Unit ID: 898

Domain **FOUNDATION BUILDING SCIENCE AND DRAWING SKILLS**

Title: **Apply knowledge of fundamental building science in different contexts**

Level: 3 **Credits: 6**

Purpose

This unit standard specifies the competencies required to apply knowledge of fundamental building science in different contexts. It includes apply knowledge of Archimedes principle, demonstrate knowledge of surface tension and carry out related calculations, outline the concept of heat and carry out related calculations, demonstrate basic knowledge of roof coverings, demonstrate knowledge of concurrent forces and carry out related calculations, demonstrate knowledge of moments of a force and carry out related calculations, demonstrate knowledge of couples and centroids and carry out related calculations and demonstrate knowledge of frames and carry out related calculations. This unit standard is intended for people requiring fundamental building drawing skills as applied in different contexts.

Special Notes

1. This unit standard may be assessed in any context of operation and may be assessed in conjunction with other relevant technical unit standards selected from a particular domain that has a thematic link to this unit standard.

2. Assessment evidence may be collected at any realistic place where logical collection of such evidence can be achieved.

3. This unit standard gives users exposure to a holistic approach of study and world of work to gain an understanding of the world as a set of related systems, by recognizing that problem solving contexts do not exist in isolation but that they may differ from context to context according to the area of application.

4. The correct use of the suitable technical terminology must be stressed, especially in formulating definitions and principles.

5. Scientific pocket calculators may be used in solving mathematical problems. Basic instruction must be offered in the practical use and operational abilities of the calculator. A comma has to be used for the decimal sign throughout calculations.

6. $g = 10\ m/s^2$ should be taken as the value for gravitational acceleration in all applicable calculations.

7. Regulations and legislation relevant to this unit standard include the following:
   - Labour Act, No. 11, 2007.
   - Occupational Health and Safety Regulations No. 18, 1997 and all subsequent amendments.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which meet the accreditation requirements set by the Namibia Qualifications Authority and the Namibia Training Authority and which comply with the national assessment and moderation requirements. Details of specific accreditation requirements and the national assessment arrangements are available from the Namibia Qualifications Authority and the Namibia Training Authority on www.nta.com.na.

Elements and Performance Criteria

Element 1: Apply knowledge of Archimedes principle.

Performance Criteria

1.1 Archimedes' principle is explained to illustrate mass (weight) loss when an object is immersed in a liquid.

1.2 Archimedes' principle is applied to calculate the volume of an irregular object.

1.3 The principle of flotation is explained and applied to determine whether an object will float or sink.

1.4 Applicable formulas are defined, interpreted and applied to determine the density and relative density and/or specific gravity of an object or substance.

1.5 The specific gravity of various insoluble solids and liquids are determined.

1.6 Density and relative density of different building materials is determined.

Element 2: Demonstrate knowledge of surface tension and carry out related calculations.

Performance Criteria

2.1 Terms surface tension and capillarity are defined and various experiments to the existence of surface tension and capillary action are described.

2.2 The difference between absorption and permeability is explained in terms of their respective properties and examples of absorptive and non-absorptive solids are given.

2.3 The purpose and the methods of applying water-repellents to prevent capillarity are explained and types of water-repellent products and their application are identified.

2.4 The term porosity is defined and its influence on the strength of a material is explained.

2.5 A difference between solid density and bulk density as well as solid volume and bulk volume of a material is explained.

2.6 The relationship between porosity and strength as well as porosity and absorption is explained.

2.7 The term saturation is defined.

2.8 The percentage of porosity is calculated using the bulk volume and solid volume of materials as well as using solid density and bulk density of materials.

2.9 The saturation coefficient of materials is calculated.

Element 3: Outline the concept of heat and carry out related calculations.

Range

Formulae: linear expansion: $\Delta\ell = \ell_0 \times \alpha\Delta t$ expansion: $\ell_0 + \Delta\ell = \text{New Length}$ new, contraction: $\ell_0 - \Delta\ell = \text{New Length}$

Performance Criteria

3.1 The theory of heat and temperature is outlined in terms of the difference between the two, effects of heat on matter, types and uses of thermometers used to measure temperature.

