

Employer-Managed (Technical) Programme (CEng) and Self-Managed (Technical) Programme (CEng)

Introduction

Chartered Engineers are characterised by their ability to develop appropriate solutions to engineering problems, using new or existing technologies, through innovation, creativity and change. They might develop and apply new technologies, promote advanced designs and design methods, introduce new and more efficient production techniques, marketing and construction concepts, or pioneer new engineering services and management methods. Chartered Engineers are variously engaged in technical and commercial leadership and possess effective interpersonal skills. (UK Spec)

Note that your portfolio should contain a brief reflective statement for each Learning Outcome (LO) to state the activity undertaken and evidence to support completion.

These tables are for guidance only and contain examples of the types of activities and evidence which could be undertaken and submitted to complete the appropriate Learning Outcomes. The opportunities available for learning will depend entirely on the graduate's place of work and therefore the Learning Plan should be tailored to the individual.

Please note that not all of these Learning Outcomes have to be achieved but trainees/students must complete all Level 1 (9 LOs) for their pathway, the majority of Level 2 (6 LOs) and, if possible the Level 3 (1 LO). Trainees need to provide evidence of higher level of knowledge in a new situation. Further Learning will involve some additional private study to enable trainees to fully meet all the requirements. The levels referred to in this document have been defined by the JBM and do not relate to educational framework levels.

The expectation of the JBM is that the Learning Outcomes are addressed as demonstrated below but it should be remembered that this is only indicative and it is the responsibility of each candidate to submit a learning plan which identifies the Learning Outcomes that are necessary to enable that individual to reach the desired educational base and how these will be achieved.

Level of importance:

1. An **essential** LO – there must be evidence to show that this has been achieved
2. A **desirable** LO – ideally there should be evidence to show that this had been achieved but it is not essential; it will depend on the opportunities available
3. An **optional** LO – it is not a requirement to produce evidence to show that this has been achieved but if the opportunity arises then it is of value to collect the evidence

Category:

U – Understanding In order to apply the knowledge you have gained through education and experience you need to understand what that knowledge means. Therefore if you were challenged to explain something and were able to do so correctly or were able to correctly relate the relevant piece of knowledge to a new situation then you will understand that piece of knowledge. Knowledge is the term used to describe the information you have gathered through education and experience. It can be both practical and theoretical. This information will be based on observations of products, processes and behaviour of materials; and facts about materials, products and processes derived from various sources; as well as information about the mathematical and scientific principles that underpin engineering.

A – Ability This means that you are able to do something correctly. You must have the knowledge and understand that knowledge in order to complete a task successfully. Importantly, though, you must be able to apply your knowledge to a new situation.

Summary

- (i) A1 The ability to develop, monitor and update a plan, to reflect a changing operating environment (this change could be financial, environmental, resource, delays, site conditions)
- (ii) A1 The ability to monitor and adjust a personal programme of work on an on-going basis, and to learn independently
- (iii) A1 The ability to exercise initiative and personal responsibility, which may be as a team member or leader
- (iv) A1 The ability to learn and apply new (to the graduate) theories, concepts, methods etc in unfamiliar situations
- (v) U2 A comprehensive understanding of the relevant scientific principles of the specialisation
- (vi) U1 A critical awareness of current problems and/or new insights much of which is at, or informed by the forefront of the specialisation
- (vii) U3 An understanding of concepts relevant to the discipline, some from outside engineering, and the ability to critically evaluate and apply them effectively.
- (viii) A2 Ability to use fundamental knowledge to investigate new and emerging (in other companies and countries rather than new and emerging in society as a whole) technologies
- (ix) A1 Ability to apply appropriate models for solving problems in engineering, and the ability to assess the limitations of particular cases
- (x) A1 Ability to collect and analyse data and use appropriate engineering tools to tackle problems that are unfamiliar to the graduate, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaption of engineering analytical methods
- (xi) A2 The ability to apply original (genuinely original, not just original to the candidate) thought to the development of practical solutions for problems, systems, components or processes
- (xii) U2 Knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately, in the context of the particular specialisation.
- (xiii) A1 The ability to make general evaluations of risk through some understanding of the basis of such risks.
- (xiv) U1 A thorough understanding of current practice and its limitations, and some appreciation of likely of new developments;
- (xv) U1 Advanced level knowledge (not necessarily advanced materials) and understanding of a wide range of engineering materials and components;
- (xvi) A1 Ability to apply engineering techniques taking account of a range of commercial and industrial constraints.

