| SECTION A | | | | | | | |
|---|---|---|---|---|---|---|---|
| QUALIFICATION DEVELOPER | GABORONE UNIVERSITY COLLEGE OF LAW AND PROFESSIONAL STUDIES | | | | | | |
| TITLE | DIPLOMA IN CONSTRUCTION ENGINEERING | | | | NCQF LEVEL | 6 | |
| FIELD | PHYSICAL PLANNING AND CONSTRUCTION | | SUB-FIELD | | BUILDING AND CONSTRUCTION | | |
| New qualification | ✓ | | Review of existing qualification | | | | |
| SUB-FRAMEWORK | General Education | | TVET | ✓ | Higher Education | | |
| QUALIFICATION TYPE | Certificate | | Diploma | ✓ | Bachelor | | |
| | Bachelor Honours | | Master | | Doctor | | |
| CREDIT VALUE | | | | | 396 | | |

## RATIONALE AND PURPOSE OF THE QUALIFICATION

***RATIONALE***

Construction engineers and technicians team-up together to plan, design, construct and maintain road and rail transportation systems, port and airport facilities, bridges, tunnels, dams, and buildings of all types; water, gas and oil pipelines; energy-generating facilities, water, air and waste treatment plants. Construction Engineering as a professional discipline deal with all these areas. The qualification proposed here therefore aims at producing engineers and technicians who have a solid ground in the basic sciences and a wide-ranging view of construction engineering and its applications in developing and improving contemporary societies and it seeks alternative solutions that respect the built environment. The qualification brings together the technological problem-solving ability of engineering and the organisational, administrative, and planning abilities of management in order to oversee the operational performance of complex construction engineering projects.

HRDC Priority Skills of 2016 and 2019 as well as the latest of 2021 have advocated for construction knowledge and skills occupations. The proposed qualification has responded to the following skills of construction such as technical skills, occupational health and safety, first aid, estimating and tendering Supervision, site management, project management and business skills, as listed in HRDC Top Occupations Report of 2019.

This qualification has also been noted that access into higher education is limited mainly to school leavers who have passed extremely well, and yet leaving out post-school youths and adults who are employed and may have acquired learning and experience informally or non-formally and may want to further their careers. This qualification will therefore take into recognition of these prior learning to be a gateway to higher education and further studies in the same field.

***PURPOSE***

This qualification will contribute towards the intended outcomes by providing learners with a range of advanced knowledge and skills in the construction industry. It will provide the learners with integrated knowledge, theory and practice of civil engineering and construction management principles.

Graduates of this qualification will be able to:

- Manage construction resources and construction project
- Test soils to determine the adequacy and strength of foundation structures
- Prepar**e** and analyse engineering design, conducting environmental impact studies, assembling data.
- Adhere to engineering practice standards through regulatory bodies
- Analyse and solve any emerging construction technical problems

**ENTRY REQUIREMENTS (including access and inclusion)**

- A minimum entry of NCQF level IV (BGCSE) or equivalent with a pass in basic sciences (English, Mathematics, Physics and Chemistry)
- Recognition of Prior Learning (RPL) and/or Credit Accumulation Transfer (CAT) will be considered for access and inclusion.

| QUALIFICATION SPECIFICATION: SECTION B | |
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| **GRADUATE PROFILE (LEARNING OUTCOMES)** | **ASSESSMENT CRITERIA** |
| 1.1 Apply advanced mathematical principles and concepts in planning, executing and managing construction projects. | 1.1.1 Apply verbal quantitative situations algebraically and evaluate these expressions for given replacement values of the variables.<br>1.1.2 Apply the square roots and cube roots of whole numbers and the square root of a monomial algebraic expression in simplest radical form.<br>1.1.3 Solve multistep linear inequalities in two variables<br>1.1.4 Apply mathematical solutions to construction engineering problems<br>1.1.5 Investigate and analyse function (linear and quadratic) families and their characteristics both algebraically and graphically<br>1.1.6 Solve functions trigonometrically by applying sectors, Pythagorean, double angle identities, circular functions, and sinusoidal curves<br>1.1.7 Deduce application of a variety of series including Power and Taylor series.<br>1.1.8 Apply complex numbers into product, summation and special products.<br>1.1.9 Draw up different techniques of categorizing numbers.<br>1.1.10 Apply basic introductory calculus. |

