education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATES (VOCATIONAL)

SUBJECT GUIDELINES

MATERIALS

NQF Level 2

April 2008

MATERIALS LEVEL 2

CONTENTS

INTRODUCTION

A. What is Materials about?

This subject has been designed to instil an understanding and appreciation of the chemical and physical properties of construction materials so that students may understand:

- Why materials behave the way, they do.
- How materials interact within the environment where they are used.
- How to select and use materials correctly.
- What effect materials may have on the behaviour of structures.
- How to shape, cut, join and combine materials to fabricate structures.

B. Why is the subject Materials important in the Construction learning programme?

An understanding of the materials used, their properties, how these interact with the environment and to each other, is essential for anybody intending to work in the construction industry.

C. The link between the Learning Outcomes for Materials and the Critical and Developmental Outcomes

Students will be able to identify different types of construction materials suitable for various construction activities. They will work effectively with the other team members to complete activities such as identifying and describing different construction material characteristics. Materials also prepares students to communicate understanding of the different characteristics of construction materials appropriate for uses in specified circumstances.

D. Factors that contribute to achieving Learning Outcomes

- Thorough preparation for teaching and learning activities
- An environment conducive to teaching and learning through effective learner support, motivation, commitment and a positive attitude
- An interest in construction materials

1 DURATION AND TUITION TIME

This is a one-year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided the student meets all the assessment requirements.

Students with special education needs (LSEN) must be catered for in a way that eliminates barriers to learning.

2 SUBJECT LEVEL FOCUS

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- What effect materials may have on the behaviour of structures
- How to shape, cut, join and combine materials to fabricate structures.

3 ASSESSMENT REQUIREMENTS

3.1 Internal assessment (50 percent)

3.1.1 Theoretical component

The theoretical component forms 40 percent of the internal assessment mark.

Internal assessment of the theoretical component in Materials Level 2 takes the form of observation, class questions, group work, informal group competitions with rewards, individual discussions with students, class, topic and semester tests and internal examinations. Lecturers can observe students when marking exercises from the previous day and asking class questions.

Assignments, case studies and tests can be completed at the end of a topic. Tests and internal examinations must form part of the internal assessment.

3.1.2 Practical component

The practical component forms 60 percent of the internal assessment mark.

Practical components include applications and exercises. All practical components must be indicated in a Portfolio of Evidence (PoE).

Internal assessment of the practical component in Materials Level 2 takes the form of assignments, practical exercises, case studies and practical examinations in a simulated business environment.

Students may complete practical exercises daily. Assignments and case studies can be completed at the end of a topic. Practical examinations can form part of internal practical assessment.

- **Some examples of practical assessments include, but are not limited to:**
  - A. Presentations (lectures, demonstrations, group discussions and activities, practical work, observation, role-play, independent activity, synthesis and evaluation)
  - B. Exhibitions by students
  - C. Visits undertaken by students based on a structured assignment task
  - D. Research
  - E. Task performance in a “Structured Environment”

- **Definition of the term "Structured Environment"**

For the purposes of assessment, "Structured Environment" refers to a simulated workplace or workshop environment. Activities in the simulated workplace or environment must be documented in a logbook with a clear listing of the competencies to be assessed. The following information must be contained in the logbook:

- Nature of department or environment in which practical component was achieved
- Learning Outcomes
- Activities in the environment with which to achieve the Learning Outcomes
- Time spent on activities
- Signature of facilitator or supervisor and student

For the logbook to be regarded as valid evidence, it must be signed by an officially assigned supervisor.

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the students' Portfolio of Evidence. The assessment instruments used for the purpose of conducting these assessments must be part of the evidence contained in the PoE.

3.1.3 Processing of internal assessment mark for the year

A year mark out of 100 is calculated by adding the marks of the theoretical component and the practical component of the internal continuous assessment (ICASS).

3.1.4 Moderation of internal assessment mark

Internal assessment is subjected to internal and external moderation procedures as set out in the *National Examinations Policy for FET College Programmes*.

3.2 External assessment (50 percent)

A national examination is conducted annually in October or November by means of a paper(s) set and moderated externally. The practical component will also be assessed.

