied.

7.8.6 When determining wind forces, the areas of equipment, falsework and other auxiliary construction works exposed to wind actions, should be taken into account.

7.9 Actions caused by water

7.9.1 In general, actions due to water, including ground water, Q_{wa}, should be represented as static pressure.

7.9.2 Actions caused by water may be taken into account in combinations as permanent or variable actions.

NOTE The classification of actions caused by water as permanent or variable may be defined for the individual project taking account of the specific environmental conditions.

7.9.3 Actions from rainwater should be taken into account for the conditions where there may be collection of water such as ponding effects from, for example, inadequate drainage, imperfections of surfaces, deflections and/or failure of dewatering devices.

7.10 Construction loads

7.10.1 General

7.10.1.1 Construction loads Q_C should be represented in combinations of actions by one or more single variable actions Q_{C1}, Q_{C2}, etc., as appropriate, depending on the design of the structure and the loads to which they may be subjected. Groupings of construction loads should be applied as a single variable action for combination, as appropriate, with other non construction load variable actions. Actions to be included for consideration are defined in table 4.

NOTE See also table 2.

Table 4 - Representation of construction loads Q_C

1	2	3	4	5
Actions			**Representation**	**Notes**
Type	**Symbol**	**Description**		
Personnel and hand-tools	Q_{ca}	Working personnel, staff and visitors, possibly with hand-tools or other small site equipment	Modelled as a uniformly distributed load q_{ca} and applied as to obtain the most unfavourable effects	- The recommended value of the characteristic uniformly distributed load $q_{ca,k}$ is 1.0 kN/m^2.
Storage of movable items	Q_{cb}	Storage of moveable items, e.g.:building and construction materials, precast elements, equipment	Modelled as free actions and be represented separately or together, as appropriate, by:a uniformly distributed load q_{cb} a concentrated load Q_{cb}	For densities of construction materials, see SANS 10160-2
Non permanent equipment	Q_{cc}	Non permanent equipment in position for use during execution, either: static (e.g. formwork panels, scaffolding, falsework, machinery, containers) or during movement (e.g. travelling forms, launching girders and counterweights)	Modelled as free actions and be represented as appropriate by:a uniformly distributed load q_{cc} concentrated loads Q_{cc} representing identifiable objects	1. These loads may be defined by using information given by the supplier. 2. Unless more accurate information are available, they may be modelled by a uniformly distributed load with a recommended minimum characteristic value of $q_{cc,k}$ = 0,5 kN/m^2.

Table 4 *(concluded)*

1	2	3	4	5
Actions			**Representation**	**Notes**
Moveable heavy machinery and equipment	Q_{cd}	Usually wheeled or tracked, e.g. cranes, lifts, vehicles, lift-trucks, power installations, jacks, heavy lifting devices	Modelled as free actions and be represented as appropriate by: - a uniformly distributed load q_{cd} - concentrated loads Q_{cd} representing identifiable objects	These loads should be defined by using information given by the supplier.
Accumulation of waste materials	Q_{ce}	For example surplus construction materials, excavated soil, or demolition materials	Should be taken into account by considering possible effects on horizontal, inclined and vertical elements (such as walls), depending on the build-up, and thus mass effects of the accumulation of material.	See also SANS 10160-5
Loads from parts of a structure in temporary states	Q_{cf}	Loads under execution before the final design actions take effect	Taken into account and modelled according to the planned execution sequences, including consequences of those sequences, for example, loads and reverse load effects due to particular processes of construction, such as assemblage	See also 7.10.2 for additional loads due to concrete being fresh

7.10.1.2 Characteristic values of construction loads, including vertical and horizontal components where relevant, shall be determined according to the technical requirements for the execution of the works and the requirements for combination of actions as specified in SANS 10160-1.

7.10.1.3 The characteristic values of construction loads applied in the combination with other actions shall take account of the simultaneous occurrence of these actions and treated in accordance with SANS 10160-1.

7.10.1.4 Horizontal actions resulting from the effects of construction loads shall be determined and taken into account in the structural design of a partly completed structure as well as the completed structure.

7.10.1..5 Horizontal actions resulting from, for example, wind forces and the effects of sway imperfections and sway deformations shall be taken into account.

7.10.1.6 Nominal horizontal forces (F_{hn}) may be applied only when such a method can be justified as appropriate and reasonable for a particular case. In such cases, the determined nominal horizontal forces should be applied at locations to give the worst effects, and may not always correspond to those of the vertical loads. A value of 3 % of the vertical loads from the most unfavourable combination of actions should be used.

7.10.1.7 Dynamic effects shall be considered where it is anticipated that the construction loads will cause such effects.

7.10.2 Construction loads during casting of concrete

7.10.2.1 Actions to be taken into account simultaneously during casting of concrete may include working personnel with small site equipment, Q_{ca} , formwork and load-bearing members, Q_{cc} , and the weight of fresh concrete (which is one example of, Q_{cf}), as appropriate.

