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Investing in a Smart, Sustainable and Inclusive Future

Higher Apprenticeships

Framework document for

Civil Engineering

at SCQF level 8

April, 2017

Document control

Version history

Version	Revision(s)	Approved by	Date
1.0	Full template	SDS	18.4.17
2.0	Minor template updates, including splitting out the high- and low-level outcomes in separate appendices	TEG members	20.4.17
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3.0	Update Higher Apprenticeship reference	SDS	26.6.19

Terms and abbreviations

Term	Meaning
SDS	Skills Development Scotland
HA(s)	Higher Apprenticeship(s) / Apprentice(s)
SCQF	Scottish Credit and Qualifications Framework
TEG	Technical Expert Group
QA	Quality Assurance
CIV	Civil Engineering
DipHE	Diploma of Higher Education
HND	Higher National Diploma
ICE	Institute of Civil Engineers
ICT	Information and Communication Technology
JBM	Joint Board of Moderators
IstructE	Institution of Structural Engineers
IHT	The Institute of Highways and Transportation
IHE	Institute of Highway Engineers

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Contents

1. Higher Apprenticeships in Scotland

1.1 Purpose of the Higher Apprenticeship framework document

The purpose of this document is to provide employers and learning providers with information required to deliver a Higher Apprenticeship in **Civil Engineering**. The framework sets out the skills and learning outcomes identified through employer consultation that are required to support the development of this programme.

This framework document should be read in conjunction with the following publications:

1. Work-based Learning Principles
2. Product Specification at **SCQF level 8**
3. Quality Assurance Guidance

This documentation is available on the Skills Development Scotland (SDS) corporate website:

www.skillsdevelopmentscotland.co.uk

1.2 What are Higher Apprenticeships?

Higher Apprenticeships (HAs):

- are accredited work-based learning programmes that lead to degrees or degree-level, professionally recognised qualifications
- are part of the apprenticeship family, supporting the transition into employment by providing work-based learning pathways from Foundation and Modern Apprenticeships to Higher and Graduate Apprenticeships, at SCQF Levels 8 –11
- have been developed as part of the Scottish Government's approach to developing Scotland's young workforce and Skills Development Scotland's work-based learning strategy

1.3 Why do we need Higher Apprenticeships in Scotland?

International experience demonstrates how degree-level apprenticeships can drive economic growth. We believe this approach can benefit the Scottish economy.

The range of approaches taken in countries including Switzerland and Germany to develop employer-led, work-based learning pathways to learning and employment provide the basis for how Scotland can use work-based learning to improve the operation of the labour market and to deliver economic growth[1]. Skills Development Scotland is now leveraging the development of Higher Apprenticeships to support this change.

[1] **PWC (2015) Young Workforce' Index: How well are OECD economies developing the economic potential of their young people?**

1.4 Who develops Higher Apprenticeships?

Higher Apprenticeships are developed by Skills Development Scotland through consultation with employers, universities, professional bodies and qualification authorities in the form of Technical Expert Groups (TEGs). The TEGs act as advisory groups on behalf of the sector and are based on the current and future skills needs of industry. They advise on the topics and related outcomes that should be included in a framework.

More information about who was involved in the development of this framework can be found in **Appendix C**.

1.5 Who are Higher Apprenticeships for?

Higher Apprenticeships provide a new way into degree-level study for individuals who are either currently in employment or are entering into employment. HAs are available to employees aged 16 or over.

1.6 Who delivers Higher Apprenticeships?

Higher Apprenticeships are delivered by universities in partnership with employers and college learning providers. An up-to-date list of learning providers and the frameworks they offer can be found on **www.apprenticeships.scot**.

2. Delivery

As Higher Apprentices are work-based degrees, the place of employment is the place of learning. The learning and skills development must be fully integrated into both the **delivery and assessment** of the degrees when part of a Higher Apprenticeship. This integration can only be satisfactorily achieved by proper planning and design prior to delivery and not by add-on components or ad-hoc modifications.

The authenticity of the programme is shown in the way employers are involved in the design and delivery of the degrees and the way in which work-based learning is positioned as integral to both the learning and the assessment needed for successful completion of the programmes.

Higher Apprenticeships are designed as full-time programmes. They are not part-time or sandwich courses. Attendance at the place of learning will be agreed between the provider and the employer sending individuals on the programmes. Examples of how this might work are:

- by day release or
- by block release of three or four week duration, three times per year
- through distance learning with an initial “boot camp or induction”

Fundamentally, most of an individual’s time should be spent in the workplace on directed study.