3.2 The difference between Celsius and Kelvin scale and conversion between the two scales is explained.

3.3 Manners through which heat is transferred and the effect of heat on metals is described.

3.4 The specific heat capacity of a material is defined and the unit in which it is expressed is indicated.

3.5 Formula Q = m $\times$ shc $\times$ Δt is applied and/or manipulated to determine the heat energy gained or lost by a substance.

3.6 Expansion of different substances and the effect of expansion on building materials are explained.

3.7 The reason water freezes and the damage to building that frost can cause as well as ways to prevent these problems are explained.

3.8 The reason why heat insulation is necessary is explained and examples of good and poor insulating materials are given.

3.9 Calculation of linear expansion of substances or materials and new length (after expansion or contraction) of substance is carried out using a correct formula.

Element 4: Demonstrate basic knowledge of roof coverings.

Performance Criteria

4.1 The criteria considered by an architect when deciding on a suitable roof covering is described.

4.2 The basic criteria for choosing an ideal roof covering are described.

4.3 The different types of roof covering materials are described in terms of manufacturing, characteristics and properties.

4.4 Different roof covering materials are compared with special reference to their advantages and disadvantages.

Element 5: Demonstrate knowledge of concurrent forces and carry out related calculations.

Range

Terms related to graphical representation of forces may include but are not limited to resultant, equilibrant, equilibrium, bow's notation, triangle of forces, fixed reference points, components of forces, polygon of forces, parallelogram of forces, coplanar force, concurrent force, space diagram and force diagram.

Performance Criteria

5.1 A force is defined and represented graphically using suitable scales.

5.2 Terms related to graphical representation of forces are defined and explained.

5.3 Bow's notation is applied to letter the spaces between the forces on a space diagram.

5.4 The resultant and equilibrant of forces are determined graphically using the parallelogram of forces.

5.5 The triangle of forces is applied to determine the magnitude and direction of three forces in equilibrium.

5.6 The vertical and horizontal components of a force are determined graphically and calculated analytically using trigonometry.

5.7 The polygon of forces is applied to determine the resultant and equilibrant graphically.

5.8 The resultant and equilibrant of a system of forces is calculated.

Element 6: Demonstrate knowledge of moments of a force and carry out related calculations.

Performance Criteria

6.1 The moment of a force is defined and described with respect to turning point and factors that determine the moment of a force using a formula and a diagram.

6.2 The moment of a force is calculated.

6.3 The law of moments is defined and applied to calculate an unknown force or its distance from the fulcrum and reaction force in a lever using a formula and a graph.

6.4 Terms (as apply to beams) funicular, equilibrium/link polygon, simply supported beam, load, reaction, uniformly distributed load, shear force and bending moment are defined.

6.5 The reaction of the supports of beams with or without overhanging ends is calculated using the law of moments.

6.6 The magnitude of the reactions as well as the position of the resultant of beams with and without overhanging ends and uniformly distributed loads is determined analytically and graphically.

6.7 The resultant of forces acting on a beam and its distance from the left reaction (RL) or right reacting (RR) is calculated.

6.8 Shear forces and bending moments for vertical point loads are determined.

Element 7: Demonstrate knowledge of couples and centroids and carry out related calculations.

Range

Line figures may be square, rectangle, rectangular, (right-angled) triangle, isosceles and/or equilateral triangle and/or circle.

Performance Criteria

7.1 Terms couple, centroids and lamina are defined using examples.

7.2 The formula used to determine the moment of a couple is expressed and applied to calculate the moment of a couple.

7.3 The centroid of a thin piece of metal determined experimentally.

7.4 The fixed position of centroids on line figures is determined.

7.5 The centroid of laminas is calculated using moments and areas symmetrical to one axis.

Element 8: Demonstrate knowledge of frames and carry out related calculations.

Performance Criteria

8.1 The term frame is defined.

8.2 Tensile forces and compressive forces exerted on the members in a frame are defined.

8.3 Newton's third law of motion as it applies to tensile and compressive forces is explained.

8.4 A difference between strut and a tie is stated.

8.5 The magnitude of forces and the nature of the members of simple frames are determined graphically.

8.6 Members in a frame are identified and shown correctly on a diagram.

8.7 The magnitude of forces and the nature of the members in a cantilever frame are determined.

Registration Data

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