External assessment details and procedures are set out in the *Assessment Guidelines:* Materials Level 2

4 WEIGHTED VALUES OF TOPICS

TOPICS	WEIGHTED VALUE
1. Introduction to materials	10%
2. Basic geology concepts	10%
3. Soil and earth as a foundation and building material	10%
4. Masonry units (bricks and blocks)	15%
5. Cement and concrete	25%
6. Mortar	10%
7. Plaster	10%
8. Screeds and toppings	10%
TOTAL	**100**

5 CALCULATION OF FINAL MARK

Internal assessment mark: Student's mark/100 x 50 = a mark out of 50 (a)

Examination mark: Student's mark/100 x 50 = a mark out of 50 (b)

Final mark: (a) + (b) = a mark out of 100

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, reporting, moderation and verification purposes.

6 PASS REQUIREMENTS

A student must obtain at least 50 percent in ICASS and 50 percent in the examination in order to achieve a pass in this subject.

7 SUBJECT AND LEARNING OUTCOMES

On completion of Materials Level 2, the student should have covered the following topics:

Topic 1: Introduction to materials
Topic 2: Basic geology concepts.
Topic 3: Soil and earth as a foundation and building material
Topic 4: Masonry units (bricks and blocks)
Topic 5: Cement and concrete.
Topic 6: Mortar
Topic 7: Plaster
Topic 8: Screeds and toppings

7.1 Topic 1: Introduction to materials

7.1.1 Subject Outcome: Describe and apply properties of materials and material selection.

Learning Outcomes

The student should be able to:

- Explain terminology used to define material properties.
- Explain the concepts stress and strain as well as the relationship between stress and strain in elastic and plastic material.
- Identify and explain the criteria used for selecting materials fit for purpose for a particular application.
- Explain the concept of sustainability with reference to using non-renewable resources, recycling and energy efficient building design.
- List the advantages of using materials that meet the SABS/SANS standards.

7.2 Topic 2: Basic geology concepts

7.2.1 Subject Outcome: Explain origins of construction materials

Learning Outcomes

The student should be able to:

- Define the concepts “geological time”, “formation of the earth” and “plate tectonics”
- Briefly explain the structure of the earth in a diagram
- Explain the formation of basic rock categories.
- Referring to geological timescales, briefly describe the major events in South Africa’s past that resulted in the deposits that are currently mined.
- Relate geological timescales to sources of mining wealth from which commodities are obtained
- Explain the geological process of soil formation.

7.3 Topic 3: Soil and earth as a foundation and building material

7.3.1 Subject Outcome: Explain properties of soil and use soil as a building and foundation material

Learning Outcomes

The student should be able to:

- Explain the elements that constitute soil.
- Explain compacting of soil and the effect this has on its mechanical and physical properties.
- Explain the role of moisture in aiding compaction.
- List the advantages of compacting soil in thin layers.
- Identify and use different types of compaction equipment.
- Perform a simple hand-test to determine optimum moisture content of soil.
- Explain the history of adobe and its importance as a building material.
- Describe with examples various types of traditional and modern earth building techniques.
- List problematic founding materials commonly found in South Africa and describe appropriate types of foundations for each of these.

7.4 Topic 4: Masonry units (bricks and blocks)

7.4.1 Subject Outcome 1: Explain and apply burnt clay masonry.

Learning Outcomes

The student should be able to:

- Describe with examples different brick manufacturing processes.
- List the classifications of face bricks and identify different bricks.
- List compressive strength requirements and water absorption requirements according to prescribed national standards.
- Explain and demonstrate porosity and permeability of clay bricks and how they should be treated before use.
- Explain moisture induced expansion and demonstrate how to combat it.
- Explain with examples brickwork deterioration and provide appropriate remedies to combat each problem.
- Explain vanadium staining of clay brickwork and provide appropriate prevention remedies or measures.
- State reasons for brick bonding and demonstrate various bonding techniques.
- Explain and demonstrate proper cleaning of mortar smears and droppings of face brickwork.

