

TECHNICAL EDUCATION FOR YOUR WORKFORCE: CONCRETE SECTOR DISTANCE LEARNING WITHIN HIGHER EDUCATION IN THE UK

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ABSTRACT. The traditional route for knowledge and technical understanding of the production of concrete for civil/structural engineering based projects is through the standard undergraduate programmes offered by universities across the globe. The product (graduates) of these programmes of Higher Education are often very competent “engineers” who have vast knowledge of theory, but often have little in the way of practical experience in the “real world”.

At the Centre for Mineral Products (C4MP), we do things slightly differently:

- Firstly, the study materials have been produced in ‘partnership’ with the UK concrete sector itself, therefore the content is very much aligned to the ‘needs’ of the sector.
- Secondly, we only have students who are currently in full time employment within the ready-mix and precast concrete sector.
- Thirdly, these students are nominated and supported by their respective companies, therefore the cost of the programmes are covered by the sponsoring company.
- Fourthly, as our programmes are all based on a part-time Blended-Distance Learning model, there is no need to come to Derby to study at all, opening up the programmes to overseas students.
- Finally, unlike most UK based HE programmes, there are no formal entry requirements in terms of School or College certificates. Our aim is to widen participation in Higher Education (Tertiary Education) to all those in the concrete sector who have the motivation to undertake the programmes.

This new model of the provision of Higher Education technical programme to “Industry” is now firmly established, and widely supported by all the major national and multinational concrete producing companies.

Keywords: Blended-Distance Learning, Concrete Technical Qualifications, Industry Sector Partnership

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INTRODUCTION

The traditional route for tertiary education, up to degree level, within the Higher Education (HE) sector in the UK and other parts of the world has, in the main, been one where the individual gains the academic qualification prior to joining and employer within the concrete sector. In essence this puts ‘theoretical’ knowledge chronologically before ‘experiential and practical’ knowledge development. For many this has been a very successful career pathway, however it is predicated upon the ‘recruitment’ of new employees, predominantly at the start of their careers, rather than the ‘up-skilling’ of existing employees, who often have a wealth of practical knowledge and experience.

It is widely acknowledged that the workforce within the construction sector in the UK, including the concrete sector, is ageing. A report by the Construction Products Association (CPA) posted in 2017 [1] states; “*The construction industry, like all other industries is made up middle-aged and older workers but the latest figures suggest that the construction workforce has a slightly larger component of older workers relative to other sectors.*” In 2017 57.9% of the workforce were between 25-49 years of age, and 32.5% were 50 and over. This coupled with a reduction in engineering graduates from the UK, concrete technology specialists and specifically materials/civil/structural engineers that specialise in concrete, means that the workforce is not being replenished.

In 2015 a skills survey of the trade associations who are members of the Construction Products Association [2], highlighted a number of ‘big issues’, reflecting the existing and projected future skills shortage in the sector. The top 7 ‘big issues’ were:

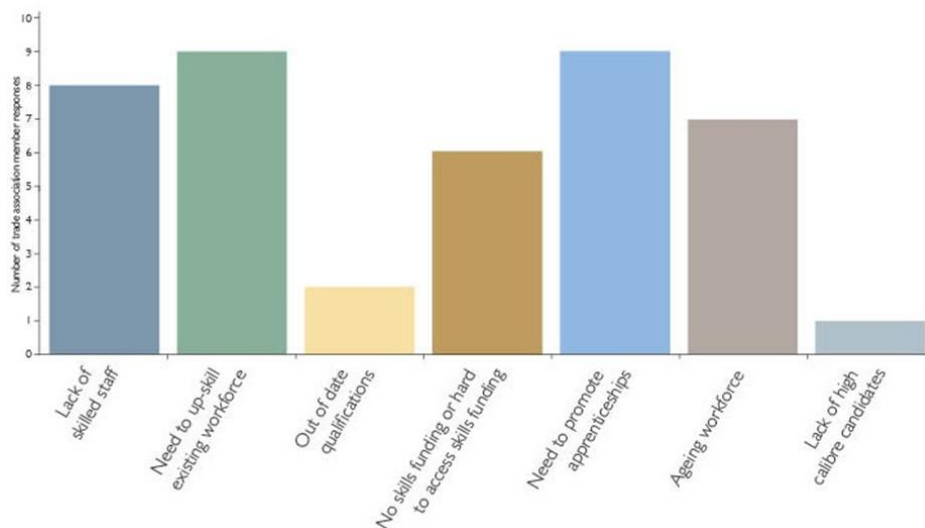


Figure 1 Big Issue Skills Challenges from the Construction Products Association Skills Survey 2015