Employer-Managed and Self-Managed (Technical) Programme (CEng) - General Learning Outcome (i)	
The ability to develop, monitor and update a plan, to reflect a changing operating environment (this change could be financial, environmental, resource, delays, site conditions)	
This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>It is routine practice to plan activities in the workplace. For example,</p> <ul style="list-style-type: none"> • Developing a programme of work to produce a scoping document through discussions with a client and colleagues and study of case histories including company records and published material; • Developing a plan for a construction activity (e.g. temporary excavation, floor construction) which ultimately leads to a method statement and specification • Developing a plan for a design process which includes assessing the design brief, identifying the relevant codes of practice and regulations, assembling the data including manufacturers information on materials and products, undertaking design calculations, producing design drawings and presenting the output for approval • Developing a budget for a project or part of a project showing the link between the costs and the construction process • Dealing with a claim of variation showing how the claim was assessed, the variation required, the implementation of the variation and the cost of that implementation • Maintaining a personal plan to complete the further learning programme showing changes that were made and identifying what additional activities were needed 	<p>The evidence could include:-</p> <ul style="list-style-type: none"> • Gantt Charts; • Minutes of meetings with clients/managers to show how decisions were made and how the actions arising from those decision were implemented and the impact on cost; • Reports describing the programme of work/design process/budget; • The further learning plan; • Claim for variation with supporting evidence to show why the variation was carried out ;

Employer-Managed and Self Managed (Technical) Programme (CEng) - General Learning Outcome (ii)	
The ability to monitor and adjust a personal programme of work on an on-going basis, and to learn independently	
This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>As a professional engineer it is necessary to maintain a personal development record and if working for a professional qualification through the further learning route, a further learning plan. Examples include:-</p> <ul style="list-style-type: none"> • Maintaining a personal plan to complete the further learning programme showing changes that were made and identifying what additional activities were needed • CPD record including attendance at learned society meetings, published articles and papers, • Records of appraisals showing agreed actions and how they were implemented • Reflective reports on what had been learnt from undertaking a task and how improvements could be made next time a similar task was undertaken 	<p>The evidence could include:-</p> <ul style="list-style-type: none"> • Personal FL plan with statements on how the additional learning/knowledge has been achieved (e.g., course, mini project, research); • Gap analysis to show what knowledge is needed to cover in the plan that is not possessed at the start of the programme • Reports on learned society meetings and other knowledge based activities • Published papers and articles • Reflective reports

Employer-Managed and Self Managed (Technical) Programme (CEng) - General Learning Outcome (iii)	
The ability to exercise initiative and personal responsibility, which may be as a team member or leader	
This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>Civil engineers are part of the built environment team. Teamwork is an essential skill that involves not only working with people from different backgrounds and disciplines but collectively producing a solution that is creative and innovative. Civil engineers also have a duty of care given their knowledge. Examples include:-</p> <ul style="list-style-type: none"> • Undertaking a risk assessment, identifying the mitigation measures and ensuring that action is taken to implement them • Contributing to meetings to ensure that the civil engineering input is taken into account • Tackling issues arising in the workplace by seeking advice or taking action • Building networks amongst built environment professionals • Undertaking research into innovative materials, processes, and products • Visits to site to clarify design issues and observe construction practice • Contacts with suppliers to obtain information • Attending learned society and other knowledge based meetings 	<p>Example include:-</p> <ul style="list-style-type: none"> • Research reports • Minutes of meetings in which your contribution was recorded • Records of site visits • Reports on knowledge based meetings attended • Reflective statements on networks and business contacts • Health and safety reports • Risk assessments
This type of outcome can also be found outside of the workplace. For	There are many examples of this type of activities. In all cases the contribution has

example:-

- Being a member of a sports team, drama club or other group which has an acknowledged status
- Involvement in a charity or major charitable activity

to be significant and the activity has to be recognised by others as being meaningful

