

A close-up, vertical image of a pencil tip, showing the sharp lead point and the surrounding wooden casing, positioned on the right side of the cover.

Guide to Good Practice for Structural Engineering

2nd Edition

Joint Structural Division

Second Edition

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Preface

The Institution of Structural Engineers (IStructE) is the world's largest membership organisation dedicated to the art and science of structural engineering. The Institution of Structural Engineers is an internationally recognised source of expertise and information concerning all issues that involve structural engineering and public safety within the built environment.

The South African Institution of Civil Engineering's mission is to advance professional knowledge and improve the practice of civil engineering including structural engineering. The Joint Structural Division (JSD), a division of these two institutions, was established to advance the theoretical knowledge and practice of structural engineering, to encourage the improvement of standards and techniques and to enhance the standing of this branch of the engineering profession.

This Guide to Good Practice for Structural Engineering;

- establishes ethical values for those engaged in the practice of structural engineering;
- identifies the work performed by structural engineering practitioners;
- suggests that structural engineering practitioners function at one of four distinct levels of practice;
- categorises structural engineering work in terms of levels of risk;
- outlines the levels of competence required to practice structural engineering, based on level of risk and type of work; and
- makes recommendations for the practice of structural engineering work.

This Guide also offers an overview of the legislation which directly impacts upon structural engineering practice.

This guide is intended to provide insights into a wide range of aspects of structural engineering practices for both users and providers of structural engineering services.

The JSD has also published the following two complimentary publications:

- ***Standard for Structural Engineering Services*** which establishes requirements for those responsible for determining or confirming the structural safety and serviceability performance of structures. It covers the design of structures, the checking of another structural engineer's design, condition assessments, the use of structural engineering software and the certification of structures.
- ***Checklist Guide for Structural Engineering Design*** which:
 - provides a checklist for those involved in structural engineering design; and
 - highlights common design considerations for foundations and the primary structural materials (concrete, steel, masonry and timber) and identifies reference standards for design, materials and construction.

Marelize Visser

Chairperson
Joint Structural Division

Guide to Good Practice for Structural Engineering

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1 INTRODUCTION

1.1 Scope

This document provides:

- a) guidance on acceptable practice in the field of structural engineering;
- b) a classification of structural engineering work according to the complexity of the structure, nature of the environment, the design methods employed, the risks involved and the consequences of failure; and
- c) suggestions on the level of competence required for the performance of structural engineering work of varying complexity and sets ethical and technical standards for the execution of structural engineering work.

Note: Annexure A contains suggested minimum competence levels to undertake types of structural engineering work. Annexure B contains an overview of the legislation which directly impacts upon structural engineering practice.

1.2 Definitions

In this document, any word or expression has the following meaning, unless the context otherwise dictates:

actions: an assembly of concentrated or distributed mechanical forces acting on a structure or the cause of deformations imposed on the structure or constrained in it

client: the person who makes use of the services of a structural engineering practitioner

load: value of force corresponding to an action

risk: the effect of uncertainty on the objectives of a design and is expressed in terms of a combination of the consequences of an event and the likelihood of occurrence

structural engineering: the science and art of designing and constructing, with economy and elegance, buildings, bridges and frameworks and other similar structures so that they can safely resist the actions to which they may be subjected

2 ETHICAL VALUES

Structural engineering practitioners should in addition to observing all applicable legislation and statutes:

- a) take reasonable care to ensure the quality and safety of all structural engineering work entrusted to them and adopt a balanced, disciplined and comprehensive approach to problem solving;
- b) take into account the hazards relating to any subsequent maintenance of the relevant structure and make provision in the design for such work to be performed in a manner that minimises the associated risk;
- c) recognise that the lives and safety of the people are dependent upon engineering judgments, decisions and practices incorporated into structures;
- d) not accept anything in cash or in kind which prejudices independent and impartial judgment and declare to their clients or employers any interest which may influence their professional judgment;
- e) not misrepresent their areas or levels of experience and responsibility;
- f) not agree to or comply with any instructions requiring dishonest action or the disregard of established norms of safety or levels of risk in design and construction;
- g) take reasonable steps to minimise the risk of the loss of life, injury or suffering which may result from their work or the effects of their work and to point out the level and significance of risk associated with their work to those affected;
- h) ensure, where their structural engineering judgment is ignored or rejected, that their clients or employers are informed of the possible consequences; and
- i) report to the appropriate organisation or authority any situation of which they became aware where a structure or structural system places the safety of the public at risk.