In the foreword to the CPA skills survey report [2], the then Chief Executive of the Construction Industry Training Board (CITB), Adrian Belton, concludes: “*We have to create more relevant qualifications, a greater number of apprenticeships and better continued professional development of the existing workforce to tackle these issues.*” This report was the first of many reviewing the current state of the supply of Level 3+ and Level 4+ qualified employees. In the UK Educational System Level 3+ relates to Further Education qualifications, whilst Level 4+ are Higher Education qualifications (University Certificates,

Diploma, Foundation Degrees and Honours Degrees). Table 1 shows the current structure of the UK’s HE qualifications (Levels). Currently the C4MP programmes in concrete technology provide the following:

Table 1 UK Framework for Higher Education Qualifications and the Programmes currently provided by the Centre for Mineral Products at the University of Derby in Concrete Technology

LEVEL	TYPICAL QUALIFICATION [3]	CENTRE FOR MINERAL PRODUCTS – CONCRETE TECHNICAL PROGRAMMES
8	<ul style="list-style-type: none"> • Doctoral Degrees (eg PhD, DPhil, EdD) 	<ul style="list-style-type: none"> • Industry sponsored Research Doctorates (PhD)
7	<ul style="list-style-type: none"> • Masters Degrees • Integrated Masters Degrees • Postgraduate Diplomas • Postgraduate Certificate of Education • Postgraduate Certificates 	
6	<ul style="list-style-type: none"> • Bachelors Degrees with Honours • Bachelors Degrees Professional Graduate Certificate in Education • Graduate Diplomas • Graduate Certificates 	<ul style="list-style-type: none"> • BSc Honours Degree (Top Up) Minerals Management
5	<ul style="list-style-type: none"> • Foundation Degrees Diplomas of Higher Education • Higher National Diplomas 	<ul style="list-style-type: none"> • Fd (Science) Concrete Technology • Fd (Science) Mineral Products Technology ((Higher Apprenticeship Concrete Pathway) • Diploma Concrete Studies
4	<ul style="list-style-type: none"> • Higher National Certificates • Certificates of Higher Education 	<ul style="list-style-type: none"> • University Certificate in Concrete Technology (3 Modules) • Certificate of Credit Ready-mix Concrete Technology (1 Module)

Published in 2018, Warwick Institute for Employment Studies undertook research on behalf of Engineering UK, the Engineering UK 2018; Synopsis and recommendations [4]. A number of startling predictions are contained within the report;

- Net requirement projections from Working Futures 2014-2024 indicate that by 2024, 54.1% of the workforce will require Level 4+ qualifications. This compares with 41.1% in 2014.
- Between 2014 and 2024, 1,240,000 graduate and technician core engineering jobs will arise across all industries as a result of both replacement demand (i.e. the result of people leaving the labour force) and expansion demand (i.e. new jobs). Assuming that this is uniformly distributed across the ten years, this translates to a need to fill 124,000 Level 3+ core engineering roles every year.
- 61% of businesses were not confident there will be enough people with the skills to fill their high-skilled job vacancies.
- Given the supply of engineering talent coming from the educational pipeline through apprenticeships and higher education, we estimate there to be a shortfall of between 37,000 to 59,000 in meeting an annual demand for 124,000 core engineering roles requiring Level 3+ skills. Within this, we expect a graduate-level shortfall of at least 22,000 per year.

The 'need' has therefore been identified, and current predictions are that there will be a significant shortfall, but why should this be the case? The Engineering UK report identifies some stark 'realities' as to why this shortfall exists;

- There has been considerable change to the higher education landscape in recent years, with reductions in public funding across the UK and increasing undergraduate tuition fees in England.
- 28% of students in engineering-related first degree courses and 69% students in postgraduate taught courses were not from the UK.

From the UK perspective, it has been clear for a number of years that the traditional route for tertiary education technical training and qualifications is not meeting the demand of employers. One of the perceived solutions to the shortfall in recruiting younger employees has been the development and roll out of Modern Apprenticeships, including Higher Apprenticeships (Level 5) and Degree Apprenticeships (Level 6). In April 2017, the apprenticeship levy came into force in England, requiring companies with a wage bill exceeding £3 million to fund apprenticeships, in part to meet the UK government's target of 3 million apprenticeship starts in England by 2020 [5]. The apprenticeship levy is in effect a ring fenced funding resource that employers can use to fund workforce skills development. Initially aimed at the 16-24 age bracket, but in 2017 the age restrictions were dropped, when the Apprenticeships were changed from 'Frameworks' to 'Standards', in order that employers could better spend their levy money on up-skilling the whole workforce.