Employer-Managed and Self Managed (Technical) Programme (CEng) - General Learning Outcome (iv)	
The ability to learn and apply new (to the graduate) theories, concepts, methods etc in unfamiliar situations	
This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>This is very much an extension of formal education in which you learnt about the underlying engineering and scientific principles and how to apply them. You will be introduced to materials, products and processes new to you which will require some work on your behalf to learn about them. These include</p> <ul style="list-style-type: none"> • Design for temporary works • Use of new materials, products and processes in design and construction • Use of codes of practice, design guidelines and British and European Standards • Use of carbon accounting tools • Sustainability assessments • Integration of environmental data (e.g. weather, flood levels, contamination) • Use of numerical packages • Interpretation of geological and geotechnical data • Monitoring of construction processes and construction projects 	<p>It is important that these examples are not just copies of other peoples work. You have to have taken responsibility and show through reflective statements and interviews what you had learnt. Examples include:-</p> <ul style="list-style-type: none"> • Design calculations for temporary works • Design calculations based on British and European Standards • Description of materials, products and processes giving reasons for their choice and how they were implemented in the construction process • Reports on outputs from numerical analyses • Selection of data including a critical assessment of the choice and the interpretation • Reports on tests with conclusions as to the findings • Site investigation reports • Monitoring reports • BREEAM assessments

Employer-Managed and Self Managed (Technical) Programme (CEng) - General Learning Outcome (v)	
A comprehensive understanding of the relevant scientific principles of the specialisation	
This is an essential (level 1) outcome and candidates must be able to demonstrate (Category U) an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>Engineering solutions are founded on physical, biological, natural and social sciences. Therefore there is a need to have an understanding of those sciences. You are continuously developing this knowledge formally and informally but there are particular aspects of these sciences that relate to civil engineering and this will depend on the branch of civil engineering you are in. Fundamentally this is about explaining things. Activities include:-</p> <ul style="list-style-type: none"> • Selection of materials, products and processes that solve a particular problem which requires researching those items • Reading technical journals and attending technical meetings • Value engineering and the observational techniques to explain the difference between prediction and behaviour • Validation of design predictions • Materials (including geo materials) testing • Use of qualitative and quantitative assessments • Community surveys • Forensic reports • Condition surveys • Asset management reports • Numerical analyses 	<p>Many of these examples will be in the form of a report in which conclusions are reached after analysing the output of some research, monitoring programme, testing or survey. Examples include:-</p> <ul style="list-style-type: none"> • Monitoring reports which include conclusions based on interpretation of the data supported by review of the background to the data and project • Design of surveys explaining the issues to be measured and how they were measured and what the measurements meant. These include quantitative and qualitative surveys. • Reports on technical papers and technical articles • Papers published in technical journals • Reports on numerical analyses

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Underpinning Science, Mathematics) (vi)	
A critical awareness of current problems and/or new insights much of which is at, or informed by the forefront of the specialisation	
This is an desirable (level 2) outcome and candidates must be able to demonstrate (Category U) an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>The world is continually changing and as engineers we are party to that change as we deal with social, environmental, economic and technological issues. Therefore a broader understanding of the world is desirable. This is particularly important now because of climate change, resource depletion, the carbon economy and security of resource supply. As engineers we will be engaged with government and society in making ethical decisions. Some of these will be based on scientific evidence which we have to master. Activities include:-</p> <ul style="list-style-type: none"> • Member of technical panels of the ICE or other bodies • Member of editorial panels of technical journals • Reviewer of technical papers and proposals • Attending technical meetings (e.g. ICE) • Reading the construction press (e.g. NCE) 	<p>This is about the underpinning scientific and engineering principles, that is the technical issues. Therefore the evidence has to relate to those technical matters. Examples include:-</p> <ul style="list-style-type: none"> • Technical presentations on state of the art matters to colleagues • Research papers published in technical journals • Reviews of technical papers • Contributions to technical panels and consultations