In designing the degrees to meet the work-based learning requirements of the HA, learning providers must ensure that they also meet the principles and criteria noted here:

Box 1. Principles and criteria

This HA is an **SCQF level 8** work-based degree. All proposed university degree programmes for this HA framework must:

- be **240 credits**
- be based on a partnership between employers and the learning provider
- evidence how the programmes exemplify the work-based learning requirements
- have clear goals and aspirations in support of equality and diversity with appropriate monitoring and other processes in place
- demonstrate how they will ensure that apprentices, upon graduation, will consistently achieve the necessary industry skills, knowledge and competence defined in **Appendix A**
- develop learning through reflection and review of work processes and experience
- meet the requirements to apply for professional body recognition

NB Delivery models based on sandwich years or industrial placement block release are not considered as work-based learning as part of this framework.

The successful delivery of Higher Apprenticeships depends upon an effective partnership between the apprentice, the employer and the learning provider. This will involve additions to their normal responsibilities for employees, learning providers, and apprentices.

Delivery of the content of the HA will be agreed by the participating learning providers, which may involve delivery of specialist or employer-specific content. Employers should also be closely involved with all aspects of the programme, including the course specification, delivery, and assessment of practical activities.

The learning provider has responsibility for the quality assurance and enhancement of all elements of the programmes but they must adhere to the SDS specified documents referenced in **Section 1** and any additional guidance documentation provided as part of their competitive grant award. Practical activities must make use of the work environment and course content must take account of the technologies used in the apprentice's employment.

Apprentices must have individual learning and training plans. The learning provider and existing employer HR systems should be co-ordinated during the development of the individual learning and training plan to ensure that the required employer contextualisation is effective. Even within a specific employer, there may be apprentices who use differing technologies.

3. Roles and responsibilities

3.1 Role of the employer

Apprentices are employees and subject to the standard terms and conditions applying to all employees.

Employers participating in the Higher Apprenticeship programme must:

- consider whether a candidate has a reasonable chance of achieving the chosen programme during the selection process – this includes not only the course content but the acquisition of wider attributes
- provide agreed information to support the candidate's application to the degree course
- provide apprentices with suitable opportunities to gain the type of experience in the workplace that will support their learning and skills acquisition
- provide each apprentice with a nominated mentor who must be readily accessible to the apprentice and to the learning provider
- liaise with the learning provider on the content and practical activities in the apprentice's individual learning and training plan
- provide information that will support the individual apprentice and their assessment

3.2 Role of the learning provider

Apprentices are both employed by the employer, as well as enrolled with the learning provider. As such they should have access to the same facilities as any other student.

HA course design and delivery must adhere to the principles detailed in preceding sections and in addition the learning provider must:

- adopt a flexible approach to considering the suitability of candidates by taking account of the portfolio of previous learning and experience an individual brings to the programme – this will include any relevant Foundation or Modern Apprenticeship undertaken – and support best practice in assessing individuals and in gathering evidence from employers where this is required
- liaise with the employer on the content and practical activities in the apprentice's individual learning plan

In addition, the learning provider should liaise with existing employer Training and Development and Quality Assurance (QA) systems to minimise double assessment. Development and meaningful implementation of individual learning plans is an essential component of the HA and assessments should take account of existing evidence wherever possible.

New evidence that directly relates to the workplace may be authenticated by employers or the individual's mentor.

There are a range of different delivery mechanisms, but the integration of knowledge within contextualised learning opportunities must be the overriding factor.

3.3 Content Delivery and Assessment

Content delivery and assessment responsibilities

	Employer	Learning Provider	Other
Delivery of knowledge and understanding content	✓ Employer specific topics	✓ Generic and non-employer specific	✓ Private providers
Assessment of practical application	✓	✓	✓ Apprentice
Development of personal and business skills	✓ Specification, delivery, progress monitoring, assessment and mentoring	✓ Specification, delivery, progress monitoring and assessment	✓ May be third party for delivery, monitoring and assessment

4. Entry

4.1 Eligibility

- Higher Apprenticeships are available to new and existing employees of participating employers.
- Candidates must be at least 16 years of age. However, the suitability of an individual for entry onto a HA will be decided by the employer and their learning provider partner.
- Candidates must be resident in Scotland throughout the Higher Apprenticeship. In addition to this, their employer's working premises must also be located in Scotland. When applying to become a Higher Apprentice the individual will be required to satisfy the employer that they have the right to live and work in the UK.
- Entry requirements are likely to vary across learning providers. For courses where there is a mandatory requirement for a specific subject, learning providers should consider ways they can provide support to individuals who don't hold a traditional qualification but have nevertheless shown aptitude and competence at the necessary level.

4.2 Recognition of prior learning

Candidates will undergo a selection process for a Higher Apprenticeship, based on employer HR processes. The admissions departments need to take account of this and liaise with employers to provide advice and guidance on the prior learning and experience that will be accepted for entry onto the course.