7.4.2 Subject Outcome 2: Explain and apply concrete masonry

Learning Outcomes

The student should be able to:

- Describe with examples different concrete brick manufacturing processes.
- Describe materials used in the manufacturing of concrete units and indicate the importance of quality controls.
- Explain requirements for the maturation of concrete units.
- Explain appropriate use and precautions to take when laying concrete units.
- Explain and demonstrate correct orientation in the laying of the taper of hollow units.
- Explain the concept of shell-bedding and its use.
- Discuss the role of standard size concrete units in the context of building.

7.5 Topic 5: Cement and concrete

7.5.1 Subject Outcome 1: Understand cement and concrete as construction materials

Learning Outcomes

The student should be able to:

- Define and explain concrete terminology.
- Briefly discuss the historical development of concrete
- Explain the hardening and strength gaining of concrete.
- Explain and demonstrate compacting of concrete and adding of strong stone.
- Explain tensile and compressive strength of concrete and the impact of reinforcing steel.
- List the dangers of working with cement and concrete and describe good working practices.

7.5.2 Subject Outcome 2: Describe and select materials for mixing concrete.

Learning Outcomes

The student should be able to:

- Briefly describe the process of manufacturing Portland cement and indicate the two principal raw materials used.
- Identify the type of extenders included in a bag of cement and list the advantages and disadvantages of using extenders.
- Explain the precautions taken with regard to curing and formwork stripping times.
- Describe the benefits of specifying and buying materials according to the prescribed national standards.
- List and describe suitable and unsuitable materials to use for making concrete.*
- Apply a simple test to determine suitability of water for concrete making.
- Differentiate between common and masonry cement and indicate where masonry cement should not be used.
- Compare the manufacturing processes of normal setting cements with High Early Strength (HES) cements.
- Explain the correct procedure for storing cement.
- Explain the correct procedure for ordering, receiving and storing aggregates.
- List the common admixtures and explain their uses.
- Explain the advantages and disadvantages of admixtures.
- Explain the effect of calcium chloride in reinforced concrete.
- Explain and apply the principles of good housekeeping when storing and using admixtures.

7.5.3 Subject Outcome 3: Produce fresh concrete

Learning Outcomes

The student should be able to:

- State minimal suitable concrete strengths for strip footing house foundations, surface beds in a house and reinforced concrete for a column.
- Explain and demonstrate how to apportion ingredients to make different strengths of concrete.
- Explain limitations of volume batched mixes and give an example where volume batched concrete would be dangerous.
- Discuss the advantages and disadvantages of using ready mix concrete.
- State the purpose of a slump test and explain how the slump value is used.
- Demonstrate the correct procedure to test and record the slump of concrete according to prescribed national standards.
- State the tolerance on a slump test.
- State the slump ranges best suited to hand-placement of concrete.
- Use a hand-trowel to identify different concrete mixes and explain how to rectify them.
- Explain and demonstrate the hand-mixing procedure for concrete.
- Demonstrate how to set-up, care for, use and maintain a concrete mixer.
- Explain correct timing for the placing of concrete.
- Describe the effect of adding water to concrete to restore workability.
- Test and demonstrate how to judge whether concrete is properly compacted with a poker vibrator.
- Explain the mechanism known as “bleeding” in fresh concrete and list the advantages and disadvantages of bleeding.
- Explain and demonstrate how bleeding can be reduced.
- Identify and distinguish between plastic settlement cracks and plastic shrinkage cracks and explain the mechanisms responsible for the formation of each.
- Explain how plastic shrinkage cracks can be prevented and how plastic settlement cracks can be eliminated.
- Explain the purpose and importance of making concrete test cubes according to prescribed national standards.
- Demonstrate the correct procedure for making and curing concrete test cubes according to prescribed national standards
- Explain the effects of curing on concrete strength, hardness, water-tightness and durability.
- Demonstrate different methods of curing.
- Explain “freezing” of fresh concrete.
- Describe the result of floating a ground slab either too early or too late.
- Demonstrate different surface finishes on ground-slabs
- Describe when ground slabs are ready for first and subsequent passes with a float.
- Identify concrete not yet ready for floating and concrete that has been left too long before floating.