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| **2.** Demonstrate advanced knowledge on basic concepts of solid mechanics in particular stress, strain and stability. | 2.1.3 Differentiate types of forces and the reaction of solids to external force.<br>2.1.4 Calculate the reaction of solid bodies when subjected to external forces.<br>2.1.5 Draw-shear force diagrams and bending moment diagrams.<br>2.1.6 Compute geometrical properties of sections by drawing by calculating moment of inertia.<br>2.1.7 Apply and calculate normal stresses in beams, shear stresses in beams and plastic bending of beams.<br>2.1.8 Demonstrate knowledge in introduction and stability of columns. |
| **3.** Apply structural elements commonly encountered in engineering practice, their behaviour under load and the actions to be taken to mitigate for failure, | 3.1.3 Demonstrate competency in structural design mathematical models and forces.<br>3.1.4 Calculate moments of forces, measurements of moments, conditions of equilibrium, resultant of parallel forces, couples, and beam reactions.<br>3.1.5 Analyse framed structures, determine their stability, calculate determine resultant forces<br>3.1.6 Assess the structural behaviour of Steel structures under stress, strain and in tension.<br>3.1.7 Assess sectional properties of regular and irregular objects.<br>3.1.8 Design of simply supported RCC beams using limit state method.<br>3.1.9 Design and detail all components of structural timber.<br>3.1.10 Critically analyse effects of different loads on structural timber.<br>3.1.11 Design flexural members of timber.<br>3.1.12 Design compression members of structural timber<br>3.1.13 Design tension members of structural timber<br>3.1.14 Apply support modes for structural timber.<br>3.1.15 Design steel structures<br>3.1.16 Design columns and beams using British standards or Eurocodes |

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| **4.** Demonstrate advanced knowledge in testing soils to determine the adequacy and strength of foundations | 4.1.1 Compile technical and safety data reports to support planning permissions and license applications.<br>4.1.2 Profile soil to determine suitability of the soil and assess whether it can accommodate your construction project such as sieve analysis, compression test etc.<br>4.1.3 Compile results and observe the development of the soil throughout your construction project for maximum quality and safety.<br>4.1.4 Test soil for strength, density, compaction, contamination, organics and sand content, and assess their impact on your construction project.<br>4.1.5 Demonstrate soil quality control measures through Moisture content test, Atterberg limits tests, Specific gravity of soil, Dry density of soil and Compaction test (Proctor's test) |
| **5.** Apply architectural working tools and equipment employing Computer Aided Design (CAD) graphics and presentation skills. | 5.1.3 Demonstrate competency in the use of hand and machine equipment of a building workshop and simple construction and installation methods.<br>5.1.4 Define basic terms used in graphic drawing: point, line, plane and volume.<br>5.1.5 Draw detailed diagrams in isometric, orthographic and axonometric projections.<br>5.1.6 Draw assembly mechanical drawings.<br>5.1.7 Apply perspective drawing and shadow projections. |
| **6.** Illustrate proficiency in reading, understanding general and technical English, and communicate effectively both orally and in writing through research data collection and analysis | 6.1.3 Make oral presentations using technological advancements<br>6.1.4 Produce high quality technical reports through analysis using Monte Carlo Simulation, Multi variate analysis and Stochastic Modelling<br>6.1.5 Read and understand various professional journals and newsletters<br>6.1.6 Produce high quality technical reports<br>6.1.7 Application of statistical and other official documents using software's such as SPSS |