A more flexible approach to entry requirements should be adopted by learning providers, and be done in consultation with employers. This should involve consideration of candidates on a case by case basis, who have completed relevant Foundation, Modern or Technical Apprenticeships as well as industry / vendor certifications.

Universities and other providers are asked to consider ways they can optimise the apprentice's prior learning within the programme to ensure there is no unnecessary repetition of content.

5. Demand

The Construction sector includes planning for construction projects (architecture, urban planning etc.), the manufacture of products needed for construction projects (cement, heating systems etc.), and the sub-sectors necessary to build developments (electrical installations, joinery etc.). The sector covers the construction of a wide range of projects from domestic buildings to roads and railways.

Employment[2]
In 2017, employment in the sector was 233,600 accounting for eight per cent of all employment in Scotland. This makes it the third largest employing sector. Since the recession in 2008 employment in the sector has declined by ten per cent, which is faster than the one per cent decline for all industries. However, more recently (since 2015) employment has grown by two per cent, compared to no growth across all industries. This suggests a large sector which declined during the recession but has experienced recent recovery and growth.

Regionally, the highest levels of employment were in Lanarkshire (36,000), Glasgow (33,000) and Aberdeen City and Shire (33,000). Furthermore, the highest employment concentration was in West Lothian (almost double the national average). In this region the absolute level of employment was lower but the Construction sector was an important source of jobs.

The employment growth in the sector is forecast to continue and accelerate. By 2020, employment in the sector will have grown by 6,400, an increase of three per cent. This is compared to static employment across all industries. The sector's growth is expected to increase over the longer term; by 2027 employment in the sector will have increased by 11 per cent making it the fastest growing sector. By comparison, the employment growth across all industries will be three per cent.

[2] Oxford Economics Regional and Sector Forecast Data (2000-2027)

Growth will create jobs in the sector and the need to replace workers will also generate demand. Based on employment in 2017, 28 per cent the workforce will need to be replaced by 2027. The Construction Industry Training Board has highlighted the need to find over 12,000 new workers to meet the replacement demand by 2022. The sector's net requirement for workers up to 2027 will be 91,100. This is seven per cent of the net requirement for workers across all industries.
Over half of the total net requirement for workers in the Construction sector will be distributed across four regions. These are: Glasgow (16 per cent); Lanarkshire (15 per cent); Edinburgh, East and Midlothian (13 per cent); and Aberdeen City and Shire (12 per cent).

Given that ten per cent of the construction workforce in Scotland is non-UK nationals; the implications of Brexit are likely to have an impact on the industry's supply of labour. [3]

Occupations[4]
In 2017, half of the people working in the Construction sector were in mid level occupations. The proportion of the workforce in high and low level occupations was lower, 33 per cent and 17 per cent respectively. In 2027 there will be a small change in the occupational structure of the workforce with one per cent more of the workforce being in mid level occupations and one per cent fewer in low level occupations.

CITB forecast increasing demand for Civil Engineers; the industry is forecast to require 350 additional civil engineers per year for the next five years with the total number of civil engineer in Scotland reaching 7,500 by 2021.This demand stems from planned large infrastructure projects, continued skills shortages, and an increasingly ageing workforce.[5]

Demand for HAs in Civil Engineering is further evidenced by the nine per cent reduction of university student studying civil engineering in the five years to 2014, and a 32 per cent reduction in the number of further education students over the same timeframe.[6]

Construction Skills Investment Plan
The Construction Skills Investment Plan (developed in 2012) acknowledges the apprenticeship family as a means of addressing skills needs. The SIP details modern apprenticeships to be well established in the sector for technical traders however notes interest in expanding the modern apprenticeship approach into higher level skills.

[3] CITB White Paper – Migration and Construction
[4] Oxford Economics Regional and Sectoral Forecast (2000-27)
[5] Construction Skills Network Forecast (2017-21)
[6] ICE Submission of Evidence to he Education and Skills Committee of the Scottish Parliament (2016)

6. The framework

6.1 Overview

The **Civil Engineering (CIV)** Higher Apprenticeship is based on industry defined needs and has been developed in collaboration with employers and the education sector to allow knowledge, understanding, skills and competence to be developed with the necessary attributes industry expects from its graduates.

Within the **CIV** Higher Apprenticeship, the degree content must be delivered per the principles and outcomes detailed in this framework.

The specific Higher Apprenticeship included in this framework is:

- **Civil Engineering (CIV)**

The output of this Higher Apprenticeship is an award at **SCQF level 8** entitled:

- **Higher Apprenticeship in Civil Engineering**

The framework is not prescriptive about the awards to be made available by learning providers, however these should be national qualifications at **SCQF level 8** with **240 credits** and relevant vocational qualifications.