CENTRE FOR MINERAL PRODUCTS APPROACH

The Centre for Mineral Products (C4MP) at the University of Derby in the UK is a unique centre of excellence within the global mineral and construction products sector. Within the University's structure, C4MP sits within the Business Gateway / External Affairs, rather than within an academic college. The emphasis is therefore focussed on the provision of professional services to Industry partners and clients, rather than the traditional undergraduate.

The programmes currently offered within the C4MP at Derby were born out of the 'Doncaster Assisted Private Study' (DAPS) course, originally established in 1971 to provide the quarrying and extractives industry with an industry-standard knowledge-based qualification route to management in the extractives sector. For over 40 years this course has been the bedrock of professional development for the sector, on all matters technical for the extractives sector in the UK.

In 1987, an Asphalt Diploma was added to the offering at Doncaster College and since the move to the University of Derby in 2007, the C4MP has offered courses relating to concrete technology, clay technology and cement technology.

The Foundation Degree (Science)[6] was launched in 2014 to aid the 'UK Minerals Industry' drive towards 'total competence' in its workforce. The partnership between the Concrete Society and the University of Derby enables a clear knowledge based progression path to be offered to those, employed in the concrete industry, who wish to enhance their career and life-long learning opportunities. The programme was created in order to provide the

Concrete sector with a Level 5 qualification, and therefore the programme is constructed from the initially agreed aims (Programme Rationale) and objectives (Learning Outcomes).

Programme Rationale – Foundation Degree (Science) Concrete Technology

This programme aims to meet the current and future professional development needs of the Concrete Industry by:

- Meeting international, national and local skill development needs;
- Preparing students for current and future employment and further study;
- Developing students' capacity to learn (both on the programme and as independent and lifelong learners after the programme);
- Providing flexible learning opportunities, widening participation;
- Progressing the process of continuous improvement and development of 'fit for purpose' qualifications for the industry.

The objectives that subsequently follow from these aims have been used to form the learning outcomes, around which the different programmes, at the respective HE levels, have been created.

Learning Outcomes of the Programme

For the award of Foundation Degree in Concrete Technology learners must be able to:

Knowledge and Understanding

- Demonstrate broad knowledge and understanding of the principles of technology, mathematics and engineering that are relevant to, and underpin the field of Concrete Technology.
- Display knowledge and understanding of well-established health, safety, environmental and ethical principles and how these are relevant within the Concrete Technology Industry and their professional role and workplace setting.
- Demonstrate broad knowledge and critical understanding of the properties, characteristics and performance of minerals and the techniques used to manage product quality to satisfy end user requirements.
- Demonstrate knowledge of geological and technological principles to explore, locate and survey minerals relevant to the production of concrete and understand the implications of their extraction within a given area.

Intellectual Skills

- Conduct academic research or professional research activities in a coherent and systematic fashion, with design and/or application of appropriate methodologies.
- Critically evaluate the appropriateness of different approaches to solving problems and how to effectively apply these in a work context.
- Demonstrate the ability to develop ideas and construct arguments in both written and verbal form and to evaluate such ideas and arguments critically'

Subject Specific Skills

- Utilise personal and professional learning to develop an understanding of the Mineral Product Technology industry and their role within it.

- Plan and implement activities or projects designed and developed to improve practices within the Concrete Technology industry, generally and specifically within their own workplace.
- Apply practical and operational skills to produce and deliver products as required of the Concrete Industry.
- Work within the legislative framework pertaining to the field of Concrete Technology.

Transferable Skills

- Work in combination with others on activities and show skills in teamwork, negotiation, organisation and decision-making.
- Apply a range of advanced transferable skills, including written and verbal communication skills, ICT skills, negotiation skills and interpersonal skills.
- Demonstrate qualities and transferable skills necessary for employment in the Concrete industry and progression to other qualifications requiring the exercise of personal responsibility and decision-making.

Within the 3 year Foundation Degree (Science) programme in Concrete Technology, the students study 4 concrete specific modules at UKHE Level 5 as shown in Table 2, along with other core components such as Engineering (electrical and mechanical), that are taught with students on the other Mineral Products pathways, Extractives, Asphalt, Clay and Cement.

Higher Apprenticeships – Tailored approach to the mineral products sector workforce training and up-skilling.

The UK Governments publication of its National Infrastructure Plan for Skills in 2015 [5], identifies its ambition to provide clear, high quality professional and technical routes to employment through ‘modern’ apprenticeships, which are designed to be provided through:

- simplifying and streamlining the number of qualifications so individuals have a clear set of professional and technical routes to choose from;
- refocusing vocational provision to deliver the high-quality skills at intermediate and higher levels that employers need; and
- establishing a network of prestigious Institutes of Technology to deliver high standard provision at levels 3, 4 and 5, sponsored by employers, registered with professional bodies and aligned with apprenticeship standards.