NOTE 1 Recommended values for fresh concrete, Q_{cf} , may be taken from table 5 and from SANS 10160-2. Other values may have to be defined, for example, when using self-levelling concrete or precast products.

NOTE 2 Loads according to (a), (b) and (c), as given in figure 1 and table 5 are intended to be positioned to cause the maximum effects, which may be symmetrical or not.

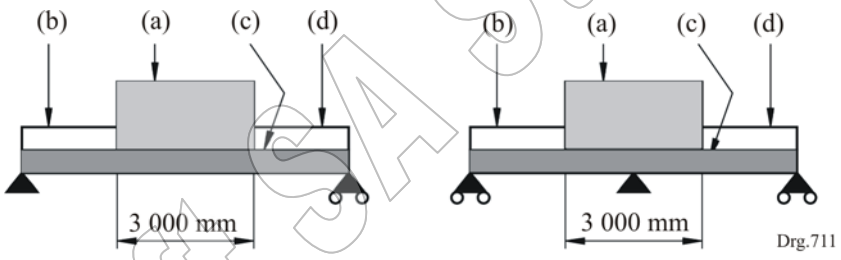

Figure 1 — Actions due to construction loads during casting of concrete

Table 5 — Recommended characteristic values of actions due to construction loads during casting of concrete

1	2	3
Action	**Loaded area**	**Load in kN/m^2**
(a)	Inside the working area 3m × 3m (or the span length if less)	10 % of the self weight of the concrete but not less than 0,75 and not more than 1,5. Includes Q_{ca} and Q_{cb}
(b)	Outside the working area	0,75 covering Q_{ca}
(c)	Actual area	Self weight of the formwork, load-bearing element (Q_{cc}) and the weight of the fresh concrete for the design thickness (Q_{cf})

7.10.2.2 Horizontal actions of fresh concrete should be taken into account.

7.10.3 Imposed construction roof loads

Imposed loads on inaccessible roofs during construction should be provided for in accordance with SANS 10160-2.

7.10.4 Accidental actions

7.10.4.1 Accidental actions such as impact from construction vehicles, cranes, building equipment or materials in transit (for example skip of fresh concrete), and/or local failure of final or temporary supports, including dynamic effects, that may result in collapse of load-bearing structural members, shall be taken into account.

NOTE 1 Abnormal concentrations of building equipment and/or building materials on load-bearing structural members are not regarded as accidental actions.

NOTE 2 A dynamic amplification factor of 2 should be used. In specific cases a dynamic analysis is needed.

7.10.4.2 The action due to incidents of equipment falling onto or from a structure, including the dynamic effects, should be defined and taken into account.

7.10.4.3 The effects of (a) and (b) above should be assessed to determine the potential for inducing movement in the partially completed structure during the various stages of execution, and also the extent and effect of any such movement should be determined, with the potential for progressive collapse assessed.

7.10.4.4 Accidental actions used for design situations should be taken into account for any changes. To ensure that the appropriate design criteria are applied at all times, measures should be taken as work proceeds.

7.11 Seismic actions

7.11.1 Seismic actions should be determined according to SANS 10160-4, taking into account the reference period of the considered transient situation.

7.11.2 The design values of ground acceleration and the importance factor γ_I should be defined for the individual project.

Annex A
(informative)

Actions on structures during alteration, reconstruction or demolition

A.1 The actual performance of structures affected by deterioration should be taken into account in the verification of the stages for reconstruction or demolition. The investigation of structural conditions to enable the identification of the load-bearing capacity of the structure and prevent unpredictable behaviour during reconstruction or demolition should be undertaken.

A.2 Guidance for the most common actions and methods for their assessment are provided in clause 7. However, some construction loads during reconstruction or demolition may be different in characteristics and representation from those shown in tables 4 and 5, and their effects on all relevant structures under transient design situations should be verified.

A.3 Combinations of actions for various design situations should be as specified in SANS 10160-1.

A.4 Unless more specific information is known, values of combination factors ψ recommended for buildings and industrial structures in SANS 10160-1 may be considered in the design for transient design situations.

A.5 All imposed loads should be considered if the part of structure remains in use during its reconstruction or partial demolition. These loads may vary at different transient stages.

A.6 The reliability for the remaining structure or parts of the structure under reconstruction, partial or full demolition should be consistent with that considered in SANS 10160-1 and the relevant design standards for completed structures or parts of structures.

A.7 The actions due to the works should not adversely affect neighbouring structures by, for example, removing or imposing loads that may cause instability.

A.8 Construction loads specific for reconstruction or demolition should be determined taking into account, for example, methods and arrangements of storing materials, the techniques used during reconstruction or demolition, the execution system and the particular stages of work. Construction loads during reconstruction or demolition may also include the effects of storage from disassembled materials or dismantled elements, including horizontal actions.

A.9 Dynamic effects should be considered where it is anticipated that activities during re-construction or demolition will cause such effects.

Bibliography

ISO 3898, *Bases for design of structures – Notations – General symbols.*