7.6 Topic 6: Mortar

7.6.1 Subject Outcome: Understand and use suitable materials to produce workable mortar for masonry

Learning Outcomes

The student should be able to:

- Identify suitable materials and mix proportions for three classes of mortar.
- Explain the differences between mortar mixes containing masonry cement and mortar mixes made with common cements.
- Explain the functions of mortar.
- Mix mortar of optimum consistency. Test and judge the workability of the mortar.
- Explain and use hydrated building lime to achieve a cohesive and workable mortar.
- Explain and demonstrate sieving of building sand with high clay content.
- Explain the relationship between mortar cube strength and brick strength.
- Explain the effect of re-tempering of mortar on its strength and mechanical properties.
- Explain and demonstrate raking out and ruling mortar joints in exposed face brickwork while the mortar is still green.

- Explain and demonstrate the difference between pre-soaking burnt clay masonry units and dry laid concrete masonry units.
- Perform a simple test to evaluate the quality of sand for mortar as described in 4.1.4 of SANS 2001-CMI.

7.7 Topic 7: Plaster

7.7.1 Subject Outcome 1: Understand and use suitable materials to mix and plaster walls

Learning Outcomes

The student should be able to:

- Explain the functions of plaster with reference to aesthetics and weatherproofing.
- Describe and demonstrate the correct preparation of different substrates to receive plaster.
- Describe suitable mixes for plaster applied internally, externally and in a damp environment according to prescribed national standards.
- Explain the differences between plaster mixes made with masonry cement and plaster mixes made with common cements.
- Explain the effects of re-tempering plaster.
- Provide reasons for mixing and consuming only small batches of plaster.
- Plan plastering activities considering possible damage by wet or dry conditions.
- Explain formation of plastic shrinkage cracks in plaster and recommend precautions to combat cracks.
- Perform a simple test to confirm whether plaster has adhered to a substrate.
- Discuss and apply alternative methods of bonding plaster to a concrete soffit.
- Provide reasons why gypsum-based products are unsuitable to use in Portland cement to improve plasticity or to make plaster stick.
- Explain the correct thickness of application of a coat of plaster and indicate consequences of incorrect applications.
- Correctly plaster a wall.

7.8 Topic 8: Screeds and toppings

7.8.1 Subject Outcome: Select suitable materials and cast screeds and toppings.

Learning Outcomes

The student should be able to:

- Describe screeds and toppings and the function of each.
- Identify suitable materials for casting screeds and toppings.
- Explain the difference between topping mix and screed mix.
- Describe bonded and unbonded screeds and toppings.
- State the nominal volume mix proportions for a domestic screed.
- Explain prevention of unbonded screed or topping adhering to the concrete substrate.
- List the advantages of using a scabbler or scarifier to prepare a smooth concrete substrate.
- Explain the importance of clean, oil and dust-free substrate when placing a bonded screed or topping.
- State the minimum thicknesses for bonded and unbonded screeds and toppings.
- Describe the sizes of stone particles that can be incorporated in a topping.
- Explain and demonstrate the correct use of a slush mixture and give a recipe for this slush mixture.
- Specify an acceptable slump range for a screed or topping and explain compacting and bond failures.
- Describe a method to ensure that screeds and toppings are applied to the correct levels and flatness.
- Explain division of screeds and toppings into panels and state the maximum dimensions of these panels.
- Describe the method and time needed for curing a screed or a topping.
- Describe a test to determine the in situ strength and quality of a floor screed.
- Describe a simple test to determine whether a screed has dried sufficiently to lay bonded PVC floor tiles or a wall-to-wall carpet.
- Specify the minimum time interval between laying a screed and tiling it with ceramic floor tiles.

8 RESOURCE NEEDS FOR THE TEACHING OF MATERIALS - LEVEL 2

8.6 Physical resources

- Classroom
- Teaching aids and pre-designed models and structures
- Work tables, work area, chairs and chalkboards
- Overhead projector

8.7 Human resources

The lecturer should have an acceptable NQF level qualification in building and civil construction and should preferably be a registered assessor. The lecturer should be committed to continually improving and expanding his or her knowledge and skills.

8.8 Other resources

- Budget according to Construction Materials requirements
- Computers
- Files and other documents