3 WORK PERFORMED BY A STRUCTURAL ENGINEERING PRACTITIONER

Structural engineering work may in terms of **Table 1** be classified as work which involves in its execution one or more **characteristics** listed in column 1, falls within the **types of work** listed in column 2, and requires for its performance any of a number of **functions** in column 3.

Table 1: Structural engineering work

Characteristics	Types of work	Functions
<ul style="list-style-type: none"> • Theoretical experimental investigation and solving of problems • Analysis and design solutions to meet specific objectives • Application of knowledge and engineering technology, based on mathematics, basic sciences, information technology as well as specialist and contextual knowledge • Management of engineering works • Addressing the safety and environmental consequences and other impacts of engineering work • Exercising judgment and taking responsibility for engineering work 	<ul style="list-style-type: none"> • Bridges and building frames • Building basement foundations • Iconic public structures, general industrial structures and special industrial structures • Tunnel supporting structures and marine structures • Liquid and material containing structures and mining structures • Lifting structures, operations and refurbishment of structures • Structural engineering opinions • Temporary structures and dam structures • Any structures that could be construed to be a structure in terms of the definition contained in the Construction Regulations 2014 issued in terms of the Occupational Health and Safety Act of 1993 (Act No 85 of 1993) 	<ul style="list-style-type: none"> • Feasibility and conceptual studies • Project definition and planning • Advising, reporting and auditing • Analysis and design • Specifying and performing tests, research and development • Application of the results of testing, research and development • Preparation of tender and / or working drawings • Provision of information for the design of services • Preparation of specifications and schedule of quantities • Cost estimates, capital and life cycle costs, financial implications and works programmes • Draft tender documentation and tender strategies. • Advise on contractors and calling for tenders • Procurement and tender adjudication • Contract administration, coordination and construction monitoring • Management of safety risk and maintenance of structures • Communication of the impacts and outcomes • Education, training and mentoring of engineering personnel

4 STRUCTURAL ENGINEERING COMPETENCIES

Structural engineering practitioners, depending on the tertiary education, training and experience, category of registration and recognition by the profession, function at one of four distinct levels as indicated in **Table 2**. The level of practitioner assuming responsibility for the design of a structure is linked to the category of risk as defined in **Table 3**.

The levels of competence required for structural engineering practitioners and a career path to achieving these levels (see also **Annexure A**) is indicated in Figure 1.

It is accepted that due to the varying nature of a structural engineering service, rigid boundaries are not applicable, but the experienced structural engineering practitioner would recognise the appropriate competence level required.

Table 2: Competence levels of structural engineering practice

Level	Designation	Typical characteristic of the practitioner	Risk associated with work done
1	Candidate	Practitioner has a tertiary education qualification in civil engineering and works under supervision and control from an appropriately registered person	Low risk
2	Registered professional in civil engineering	Practitioner is registered with the Engineering Council of South Africa as a Professional Engineer or Professional Engineering Technologist or Professional Engineering Technician in the civil engineering discipline	Low to Medium risk
3	Structural engineering professional	Practitioner, apart from being registered with the Engineering Council of South Africa as a Professional Engineer or Professional Engineering Technologist in the civil engineering discipline, has developed structural engineering competencies relating to the design of structures and has had his structural engineering competencies recognised by his or her peers	Medium to High risk
4	Structural engineering expert	Practitioner is a structural engineering professional who has developed specialist skills in aspects of structural engineering practice or knowledge in specialised field of structural engineering	High Risk

Table 3: Categories of risk

Category of structure	Level of risk	Illustrative nature of structural engineering work
1	Low	Simple structures with low structural safety and serviceability performance requirements where the analysis requires a simple application of design rules or direct interpretation of reference guidelines
2	Medium	Structures with moderate to challenging structural safety and serviceability performance requirements where the design approach involves either a process of: <ul style="list-style-type: none"> reasoning and calculation based on the application of standards, or reasoning, calculation and consideration of accepted analytical principles, based on a combination of deductions from available information, research and data, appropriate testing and service experience
3	High	Structures with challenging structural safety and serviceability performance requirements that require specialist skills, recognised expertise or knowledge beyond that required for category 2 structures

5 STRUCTURAL ENGINEERING GOOD PRACTICE

5.1 Client requirements

The full scope of the client requirements should be agreed and documented. The designer should take steps to determine any special loading or serviceability requirements, the likelihood of future changes in utilisation of the structures, or other factors that may increase the risk of failure or instability.