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Underpinning Science, Mathematics) (vii)	
An understanding of concepts relevant to the discipline, some from outside engineering, and the ability to critically evaluate and apply them effectively.	
This is a desirable (level 3) outcome and candidates must show an ability (Category U) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>This is about the technical practice of engineering. The key is being able to critically evaluate technical information and apply the output to produce an engineering solution. It is about leading edge analysis, design and construction. Activities include:-</p> <ul style="list-style-type: none"> • Developing failure mechanisms for unusual structures taking into account the possible forces, geometry • Retrofitting existing infrastructure • Application of numerical methods • Temporary works design • Design of soil structure interaction problems • Critical path programming • Evaluation of scientific data 	<p>These will be demonstrated through reports and calculations. Examples include:-</p> <ul style="list-style-type: none"> • Design reports on advance structures, temporary works and retrofit • Reports on numerical studies • Risk assessment including mitigating measures • Critical path programmes

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Engineering Analysis) (viii)

Ability to use fundamental knowledge to investigate new and emerging (in other companies and countries rather than new and emerging in society as a whole) technologies

This is a desirable (level 2) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study

<p style="text-align: center;">Activity Examples</p>	<p style="text-align: center;">Evidence Examples</p>
<p>A professional engineer has to have an ability to research into new ideas in order to enhance their work and deal with increasingly complex challenges. Activities include:-</p> <ul style="list-style-type: none"> • Application of new materials, products and processes • Review of the state of the art materials, products and processes • Innovative approaches to design • Innovative approaches to construction • Low carbon solutions 	<p>The examples will primarily be in the form of reports which results in recommendations based on critical analysis of the current state of practice. Examples include:-</p> <ul style="list-style-type: none"> • 3D designs • BIM • Research reports • Technical presentations • Technical papers

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Engineering Analysis) (ix)	
Ability to apply appropriate models for solving problems in engineering, and the ability to assess the limitations of particular cases	
This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>Much of engineering is about modelling reality to produce solutions to known hazards. Hence it includes making assumptions, choosing appropriate models, assembling data and undertaking option analyses. Activities include:-</p> <ul style="list-style-type: none"> • Appreciating the limitations of design methods • Undertaking design of non standard structures • Numerical modelling • Optional analyses 	<p>This will be based on reports since the output from the activities are primarily in this form. Examples include:-</p> <ul style="list-style-type: none"> • Design reports showing assumptions made and options considered. • Validation of numerical analyses • Brain storming exercises • Review of software • Scenario analyses

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Engineering Analysis) (x)	
Ability to collect and analyse data and use appropriate engineering tools to tackle problems that are unfamiliar to the graduate, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaption of engineering analytical methods	
This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>Civil engineering is an innovative industry as everything that is built is built for the first time. However, it is also an industry that learns from past experience including failures. It involves uncertainty which is either natural or anthropogenic. Therefore much of what is done is based on observations. These observations can be used to develop guidelines and standards, inform practice or allow solutions to be monitored. Activities include:-</p> <ul style="list-style-type: none"> • Observations of structures, traffic flow, water levels, ground conditions, • Forensic analysis of past failures • Qualitative assessments based on interviews with stakeholders • Scenario analyses • Selection and use of appropriate software packages • Selection of design parameters 	<p>Much of the evidence will be based on the interpretation of scientific data such as:-</p> <ul style="list-style-type: none"> • Selection of design parameters based on design criteria • Site surveys • Traffic and transport surveys • Flood studies data and the need to compare a wider set of data to assist them in flood risk modelling • Forensic reports • Ground investigations • Selection of appropriate models and methods of analyses

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Design) (xi)	
The ability to apply original (genuinely original, not just original to the candidate) thought to the development of practical solutions for problems, systems, components or processes	
This is a desirable (level 2) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>This is a skill that is developed over time because of the experience gained through the practice of civil engineering and the knowledge gained through independent study. It enables you to use innovative solutions to practical problems which can be beneficial to society either financially, environmentally, technically or socially. Activities include;-</p> <ul style="list-style-type: none"> • Temporary works design • Emergency planning • Retrofit solutions 	<p>Not all graduates will have the opportunity to tackle problems in this way therefore this may be assessed through interviews using hypothetical situations. Graduates may be part of a team introducing innovation so there is an opportunity to explain their contribution to the team. Other evidence includes:-</p> <ul style="list-style-type: none"> • Design calculations that involve innovative solutions • Temporary works design • Design calculations for retrofit solutions • Reflective statement in further learning report

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Economic, Social and Environmental Context) (xii)

Knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately, in the context of the particular specialisation.