6.2 Purpose

The aim of the **Civil Engineering** Higher Apprenticeships programme is to prepare Higher Apprentices for a career in Civil Engineering at Technician level, and to support their professional development in line with the requirements for membership of the industry professional bodies such as the Institute of Civil Engineers (ICE).

The **Civil Engineering** Higher Apprenticeship is designed to produce graduates with the following broad learning and skills:

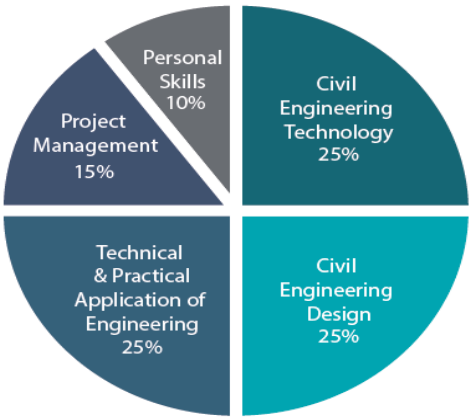
- Undertake critical analysis of and describe engineering theories and principles applying these to problems in the context of Civil Engineering.
- Use a range of approaches to select appropriate techniques, procedures and methods to undertake tasks in Civil Engineering.
- Carry out routine lines of enquiry using appropriate scientific, technical or engineering principles in design and practical applications.
- Undertake critical analysis to analyse emerging technologies and its application to Civil Engineering problems.
- Identify, organise and supervise resources effectively to complete tasks, with consideration for cost, quality, safety, security and environmental impact within a defined area of work..

- Work reliably and effectively under guidance, but without without close supervision, to the appropriate codes of practice.
- Exercise managerial/supervisory responsibility for your own work and work of others within a defined structure
- Have an in depth knowledge of the main areas pertinent to their role in relation to:
  - Health, Safety and Environmental Legislation in Construction
  - Sustainability in context of construction
  - Quality in Construction
  - Design of projects and agreeing standards

As well as developing the following Higher and employability skills:

- Manage their own learning
- Take responsibility for managing work to meet deadlines within a defined area of work
- Develop an understanding of and apply practice that shows an awareness of own and others roles to build an efficient and effective team
- Demonstrate how to evaluate and develop research skills, analyse project management, safety and sustainable construction methodologies.
- Use a wide range of routine and some advanced ICT skills to to be able to operate within defined guidelines regarding data handling, electronic communications and data protection.
- Undertake continuous professional development
- Work, under guidance, in an honest and ethical manner with appropriate awareness of equality and diversity to operate within current professional practice

A key part of the **Civil Engineering** Higher Apprenticeship is that each of the five key content areas is combined to deliver a holistic learning experience (as shown in **Figure 1**):



Details of the high level learning and skills outcomes for these content areas are provided in **Appendix A** along with some examples of low level learning outcomes in **Appendix B.**

6.3 Occupational outcomes

Completion of this framework provides broad-based training and a structured career path for a further range of technical, supervision and management roles in **Civil Engineering** including:

- Civil Engineering Technician
- Construction Supervisor

There is potential to progress to specific supervisory or site management roles, or to specialise in particular areas of the job, like construction design or estimating.

6.4 Learning outcomes

Please refer to **Appendix A** for a full list of learning outcomes for the **Civil Engineering** HA.

6.5 Professional recognition

The primary focus of the **Civil Engineering** HA is on developing the knowledge, understanding and skills outcomes sought by employers. This HA framework can also support the achievement of professional recognition and membership of the sectors relevant bodies at a minimum of Technician Level. The framework is not prescriptive about the awards to be made available by learning providers, however these should be national qualifications at **SCQF level 8** with **240 credits** and relevant vocational qualifications.

NB The framework should only be delivered by providers capable of bestowing the correct awards at the appropriate SCQF level (or working in a partnership to be able to do so). To ensure recognition by the following professional bodies all HE qualifications should be accredited by the Joint Board of Moderators (JBM) to ensure recognition by the profession bodies such as:

- Institution of Civil Engineers (ICE),
- Institution of Structural Engineers (IStructE),
- The Institution of Highways & Transportation (IHT),
- Institute of Highways Engineers (IHE).

Vocational qualifications must be accepted by Construction Skills Certification Scheme **https://www.cscs.uk.com/** at the correct level to achieve the relevant certification at technician level.