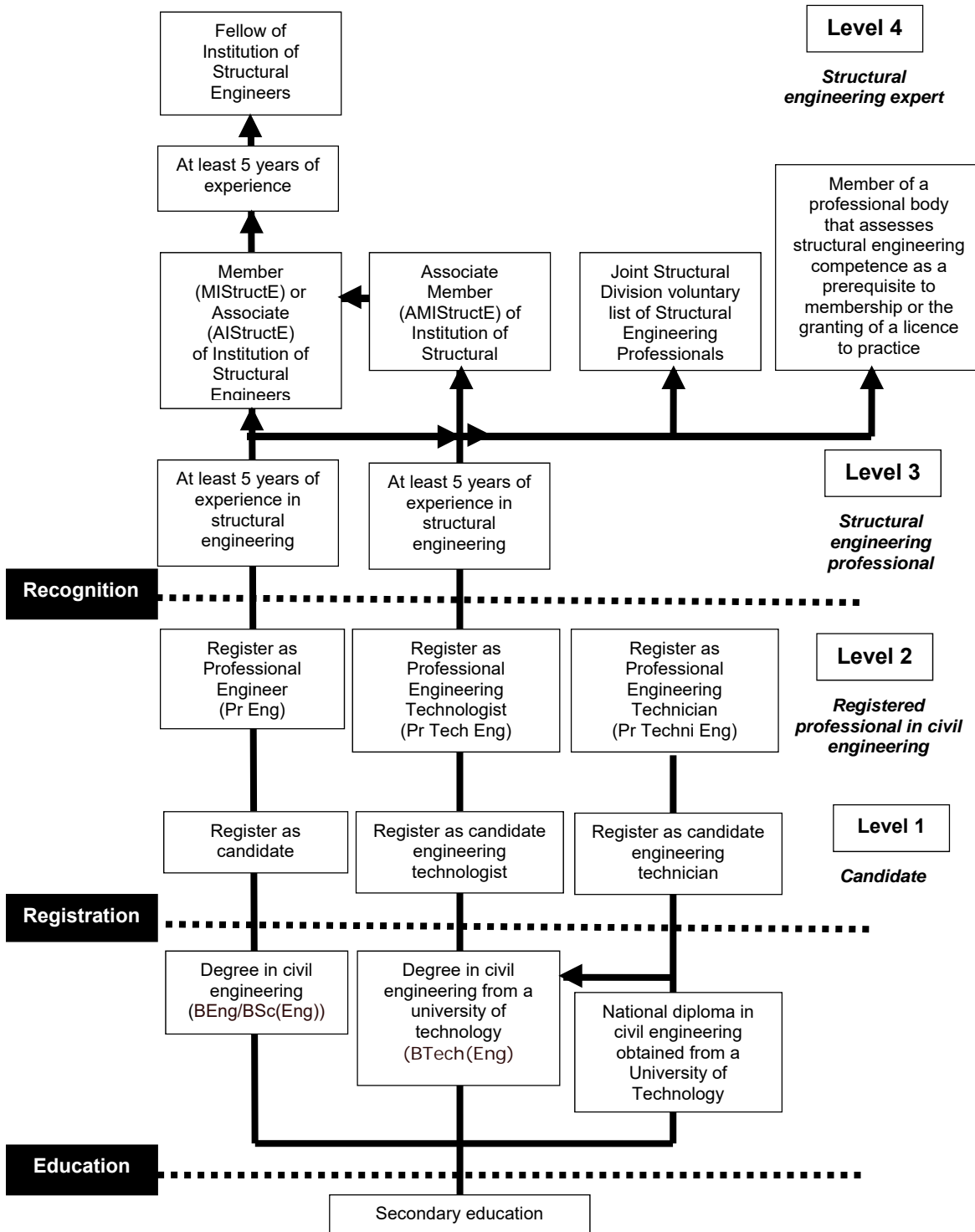


Figure 1: Levels of competence required to practice structural engineering

5.2 Site requirements

The designer should ensure that he or she understands the conditions at the intended site of the structures, including the seismic zone, foundation conditions, possible unusual wind conditions, or any other conditions that may require special treatment.

5.3 Design requirements

The design of structures needs to be performed by, or under the direction, control and supervision of a structural engineering practitioner who needs to accept responsibility for the design.

A formal risk assessment should be carried out to establish whether abnormal loads or conditions need to be considered in the design. Should the risk assessment indicate that there is a significant risk of an abnormal loading event or condition occurring, the effects of such an abnormal loading event or condition need to be taken into account in the design.