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| **7.** Demonstrate advanced skills by preparing and analysing engineering design, conducting environmental impact studies, assembling data. | 7.1.3 Conduct market research to determine project viability.<br>7.1.4 Produce documentation such as the business case, project execution plan and strategic brief.<br>7.1.5 Produce appraisals, including geotechnical studies, assessment of any contamination, availability of services, uses of adjoining land, easements and restrictive covenants, environmental impact.<br>7.1.6 Present full data results, and analysis of the final project |
| **8.** Provide sound technical advice on construction project and creatively resolve any emerging technical conflicts. | 8.1.3 Apply project management skills to resolve technical conflicts in civil or construction project.<br>8.1.4 Organize and conduct coordination meetings for construction projects.<br>8.1.5 Organize and oversee site meetings with all key stakeholders.<br>8.1.6 Produce detailed project program with constant updates.<br>8.1.7 Identify key marketing strategies for a construction project.<br>8.1.8 Inspect and implement quality control.<br>8.1.9 Procure essential materials, plant and equipment. |
| **9.** Apply engineering professionalism to any task assigned for long term career | 9.1.1 Demonstrate knowledge on all ethical practices under the country's laws through regulatory bodies such as ERB, ECSA and Engineers Alliance.<br>9.1.2 Ensure practice standards for being a professional in a work environment in lifelong learning.<br>9.9.3 Demonstrate advancement through learning by attending academic conferences, short course programs under the ERB continuing professional development guidelines. |
| **10.** Demonstrate understanding of practice and ethics of the engineering profession as well as application to personal life. | 10.1.1 Register with technical societies/associations such as Engineers Registration Board and Botswana Institute of Engineers.<br>10.1.2 Carry out all regulations in governing bodies and compliances required.<br>10.10.3 Demonstrate thorough knowledge in professional ethics and practice as required by regulatory bodies. |

| QUALIFICATION STRUCTURE: SECTION C | | | |
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| **FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses** | **Title** | **Level** | **Credits** |
| | Basic Mathematics I | 5 | 12 |
| | Basic Mathematics II | 5 | 12 |
| | Communication Skills and Computer Science | 5 | 10 |
| | Workshop Practice and Technology I | 6 | 10 |
| | Engineering Drawing I | 6 | 10 |
| **CORE COMPONENT Subjects / Units / Modules /Courses** | Engineering Materials I | 5 | 10 |
| | Engineering Materials II | 6 | 10 |
| | Basic Mathematics III | 6 | 12 |
| | Physics | 5 | 15 |
| | Geology for Engineering | 5 | 15 |
| | Engineering Drawing II | 6 | 10 |
| | Computer Aided Design for Construction Engineering | 5 | 12 |
| | Building Construction I | 5 | 10 |
| | Building Construction II | 6 | 10 |
| | Workshop Practice and Technology II | 6 | 10 |
| | Soil Mechanics I | 6 | 12 |
| | Soil Mechanics II | 6 | 12 |
| | Introduction to Land Surveying | 6 | 12 |
| | Theory of Structures | 6 | 12 |
| | Geotechnical Engineering | 6 | 12 |
| | Water Supply and Sanitation Engineering | 6 | 12 |
| | Hydraulics | 6 | 12 |
| | Mechanics of Materials | 6 | 12 |
| | Professional Practice and Ethics | 6 | 10 |
| | Principles of Foundation Engineering | 6 | 12 |
| | Concrete and steel structures | 6 | 10 |
| | Measurement and Estimation Principles | 6 | 10 |
| | Construction law and Law of Contracts | 6 | 10 |
| | Supervised Industrial Training | 6 | 60 |
| | **Choose 2 electives** | | |

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| **ELECTIVE COMPONENT Subjects / Units / Modules /Courses** | Construction Management | 6 | 10 |
| | Health, Safety and Environmental Issues in Construction | 6 | 10 |
| | Entrepreneurship Skills | 6 | 10 |
| | Building Services | 6 | 10 |
| | TOTAL | | 396 |

**Rules of combinations, Credit distribution:**

Credits for all modules are allocated based on the workload of each and every module,

The credit combination for this qualification

Fundamental component- 54 credits

Core component- 302 credits

Elective component- 40 credits

**TOTAL- 396 credits**

## ASSESSMENT AND MODERATION ARRANGEMENTS

Assessment and moderation shall be conducted by BQA registered assessors and moderators.