6.6 Related Scottish apprenticeship frameworks

The following Scottish Apprenticeship frameworks and qualifications are relevant pathways that may contribute toward progression into the **Civil Engineering** HA. The apprenticeships are eligible for funding contributions from Skills Development Scotland, and provide employers with a range of alternative pathways at different levels of entry:

In school:

- Foundation Apprenticeship in Engineering (SCQF level 6)

Foundation apprenticeship in Engineering SCQF L6

Post-school:

- Modern Apprenticeship in Engineering (SCQF level 6)

MA Civil Engineering SCQF L6

- Modern Apprenticeship in Industrial Applications (SCQF level 5)

MA Industrial Applications SCQF L5

Appendix A. Learning and Skills Outcomes

FRAMEWORK: Civil Engineering (SCQF level 8)

This section details the high level learning and skills outcomes for the HA in **Civil Engineering** that must be covered within the degree.

This presents a broad set of employer defined outcomes against which universities can position their intended provision to meet the high-level learning outcomes and flavour the programme for their intended employer audience.

Topics and high-level learning and skills outcomes:

Learning and skills outcomes for Civil Engineering	
1.	**Civil engineering technology materials**
1.1.	Apply their knowledge, skills and understanding of the components of large framed structures
1.2.	Demonstrate a specialist knowledge of infrastructure systems
1.3.	Undertake critical analysis of concepts and information and issues to determine the best selection and manufacture of materials
1.4.	Properties and use of materials
1.5.	Use a wide range of ICT knowledge and programs, within defined company specific guidelines, to apply information management and document control to a project whilst utilising numerical and graphical data to measure progress
1.6.	Use a range of professionally accepted and routine mathematical skills to convey ideas and concepts
2.	**Civil engineering design and specification**
2.1.	Demonstrate a knowledge of the scope, defining features, and main areas of Hydrology and hydraulic design and detailing
2.2.	Demonstrate a knowledge of the scope, defining features, and main areas of Geotechnics and geological design and detailing
2.3.	Apply their knowledge of a range of professional skills, techniques, ideas and concepts in Structural Analysis and steel/concrete/timber/masonry design and detailing
2.4.	Formulate and critically evaluate sustainable design
3.	**Technical and practical application of engineering**
3.1.	Use a wide range of routine and some advanced skills associated with Civil Engineering in Surveying

3.2.	Use a wide range of routine and some advanced skills associated with Civil Engineering in Dimensional control
3.3.	Use a wide range of routine and some advanced skills associated with Civil Engineering in Quality Control
3.4.	Apply a range of specialist Civil Engineering knowledge, skills and understanding of different approaches to the Measurement of quantities
3.5.	Apply a discerning understanding of a defined range of Civil Engineering concepts, theories and principles to Site Investigation and reconnaissance
4. Project delivery and management	
4.1.	Exercise autonomy and initiative at a professional level in Health, safety and environmental requirements and legislation
4.2.	Work within a defined area of work, sometimes taking the lead in Planning and programming schedules of work
4.3.	Use a wide range of complex information to evaluate the need to establish construction contracts
4.4.	Apply knowledge, skills and understanding of Civil Engineering practices' approach to Risk Management to critically analyse current practices including being encouraged to develop alternative solutions or ways of working to minimise or eliminate risks
4.5.	Exercise autonomy in specified areas of work at a professional level in Measurement and costing (budget control)
5. Interpersonal skills, communication and continual professional development	
5.1.	Demonstrate knowledge and understanding, apply skills and be accountable

Appendix B. Low-level Outcome Examples

The next section provides examples of low-level learning and skills outcomes which employers may expect individuals to cover in a Higher Apprenticeship **Civil Engineering** diploma.

The low-level learning and skills outcomes are not intended to be used as a pro-forma curriculum.

Each learning provider will have its own approach to delivering the degree and progression between stages. The low-level skills and derived learning outcomes that are detailed in the following sections will provide guidance to ensure that each degree covers the desired learning outcomes appropriately.

Table 1 Skills and knowledge coverage in Civil engineering technology materials

1. Civil engineering technology materials
1.1. Apply their knowledge, skills and understanding of the components of large framed structures
1.2. Demonstrate a specialist knowledge of infrastructure systems
1.3. Undertake critical analysis of concepts and information and issues to determine the best selection and manufacture of materials
1.4. Properties and use of materials
1.5. Use a wide range of ICT knowledge and programs, within defined company specific guidelines, to apply information management and document control to a project whilst utilising numerical and graphical data to measure progress
1.6. Use a range of professionally accepted and routine mathematical skills to convey ideas and concepts

1.1. Apply their knowledge, skills and understanding of the components of large framed structures to:

CIV1.1.a. Draft grids, drawings and outlines and refer to commonly used steel and concrete framed structures

CIV1.1.b. Detail types of frame construction including the stability of braced, ridged and portal frames

CIV1.1.c. Detail types of and draft ways of establishing walls to framed structures

CIV1.1.d. Detail types of floors and roofs associated with framed structures

CIV1.1.e. Have appreciation of Architectural & M&E requirements, including, Waterproofing, Fire Engineering, Ventilation, Lift shafts etc.