A foundation loading schedule should be prepared for all structures which clearly indicates the magnitude and direction of all foundation loads for each specific load case. The schedule should clearly indicate whether the loads are nominal loads or what load factors have been applied. The combinations of the loading cases should be defined such that the stability of the founding structure can be determined.

The design standards, specifications and related publications used in a design should be agreed with the client and clearly listed in the design calculations.

Computer design software should only be used where it can be shown that the software has been verified by manual calculation, or by comparison with different software.

Note 1: In addition to conforming to the requirement of the relevant loading and design codes, all structural engineering work needs to be carried out:

- a) in accordance with the requirements (see Annexure B) of:
 - i) the Occupational Health and Safety Act of 1993, (Act No. 85 of 1993) and the Construction Regulations 2014 issued in terms of this Act;
 - ii) where applicable, the National Building Regulations issued in terms of the National Building Regulations and Building Standards Act of 1977 (Act No. 103 of 1977); and
 - iii) where applicable, the NHBRC's Technical Requirements included in the Home Building Manual issued in terms of the Housing Consumer Protection Measures Act of 1998 (Act No. 95 of 1998); and
- b) in accordance with the Rules for Conduct for registered persons issued in terms of the Engineering Profession Act of 2000 (Act No. 46 of 2000).

Note 2: Structural engineering practitioners may be called upon to certify the structural system of a building or home in terms of the National Building Regulations and Building Standards of 1997 (Act No. 103 of 1977) or the Housing Consumers Protection Measures Act of 1998 (Act No. 95 of 1998), respectively.

5.4 Design calculations

5.4.1 General

Formal calculations should be prepared for all structures. Calculations should be recorded on calculation sheets and be neat, logically set out, short and descriptive, and easy to follow. Calculations should be documented in such a way that they can be fully referenced and traceable.

5.4.2 Information shown on sheets

Calculation sheets should include the following data:

- a) Identification of the person responsible for structural design.
- b) Name of client or owner.

- c) Project title.
- d) Title of structure or area under consideration.
- e) Name of person who carried out the calculations and date undertaken.
- f) Name of person who reviewed the calculations and date reviewed.
- g) Project number or calculations file number.
- h) Calculation sheet number and revision number.

For each structure or structural element, the following information should be shown on the relevant calculation sheet(s):

- a) **Identification:** each structure or structural element should be identified with an individual component number corresponding with a drawing or sketch, defining the general arrangement of the structure;
- b) **Geometry:** the geometry of each structure or structural element should be clearly defined by way of a sketch or drawing, included in the calculations; and
- c) **Loading:** each load and each load combination adopted in the design should be defined in an unambiguous manner by way of clear descriptions or sketches. All loading calculations should be shown, and assumed loads should be fully justified. It needs to be clearly stated whether the indicated loads are nominal loads (unfactored loads) or whether they are design loads (factored loads).

5.4.3 Headings

A logical system of main headings and sub-headings should be used to define, on each calculation sheet, the particular area of the structure and the particular structural component(s) under consideration.

5.4.4 Analysis

For manual analysis, all analysis calculations should be shown together with the results of the analysis, e.g. bending moment, shear force, torsion or axial load diagrams, or value. For computer analysis, the following information should be shown:

- a) software name and version, data file name and location;
- b) sketch defining structural computer model, e.g. node numbers, element numbers, member releases, etc;
- c) summary of all computer input, e.g. load cases and load combinations considered; and
- d) summary of computer output analysis results, e.g. bending moment, shear force torsion or axial load diagrams, or values.

When diagrams or values are shown, it needs always to be stated whether these values are nominal values (unfactored) or whether they are design values (factored).

5.4.5 Calculations record

If the design is done manually, all relevant manual calculations should be shown. If computer software is used for the design, the relevant printed computer output calculations, proving the adequacy of the selected section, should be included with the calculation sheets.

All relevant load effects should be noted in the calculations and the adequacy of the selected section to sustain all the relevant load effects should be stated.

5.4.6 References

The following references should be provided in the calculations:

- a) reference numbers of all relevant drawings (e.g. supplier's equipment drawings, mechanical layout drawings or structural design drawings);
- b) design criteria adopted;
- c) design document and specifications adopted;
- d) any statutory requirements considered; and
- e) all assumptions made, e.g. dimensions, types of loads, technical information of equipment to be supported, methods of erection / construction, local conditions that may have an effect on the structure, etc.