**Assessment**

Formative assessment shall make 60%.

Summative assessment shall make up the remaining 40%.

**Moderation**

All assessment tools shall undergo internal and external moderation. The internal and external moderation shall be conducted as ETP policies.

## RECOGNITION OF PRIOR LEARNING

There will be provision for awarding this qualification through RPL and CAT in accordance with national and institutional policies.

## PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

**Learning Pathways**

**<u>Vertical</u>**

- Bachelor of Engineering in Civil Engineering

- Bachelor of Technology in Construction Engineering

**Horizontal**

- Diploma in Civil Engineering
- Diploma in Physical Planning
- Diploma in Water Engineering

**Employment Pathways**

Upon successful completion of Diploma in Construction Engineering, the graduates may be absorbed in the following professions at entry level;

- Site Technician
- Facilities Officer
- Estimator
- Site Agent
- Soil Testing Lab Technician

## QUALIFICATION AWARD AND CERTIFICATION

Upon successful attainment of 396 credits, the learner will be awarded Diploma in Construction Engineering.

Graduates will be issued with certificates and transcripts.

## REGIONAL AND INTERNATIONAL COMPARABILITY

To establish comparability, benchmarking was conducted on identified similar qualifications regionally and internationally. The benchmarking was looking at title of the qualification, entry requirements, credits allocation, NQF level at country of origin and either exit level outcomes or modules.

The qualification is NQF Level 6 which is equivalent to level of the proposed qualification, NCQF level 6. Main exit outcomes point out entrepreneurial skills, ability to communicate effectively which are generic and similar to those of the proposed qualification. The qualification's main core outcomes are on electronics.

**Diploma in Construction Engineering: *New Era College***

Both qualifications are placed at NCQF level 6 and most of the modules and LOs are similar. However, the New Era College qualification is predominantly management as it does not offer design and synthesis modules which should be the core according to Dublin Accord and ASCA/ERB standards. The qualification also does not have natural sciences (Physics, Geology) modules which should be part of the graduate attributes (knowledge areas) of engineering qualification. Furthermore, there are modules which have combined two standalone modules such as *Professional Practice and Communication Skills (*according to ACSA/ERB standards these two are different standalone modules under Complementary knowledge area*)*, *Engineering Science & Mechanics, Hydraulics & Soil Mechanics (*Soil Mechanics is a broad module which on its own should be divided into two and it sets as a prerequisite of Geotechnical Engineering which New Era qualification does not have*)* and, *Science and Materials for Construction and the Built Environment.* New Era qualification also does not have *Concrete and Steel Structures* (which is a necessity under Design and Synthesis knowledge area) and *Principles of Foundation Engineering* (needed under

Engineering Sciences knowledge area). The qualification further separated *Construction Plant and Equipment* from *Building Technology*, which in essence it is a topic under *Building Technology. Engineering Mathematics IV* is a module to be offered at level 7 but in this qualification is offered at level 6. Lastly, this qualification does not have elective component but there are modules from the complimentary knowledge area that are supposed to be treated as elective. Such modules include, *Health and Safety, Entrepreneurship Development and Construction Management.*

**Diploma: Construction Technology: Civil Engineering SAQA**
Though it is worth 240 credits, when mapped onto NCQF it equates to NCQF level 6. Its core/specific learning outcomes are about construction (building services, drawing, building materials etc) and cut across generic ones like communication, administration, and supervision.

A comparison of the proposed qualification with the above shows that the qualification learning outcomes/core modules compares favourably with other qualifications of similar nature from other institutions/countries. Moreover, the proposed qualification has an industrial attachment and project module which the above qualifications do not have.

**REVIEW PERIOD**

The qualification will be reviewed every 5 years.