1.2. Demonstrate a specialist knowledge of infrastructure systems to be able to:

CIV1.2.a. Define and explain various road systems and pavements and from provided data calculate the various thicknesses of layers

CIV1.2.b. Design roads using a geometric approach

CIV1.2.c. In line with current legislative requiremnts, employ the principles of drainage to surface water removal and the control of ground water

CIV1.2.d. Explain and communicate the procedures employed in road maintenance

CIV1.2.e. Use environmental measures in road design and construction

CIV1.2.f. Explain, carry out and analyse a basic traffic survey

1.3. Undertake critical analysis of concepts and information and issues to determine the best selection and manufacture of materials to be able to:

CIV1.3.a. Compare and contrast materials used for Civil Engineering applications

CIV1.3.b. Sustainable selection of material, waste hierarchy and alternative materials

CIV1.3.c. Source of raw materials and alternative sources and manufacture processes

1.4. Properties and use of materials

CIV1.4.a. Perform and bring together laboratory reports on standard tests used on Civil Engineering materials

CIV1.4.b. Specify materials – for concrete mix design, soils testing and associated testing

1.5. Use a wide range of ICT knowledge and programs, within defined company specific guidelines, to apply information management and document control to a project whilst utilising numerical and graphical data to measure progress using:

CIV1.5.a. Building Information Modelling (BIM)

CIV1.5.b. The companies File handling procedures

CIV1.5.c. Use civil engineering software platforms to input, save, analyse and retrieve engineering data to produce project plans and reports

1.6. Use a range of professionally accepted and routine mathematical skills to convey ideas and concepts to:

CIV1.6.a. Employ mathematical expressions to answer civil engineering equations

CIV1.6.b. Use a range of accepted mathamatical approaches such as trigonometry, calculus, vectors algebra and circular measure formulae to work out problems common within the construction sector

CIV1.6.c. Using matrix methods create and solve equations to solve engineering problems

CIV1.6.d. Use standard functions of differentiation such as product, quotient and chain rule to solve engineering problems

CIV1.6.e. Solve problems in civil engineering by using techniques of integration

Table 2 Skills and knowledge coverage in Civil engineering design and specification

2. Civil engineering design and specification
2.1. Demonstrate a knowledge of the scope, defining features, and main areas of Hydrology and hydraulic design and detailing
2.2. Demonstrate a knowledge of the scope, defining features, and main areas of Geotechnics and geological design and detailing
2.3. Apply their knowledge of a range of professional skills, techniques, ideas and concepts in Structural Analysis and steel/concrete/timber/masonry design and detailing
2.4. Formulate and critically evaluate sustainable design

2.1. Demonstrate a knowledge of the scope, defining features and main areas of Hydrology and hydraulic design and detailing to be able to:

CIV2.1.a. Define the hydrological cycle, surface water and dewatering systems

CIV2.1.b. Solve hydrological problems such as hydrographs, flood prediction and extreme events using graphical methods

CIV2.1.c. Use the equations of continuity and energy as applied to pipelines and pumps

CIV2.1.d. Calculate forces caused by fluid flow using using the momentum equation

CIV2.1.e. Use civil engineering solutions to solve open channel flow problems

CIV2.1.f. Discuss sustainable Urban Drainage systems and legislation.

2.2. Demonstrate a knowledge of the scope, defining features and main areas of Geotechnics and geological design and detailing to be able to:

CIV2.2.a. Categorise and define the physical properties of soils

CIV2.2.b. Establish the need for ground improvement and contaminated land remediation

CIV2.2.c. Classify common rocks and geological structures on sites

CIV2.2.d. Describe the main points of soil compaction

CIV2.2.e. Design foundations based on current civil engineering practices to establish load bearing capabilities

CIV2.2.f. Determine and establish the engineering properties of various types of soil

CIV2.2.g. Check the requirements for building stable retaining walls

CIV2.2.h. Create and carry out analysis of geological maps

CIV2.2.i. Conduct, or monitor and analyse the results from a range of laboratory tests used on soils

2.3. Apply their knowledge of a range of professional skills, techniques, ideas and concepts in Structural Analysis and steel/concrete/timber/masonry design and detailing to be able to:

CIV2.3.a. Evaluate loads on elements of structures and calculate support reactions

CIV2.3.b. Analyse problems relating to direct stress & strain

CIV2.3.c. Calculate shear forces, bending moments and deflections for statically determinate beams