5.4.7 Terminology, units and symbols

Terminology used should be consistent with the relevant code of practice or standard used. The units used should be clearly stated in all calculations. All symbols used in the calculations should be consistent with the symbols used in the particular code of practice or standard being used.

5.4.8 Conclusion

For each structural element under consideration, a conclusion should always be stated in the calculations. This should be in the form of a fully dimensioned sketch in the case of reinforced concrete, clearly showing the extent and quantity of reinforcing required, or in the case of structural steel, the timber or other material element, member size and location.

5.5 Connection details and fabrication drawings

In the case of structural steel, timber or other material element design, all member forces, which are required for the design of end connections of components by the fabricator, should be defined in a suitable format.

All connection design details and fabrication drawings prepared by the fabrication contractor need to be reviewed by the responsible structural engineering practitioner to ensure and confirm that the design has been interpreted correctly and that the intent of the design is met.

5.6 Construction materials

The grades of material adopted in the design should be specified on the relevant design drawings and calculations including steel grades, bolt grades, welding consumables, reinforcing, concrete mixes and timber grades.

5.7 Tests required for design purposes

Any tests required for design purposes (including non-destructive testing where applicable) should be stated and communicated to the contractor and or client for execution. Test results, certificates of material strengths and other relevant data should be filed with the calculations.

5.8 Checking and reviewing of calculations

All structural calculations should be thoroughly checked by the person conducting the design. In addition all structural calculations should be reviewed for accuracy by a registered person.

In the case of more complex structures it is recommended that a third party review be undertaken.

The checker/auditor and / or designer should ensure that the checking/auditing is done prior to commencement of fabrication/construction.

The checker/auditor should as a minimum check the following (but not be limited to):

- a) basic technical data and design of the structure;
- b) design documents, standards, statutory requirement and specifications under which the structure was designed;
- c) the structural materials to be used;
- d) the range of tests conducted on structural and other load carrying materials;
- e) the range, individual values and combinations of the loads used by the designer in his/her calculations;
- f) the framing and stability of the structure;
- g) the stress levels within the structure;
- h) the general arrangement drawings and compatibility thereof to the design calculations; and
- i) any changes or modifications proposed by the client and / or contractor.

If the checker/auditor is required to verify the actual outcomes of the design analysis, this should be done by another means than that used by the original designer.

Any changes or modification to the design, proposed by the checker /auditor should be communicated to the designer for design and implementation. The checker / auditor should sign off on the cover sheet of the original design, stating the date, his / her name, contact detail and ECSA registration number.

5.9 Construction drawings

Construction drawings should show all information required for construction. The designer should check the final design drawings prior to being issued for construction, to ensure that the final drawings correspond to the calculations.

Construction drawings should include appropriate information for construction including where appropriate:

- a) specification of all drawing referenced materials, including grades, concrete mixes, quality and class of fasteners;
- b) corrosion protection specification;
- c) specified imposed floor load and equipment loads;
- d) ground bearing pressure;
- e) reinforcement layout and bending schedules; and
- f) procedures that influence the stability of the structure during construction.

All designs and design drawings of structures need to be approved by the responsible structural engineering practitioner. In addition, the following information should be shown on the design drawings:

- a) name of the responsible structural engineering practitioner; and
- b) name and address of the consulting firm responsible for structural design.

Note: Approval of a design means that the design is complete, that the design complies with the required standards, specifications and legislation in terms of structural strength, stability and serviceability, and that the design is fit for the intended purpose. Approval of a design drawing means that the drawing is complete, that the drawing conforms to the design and that the structural content of the drawing is correct.

5.10 *Preservation and record of design*

Irrespective of client requirements regarding the retention of design information, all design drawings, calculations, computer print-outs, test results, test certificates, etc. need to be retained in a form easily retrievable for a period not less than that specified by the Engineering Council of South Africa or relevant legislation. Data should be stored electronically in a recognised international format.

5.11 *Change control*

The designer needs to implement a system to ensure that all changes are communicated to all relevant parties in good time.

6 CONSTRUCTION REQUIREMENTS

6.1 *Compliance with design*

The designer needs to take all reasonable steps to generally ascertain that the structures constructed on site comply with the design.

6.2 *Quality control*

The designer should promote that quality control be instituted on site to ensure that the structures are built in accordance with the design. This quality control is not limited to the actual construction site only, but also needs to include any fabrication facility.