The final bullet point here is where the C4MP, in collaboration with the employers and the professional bodies, are already providing this type of ‘alternative route’ (alternative to a traditional HE route) to professional technical knowledge based training and education. Since 2016, 128 Higher Apprentices have studied or are currently studying at the C4MP, of which roughly 15% have or are following the Concrete Technology pathway (20 Apprentices in total),

Table 2 Concrete specific modules and contents that form the concrete pathway specific content for both the Foundation Degree and University Diploma in Concrete Technology.

CONCRETE TECHNOLOGY	CONCRETE CONSTITUENTS & TYPES	CONCRETE IN CONSTRUCTION	DURABLE CONCRETE STRUCTURES
Cements and Additions.	Cementitious Materials.	Formwork.	Durability.
Admixtures and Fibres.	Admixture Technology.	Surface Finish.	Permeability.
Aggregates.	Lightweight and Heavyweight Concrete.	Reinforced and Pre-Stressed Concrete.	Cracks in Concrete.
Standards and Specifications for Concrete.	High Strength Concrete.	Suspended and Composite Slabs.	Defects and Blemishes.
Properties of Fresh and Hardening Concrete.	Self Compacting Concrete.	Industrial Ground Floors.	Deterioration. Assessment.
Properties of Hardened Concrete.	Fibre Reinforced Concrete.	External Concrete Paving.	Analysis and Strength Measurement.
Mix Design and Conformity Control.	Control of Alkali Silica Reaction.	Pumping Concrete.	Corrosion of Reinforcement.
Durable and Sustainable Concrete.	Mortars, Screeds and Renders.	Sprayed Concrete.	Concrete Repair.
Production and Delivery.	Precast Concrete in Building.	Foamed Concrete.	Protection Systems.
Placing, Compacting and Curing.	Health, Safety and Environmental Aspects.	Under-Water Concrete.	Health, Safety and Environmental Awareness.
		Health, Safety and Environmental Awareness.	

and since September 2017, all the Higher Apprentices are funded via the Apprenticeship Levy, rather than being paid for by their employers.

Whilst a very specific UK up-skilling initiative, this does show how the Industry and specifically here the Concrete sector in the UK, as far as Apprenticeships are concerned, in conjunction with a ‘traditional’ HE provider, can fully meet the requirements of the ‘National Infrastructure Plan for Skills’[5].

WHAT’S UNIQUE ABOUT THE CENTRE FOR MINERAL PRODUCTS?

As previously displayed, the programme content and the educational basis for the programmes are very much aligned with the traditional HE route to level 5 and level 6 qualifications. The key differences that the C4MP at the University of Derby offer to any conventional undergraduate programmes within the Higher Education system in concrete technology are, in summary:

- C4MP is operated in ‘Partnership’ with Industry Bodies, Employers and Professional Institutes. Each is a key stakeholder and beneficiary.
- All the programmes have been developed / co-written with Industry representatives, including the key employers, as well as the Professional Institutes.

- The programmes are therefore tailored to meet the technical knowledge needs of the sector, as identified by the key players in that sector.
- The students are employed within the sector. Therefore students are ‘sponsored and funded’ by their employer. This forms part of their individual career progression pathway.
- The programmes are based on a part-time, blended distance learning blended model. Learn whilst you work, maintaining the experiential learning process but supporting this with the technical knowledge based study materials.
- All modules are accessible in a web-based format with the integration of high-quality media and interactivity. More importantly, they are available 24h a day, seven days a week anywhere in the world, making these programmes attractive, not only UK based students, but also those overseas.
- A University of Derby quality assurance system ensures that a rolling programme updates units ensuring that both the legislation, regulatory and technology content is kept up to date, on an annual basis.
- The qualifications on offer, University Certificate, University Diploma or Foundation Degree (Science) in concrete technology, are not only UK University Awards, but are recognised by the Industry and Professional Institutes.
- Provision of a Higher Apprenticeship qualification pathway, utilising the Apprenticeship Levy funds available (since 2017).

It is clear that if the standard supply chain for engineers and trained technicians in the concrete sector is not being met by the traditional HE route in the UK, there is a significant risk of a skill shortage in the coming years. The Programmes that the C4MP at the University of Derby offer therefore meets the needs for the UK but also a more global demand for “in work” technical knowledge training. Up-skilling via part-time distance learning or as a Higher Apprentices within a HE environment, not only provides the opportunity for the individual to gain qualifications that will enhance their own career prospects, but also the employer. Recruiting to fill skills gaps can be time consuming and expensive. Investing in your existing workforce will not only increase the in-house capabilities, but also instil a feeling of value and worth from the employer to the employee.

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