CIV2.3.d. Analyse pin jointed frames using the method of sections and the method of joint resolution

CIV2.3.e. Design codes and the application of partial factors etc. with respect to loads and resistance

CIV2.3.f. Use Euler's theory of simple buckling to determine stress in axially loaded columns

CIV2.3.g. Gauge the combined stresses in structural members and gravity walls and their stability

CIV2.3.h. Within structural steelwork define the plastic modulus and the plastic moment of resistance

CIV2.3.i. Use the plastic analysis method to solve problems in structural steelwork structures

CIV2.3.j. Using the moment distribution method analyse statically indeterminate beams

CIV2.3.k. Assess the appropriateness of reinforced concrete one-way spanning slabs in specific scenarios

CIV2.3.l. Assess the appropriateness of the use of singly and doubly reinforced concrete beam sections

CIV2.3.m. Assess the appropriateness of short, braced reinforced concrete columns and pad foundations used in civil engineering projects

CIV2.3.n. Evaluate the suitable use of statically determinate steel beams that are equipped with fully restrained, partially restrained or unrestrained compression flanges

CIV2.3.o. Assess the appropriateness of a range of single-storey steel column sections that are subject to combined axial load and single and bi-axial bending

CIV2.3.p. Assess the appropriateness and the design of baseplates with concentric axial loads

CIV2.3.q. Design a variety of possible connections using bolted and welded approaches

2.4. Formulate and critically evaluate Sustainable design to be able to:

CIV2.4.a. Identify the impact of SEPA's CAR regulations on both temporary and permanent designs

Table 3 Skills and knowledge coverage in technical and practical application of engineering

3. Technical and practical application of engineering
3.1. Use a wide range of routine and some advanced skills associated with Civil Engineering in Surveying
3.2. Use a wide range of routine and some advanced skills associated with Civil Engineering in Dimensional control
3.3. Use a wide range of routine and some advanced skills associated with Civil Engineering in Quality Control
3.4. Apply a range of specialist Civil Engineering knowledge, skills and understanding of different approaches to the Measurement of quantities
3.5. Apply a discerning understanding of a defined range of Civil Engineering concepts, theories and principles to Site Investigation and reconnaissance

3.1. Use a wide range of routine and some advanced skills associated with Civil Engineering in Surveying to be able to:

CIV3.1.a. Use a variety of source material such as Ordnance Survey maps and site plans to define co-ordinates, distances, gradients, bearings and the accurate measurement of areas

CIV3.1.b. Complete a levelling survey and use the results to calculate contours, sections and volumes

CIV3.1.c. Use a variety of source materials, measure angles and distances to inform a Civil Engineering survey

CIV3.1.d. Using a total station detail survey, produce a computer plot of the outcomes

3.2. Use a wide range of routine and some advanced skills associated with Civil Engineering in Dimensional control to be able to:

CIV3.2.a. Use a line and level to lay out a basic construction site

CIV3.2.b. Complete a traverse survey and compute co-ordinates from the results

CIV3.2.c. Plan and set out horizontal and vertical curves used in civil engineering

3.3. Use a wide range of routine and some advanced skills associated with Civil Engineering in Quality Control to be able to:

CIV3.3.a. Determine the accuracy and calibration checks on instruments and understand the importance of all equipment being calibrated

CIV3.3.b. Manage document control

3.4. Apply a range of specialist Civil Engineering knowledge, skills and understanding of different approaches to the Measurement of quantities to be able to:

CIV3.4.a. When calculating and billing substructures, concrete work, formwork and earthworks, use CESMM

3.5. Apply a discerning understanding of a defined range of Civil Engineering concepts, theories and principles to Site Investigation and reconnaissance so as to be able to:

CIV3.5.a. Explain the procedure of carrying out a site investigation

CIV3.5.b. Discuss and analyse the relevance of sampling and testing

Table 4 Skills and knowledge coverage in project delivery and management

4. Project delivery and management
4.1. Exercise autonomy and initiative at a professional level in Health, safety and environmental requirements and legislation
4.2. Work within a defined area of work, sometimes taking the lead in Planning and programming schedules of work
4.3. Use a wide range of complex information to evaluate the need to establish construction contracts
4.4. Apply knowledge, skills and understanding of Civil Engineering practices' approach to Risk Management to critically analyse current practices including being encouraged to develop alternative solutions or ways of working to minimise or eliminate risks
4.5. Exercise autonomy in specified areas of work at a professional level in Measurement and costing (budget control)

4.1. Exercise autonomy and initiative at a professional level in Health, safety and environmental requirements and legislation so as to be able to:

CIV4.1.a. Understand the implications of the current Health and Safety at Work Act, the Construction Design and Management Regulations (CDM) and Approved Codes of Practice (ACOPs) pertaining to Construction activities

CIV4.1.b. Understand the implications of the sources and cost implications of accidents

CIV4.1.c. Prepare risk analyses and realistic method statements for works

CIV4.1.d. Develop alternative solutions or ways of working to minimise or eliminate risks

4.2. Work within a defined area of work, sometimes taking the lead in Planning and programming schedules of work to be able to:

CIV4.2.a. Prepare schedules of works for various phases of a construction project such as pre-tender and construction phases

CIV4.2.b. Use an evidence base to critically evaluate and Identify, review and select techniques, procedures and methods to undertake engineering tasks

CIV4.2.c. Monitor and report on progress and manage resources (plant, materials etc.)

4.3. Use a wide range of complex information to evaluate the need to establish construction contracts and be able to:

CIV4.3.a. Describe procedures to establish construction contracts and the advantages and disadvantages of each

CIV4.3.b. Explain the common forms of construction contracts

CIV4.3.c. Critically analyise the different procurement options -strengths and weakness

4.4. Apply knowledge, skills and understanding of Civil Engineering practices' approach to Risk Management to:

CIV4.4.a. Critically analyse current practices including being encouraged to develop alternative solutions or ways of working to minimise or eliminate risks

4.5. Exercise autonomy in specified areas of work at a professional level in Measurement and costing (budget control) to be able to:

CIV4.5.a. Reach agreement on costings around variations, disputes and day works to establish correct payments

CIV4.5.b. Carry out Estimating

CIV4.5.c. Prepare of estimates and tenders

Table 5 Skills and knowledge coverage in interpersonal skills, communication and continual professional development

5. Interpersonal skills, communication and continual professional development
5.1. Demonstrate knowledge and understanding, apply skills and be accountable

5.1. The graduate will be able to demonstrate knowledge and understanding, apply skills and be accountable for:

CIV5.1.a.	Identifying the roles of professionals and parties within a contract
CIV5.1.b.	Using their understanding of core theories, concepts and principles clarify the roles and responsibilities of various people and professional bodies within the construction sector
CIV5.1.c.	Apply specific and specialist knowledge to be able to discuss the Introduction to history, function, status of professional bodies and be able to discuss ways/processes for achieving membership
CIV5.1.d.	Apply their knowledge of Engineering communication to be able to apply CAD, sketching, drawing, graphical, technical report, Information modelling and BIM to convey complex information to a range of audinces
CIV5.1.e.	Demonstrate an awareness of some major current issues to understand the various purposes, methods of communications and media available
CIV5.1.f.	Use a wide range of routine skills, such as freehand sketching to communicate and correctly clarify construction technology details
CIV5.1.g.	Use a wide range of standard ICT applications to process and store data to produce written records of construction activities
CIV5.1.h.	Use a wide range of standard ICT applications to process and store data to convey complex information to a range of audinces on construction site activities
CIV5.1.i.	Use standard ICT packages such as CAD to set up a 2D & 3D CAD drawing environment, to create, edit save and print orthographic and pictorial drawings
CIV5.1.j.	Practice in such a way as to operate within professional relationships, ethics and anti-bribery guidelines
CIV5.1.k.	Exercise autonomy and initiative to use Independent Judgement and Responsibility to make decisions
CIV5.1.l.	Exercise management and leadership responsibilities
CIV5.1.m.	Be responsible for acrrying out and maintaining professional development

Appendix C. Framework development summary

A Higher Apprenticeship framework sets out the required knowledge, skills and learning outcomes identified through employer and key partner consultation to support the delivery of a Higher Apprenticeship programme. This is achieved through employer and key partner input to Technical Expert Groups (TEGs).

TEGs are short life working groups designed to act as an advisory group on behalf of the sector and contributes to the development and course design of a HA. TEGs are integral to the process of developing HAs that provide quality, consistency and relevance to industry.

Each TEG is made up of employers, professional or industry bodies, learning providers, and subject/technical experts from the related industry.

The following organisations were consulted in the development of this framework:

Civil Engineering (SCQF level 8)

Employers	Learning providers	Qualification and industry bodies
Aberdeenshire Council	Edinburgh Napier University	CECA Scotland
Balfour Beatty (Chair)	Glasgow Kelvin College	CITB
Black & Veatch	Robert Gordon University	SQA
Improvement Service	University of Aberdeen	
Morrison Construction	UHI – Inverness College	
Robertson Group		
RJ McLeod		
Stewart Milne Group		

Skills Development Scotland

This framework is also available on the Skills Development Scotland corporate website:
www.skillsdevelopmentscotland.co.uk