Should the designer not be satisfied with the arrangements regarding quality control instituted on site he or she should raise this with the construction contractor, and, if necessary, with the client. Should the quality control on site remain unsatisfactory, giving inadequate demonstration that the structure is built in accordance with the design, the designer should not sign off on the structure.

It is recommended that a quality control plan (QCP) be instituted by the contractor and approved by the designer, which provides for not only conforming to all the requirements of the drawings but also to the requirements of the codes and or relevant specifications that the contractor is expected to satisfy. The steps should be signed off by the contractor as having been correctly completed and overviewed by the engineer for important issues.

6.3 *Certification of completed structure*

The designer, if satisfied that the structures have been constructed in accordance with the requirements of the design, should certify that the structures have been properly constructed.

7 MAINTENANCE INSPECTION REQUIREMENTS

7.1 Define the requirements

The full scope of the client requirements should be defined and clarified. Typical requirements may include:

- a) re-certification of the structures inspected, requiring a full design check on the existing structures in addition to the inspection;
- b) visual inspections requiring the use of various non-destructive testing procedures;
- c) stability of structures covering load cases where equipment is either operating normally or idle, or storage structures are either empty or full; and
- d) a specific inspection of damage due to an accidental or natural event.

Note: The Construction Regulations 2013 issued in terms of the Occupational Health and Safety Act place an obligation on all owners to ensure that structures are safe for continued use and are inspected annually. The National Building Regulations issued in terms of the National Building Regulations and Building Standards Act requires owners of a building to ensure the structural safety performance of their buildings.

7.2 Safety Critical Findings

7.2.1 General

The client should immediately be notified of any structural condition that is observed which may compromise the safety of persons using the structure.

7.2.2 Report of findings

All findings should be:

- a) reported to the client promptly in an agreed time frame;
- b) reported specifically and systematically, in such a manner that the client clearly understands the condition of the structures inspected;
- c) accompanied by recommended actions; and
- d) prioritised in terms of how soon the recommended actions need to be completed.

8 FURTHER INFORMATION

Further insights and information can be found in the following publications:

- Engineering Council of South Africa. Rules of Conduct for Registered Persons Engineering Profession Act, 2000. Board Notice 256 of 2013. Government Gazette No. 37123 of 13 December 2013.
- Institution of Structural Engineers. Code of Conduct and Guidance Notes. September 2014.
- The Institution of Structural Engineers. Engaging Structural Engineers – a Guide for Clients, Ref BETG 07/02, 2002.
- Watermeyer, RB. Towards a minimum standard for structural engineering work. The *Structural Engineer*, 87 (19) 6 October, p.p 12, 14, 16. 2009

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- Watermeyer, R.B, and Smith, A.J. Managing structural engineering risk. *Civil engineering*, March, 2014.
- Watermeyer, R, Smith, A, and Visser, M. The JSD List of Structural Engineering Professionals. *Civil engineering*, March, 2016.
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Annexure A: Suggested minimum competence levels to undertake types of structural work

The suggested minimum competence levels to undertake categories of structural work are indicated in Table A1.

Table A1: Competence levels required to undertake categories of structural work

Type	Category of structure (see Table 3)	Competence level (see Table 2)		
		2	3	4
Bridges	3			•
	2	•	•	•
	1	•	•	•
Building frames	3		•	•
	2	•	•	•
	1	•	•	•
Building, basement, foundations	3			•
	2		•	•
	1	•	•	•
Iconic, public structures	3			•
	2		•	•
	1	•	•	•
General industrial structures *	3		•	•
	2	•	•	•
	1	•	•	•
Special industrial structures **	3			•
	2		•	•
	1	•	•	•
Tunnel supporting structures	3			•
	2		•	•
	1	•	•	•
Marine structures	3			•
	2		•	•
	1	•	•	•
Liquid and material containing structures	3		•	•
	2	•	•	•
	1	•	•	•
Mining structures	3		•	•
	2	•	•	•
	1	•	•	•
Lifting structures and operations	3		•	•
	2	•	•	•
	1	•	•	•
Refurbishment of structures	3		•	•
	2	•	•	•
	1	•	•	•
Structural engineering opinions	3		•	•
	2	•	•	•
	1	•	•	•
Temporary structures	3			•
	2		•	•
	1	•	•	•
Dam structures	3			•
	2		•	•
	1	•	•	•

* Including static structures associated with bulk materials handling, such as belt conveyor gantries, stockpile structures and storage bins and silos, and plant structures with vibration loading such as screening plants, crusher plants and sorting plants.

** Including mobile equipment structures associated with bulk materials handling, such as travelling stackers and re-claimers and ship loaders.

Note 1: Competence Level 1 (candidates) is not shown in Table A1 as such persons are required to work under supervision and control from an appropriately registered person.

Note 2: Registered engineering technicians may not assume responsibility for a category 2 structure as a whole.

Annexure B: An overview of legislation governing the design, construction, alteration, rehabilitation, maintenance and demolition of structures

B1 Introduction

The built environment comprises the man-made surroundings that provide the setting for human activity. Structures in the form of buildings which afford shelter for humans, animals or property of any kind and bridges which enable travel and the transportation of goods between buildings are not only central to the built environment and the economy of South Africa but are also key to the well-being of its inhabitants. Buildings and bridges shape and define the environment within which humans live, work, trade and relax.

Section 24 of the Bill of Rights embedded in the Constitution of the Republic of South Africa (1996) gives “*everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected for the benefit of present and future generations.*” The three primary pieces of legislation governing the design, construction and maintenance of structures which give effect to these constitutional rights are:

- Occupational Health and Safety Act of 1993 (Act No. 85 of 1993) and the Construction Regulations issued in terms of this Act;
- National Building Regulations and Building Standards Act of 1977 (Act No. 103 of 1977) and the National Building Regulations issued in terms of this Act; and
- Housing Consumers Protection Measure Act of 1998 (Act No. 95 of 1998) and the Home Building Manual issued in terms of the Act.

B2 Construction Regulations 2014

The Construction Regulations 2014 issued in terms of the Occupational Health and Safety Act of 1993 are applicable to all persons involved in construction work which includes any work in connection with the construction, erection, alteration, renovation, repair, demolition or dismantling of or addition to a building, any similar structure or bridge. These regulations cover requirements for applications for construction work permits, notifications for construction works, duties of a client, duties of a designer, duties of a principal contractor and a contractor, management and supervision of construction work, risk assessment for construction work, fall protection, structures, temporary works, excavation, demolition work, tunnelling, scaffolding, suspended platforms, rope access work, material hoists, bulk mixing plants, explosive actuated fastening device, cranes, construction vehicles and mobile plant, electrical installation and machinery on construction sites, use and temporary storage of flammable liquids on construction sites, water environments, housekeeping and general safeguarding on construction sites, stacking and storage on construction sites, fire precautions on construction sites, construction employee facilities, construction health and safety technical committee, approved inspection authority and offences and penalties.

The client (any person for whom construction work is being performed) and the contractor are responsible for ensuring compliance with the provisions of the Act and Regulations.

These Regulations require a competent person (person who has, in respect of the work or task to be performed, the required knowledge, training and experience and, where applicable, qualifications specific work or task, and who is familiar with the Act and applicable regulations) to perform a wide range of tasks and activities. Structural engineering practitioners, depending upon their knowledge, training and experience, can as competent persons:

- perform the duties of the designer for structures and the associated temporary works as set out in Regulation 6;
- carry out periodic inspections of structures at least once every six months for the first two years after its construction and thereafter yearly in order to render the structure safe for continued use (see Sub-Regulation 11(2)(a));
- design, inspect and approve the erected temporary works associated with structures on site before use (see Sub-Regulation 12(1));

- supervise all temporary works operations associated with structures (see Sub-Regulations 11(2)(b));
- inspect temporary works structures immediately before, during and after placement of concrete, after inclement weather, or any other imposed load and at least once daily until the temporary works structures have been removed (see Sub-Regulation 12(3)(f));
- authorise the casting of concrete (see Sub-Regulation 12(3)(g));
- supervise the excavation work for structures (see Sub-Regulation 13(1)(a));
- supervise and control all demolition work on site (see Sub-Regulation 14(1));
- carry out a detailed structural engineering survey of the structure to be demolished and develop a method statement on the procedure to be followed (see Sub-Regulation 14(2));
- issue a certificate of system design for a suspended platform system (see Sub-Regulation 17(2)(b));

B3 National Building Regulations

The National Building Regulations issued in terms of the National Building Regulations and Building Standards Act of 1977 regulate the erection of buildings i.e. the alteration, conversion, extension, rebuilding, re-erection, subdivision of or addition to, or repair of any part of the structural system of, any building. Owners of buildings are required in terms of these Regulations to:

- obtain approval for the erection of any building or structure;
- notify the local authority when building work is to be commenced;
- ensure that building work is proceeded with within the stipulated time limits or apply for extension of such time limits;
- appoint competent persons (persons who are qualified by virtue of his education, training, experience and contextual knowledge) for the design and supervision of various aspects of the building as prescribed in the Act and the regulations;
- obtain certificates of occupancy for completed buildings prior to moving in; and
- notifying the local authority if a building or earthworks has become dangerous and, if so instructed by the local authority, appoint an architect or registered person to investigate the matter and report to the local authority what remedial or preventative measures must be taken to safeguard the building or earthworks.

In the case of existing buildings the owner needs to take appropriate action to prevent such buildings from becoming derelict or dangerous or face the possibility of being ordered to demolish the building by the local authority.

The Regulations consist of 21 parts namely:

Part A (Administration),
 Part B (Structural Design),
 Part C (Dimensions),
 Part D (Public Safety),
 Part E (Demolition Work),
 Part F (Site Operations),
 Part G (Excavations),
 Part J (Floors),
 Part K (Walls),
 Part L (Roofs),
 Part M (Stairways),
 Part N (Glazing),

Part O (Lighting and Ventilation),
Part P (Drainage),
Part Q (Non-Waterborne means of Sanitary Disposal),
Part R (Stormwater Disposal),
Part S (Facilities for Disabled Persons),
Part T (Fire Protection),
Part U (Refuse Disposal),
Part V (Space Heating),
Part W (Fire Installation),
Part XA (Energy usage).

The regulations are prescriptive or functional in nature. The functional regulations establish qualitative performance requirements which may be satisfied by means of one or more of the following:

- the application of deemed-to-satisfy design and construction rules;
- the rational designs (a process of reasoning and calculation) or rational assessments (assessment of the adequacy of the performance of a solution in relation to requirements, based on a combination of deductions from available information, research and data, appropriate testing and service experience) prepared by competent persons; or
- certification by the Agrément Board of South Africa.

SANS 10400 provides “deemed-to-satisfy” provisions which if satisfied enable these Regulations to be satisfied. (The parts of SANS 10400 correlate to the aforementioned parts of the National Building Regulations.)

Structural engineering practitioners who are registered professional engineers or registered professional engineering technologists, depending upon their knowledge, training and experience, can as competent persons:

- prepare rational designs and rational assessments to demonstrate that an adopted structural solution for a building as a whole or a foundation, floor, wall, glazing or roof satisfies the structural design performance requirements of the Regulations;
- judge an existing building to be capable of carrying additional loads arising from the erection or extension supported on such building; and
- specify precautionary measures where the safety or stability of any property or service is likely to be impaired by such excavation.

B4 *Housing Consumers Protection Measures Act No. 95 of 1998*

The Housing Consumers Protection Measures Act of 1998 applies to homes i.e. dwelling units constructed or to be constructed by a home builder for residential purposes or partially for residential purposes. The Act makes provision for the protection of housing consumers by requiring:

- the NHBRC establish a fund for the purpose of providing assistance to housing consumers where a home builder fails to rectify major structural defects or a roof leak attributable to workmanship, design or materials which has manifested itself within 5 years or 12 months from the date of occupation, respectively;
- the Minister prescribe technical requirements “*applying to a home builder for the design and construction of prescribed homes in respect of structural strength and stability, serviceability, materials, behaviour in fire, drainage and storm water management;*”
- the NHBRC publish a Home Building Manual which contains “*the NHBRC Technical Requirements and guidelines prescribed by the Council to comply with the NHBRC Technical Requirements;*”
- registered home builders construct homes in a workmanlike manner which are fit for habitation and comply with the NHBRC Technical Requirements; and

- registered home builders rectify at their own cost major structural defects in a home caused by the non-compliance with the NHBRC Technical Requirements and occurring within a stipulated period.

Any person in the business of home building is required to register with the NHBRC. A home builder is not permitted to commence with the construction of a home which is the subject of the Act unless the home is enrolled with the NHBRC.

A home builder is required demonstrate compliance with the performance requirements by means of one or a combination of the following:

- compliance methods (design and construction rules) prescribed by the NHBRC; and
- performance based methods involving either Agrément certification or certification by a certification body or a listed competent person whose name appears on the Council's list in the required category.

Structural engineering practitioners, depending upon their knowledge, training and experience, can as competent persons, if their names appear on the NHBRC's list demonstrate that a solution for a system, element or component satisfies the performance requirements in the following services areas:

- structural system;
- prefabricated timber truss roofing system;
- steel frame homes;
- timber frame homes;
- roof glazing installations; and
- fills, terraces and subsurface drains.