This is an optional (level 2) outcome and candidates must show an understanding (Category U) of the knowledge gained through practice, courses and private study

<p align="center">Activity Examples</p>	<p align="center">Evidence Examples</p>
<p>Civil engineers work in various locations for different types of companies. There are some common features to management and business practices and some features which are particular to the company. It is an optional item from the educational point of view since much of what is learnt has greater focus on training. These cover:-</p> <ul style="list-style-type: none"> • Health and Safety policies • Company policies • Report writing • Writing returns • Attending courses • Processes and procedures • Codes of conduct • Quality control/assurance protection 	<p>Examples include:-</p> <ul style="list-style-type: none"> • Health & Safety Analysis, e.g., financial and time costings of job • Reports approved by manager • Returns approved by manager • Self-reflective report on what was learnt and how this knowledge can be used in future. • Organisation charts and plans. Understanding of the organisation's processes and procedures • Written report to reflect on the management structure of the various sites they have worked on to cover areas such as where the structure was correct for that site and whether the company management structure was right for that particular project.

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Economic, Social and Environmental Context) (xiii)

The ability to make general evaluations of risk through some understanding of the basis of such risks.

This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study

<p style="text-align: center;">Activity Examples</p>	<p style="text-align: center;">Evidence Examples</p>
<p>Engineering is about risk; i.e. identifying the hazards, indentifying who or what will be harmed, assessing the probability of that harm occurring and mitigation against that harm occluding. According to the Engineering Council you have to be able to:-</p> <ul style="list-style-type: none"> • Apply professional and responsible judgement and take a leadership role • Adopt a systematic and holistic approach to risk identification, assessment and management • Comply with legislation and codes, but be prepared to seek further improvements • Ensure good communication with the others involved • Ensure that lasting systems for oversight and scrutiny are in place • Contribute to public awareness of risk 	<p>Examples include:-</p> <ul style="list-style-type: none"> • A hazard assessment • A risk analysis - financial, reputation, government, H&S, sustainability • Presentations on risk to colleagues • A plan to implement the mitigating measures • A means of assessing whether the mitigating measures worked as designed • Public engagement programmes to raise awareness

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Engineering Practice) (xiv)	
A thorough understanding of current practice and its limitations, and some appreciation of likely of new developments;	
This is an essential (level 1) outcome and candidates must show an understanding (Category U) of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>This is similar to (xii) but with a greater focus on business practice. Initially you will be immersed in the business following their practices. With time you will gain an appreciation of the governance structure, policies and practice thus understanding the reasons that they exist and how they are implemented. You may be involved in developing new policies and, depending on your career path, become involved with developing these with the company. You will also be exposed to engineering practice when you visit sites and other companies. Activities include:-</p> <ul style="list-style-type: none"> • Induction programmes • Following templates for design calculations and reports • Signing off drawings, calculations and reports 	<p>This is most likely to be assessed through your portfolio of evidence showing your overall view of engineering practice and through interviews. Evidence includes;-</p> <ul style="list-style-type: none"> • Portfolio of evidence

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Engineering Practice) (xv)

Advanced level knowledge (not necessarily advanced materials) and understanding of a wide range of engineering materials and components;

This is an essential (level 1) outcome and candidates must have knowledge (Category U) gained through practice, courses and private study

<p style="text-align: center;">Activity Examples</p>	<p style="text-align: center;">Evidence Examples</p>
<p>You will enhance your knowledge through CPD activities, the work you do and general observations through the media and discussions. It is important that you do this so that you are able to apply innovative techniques to produce engineering solutions. A key source of information is the internet but in order to use that successfully you need to be aware of search techniques and the quality of information you find. Activities include:-</p> <ul style="list-style-type: none"> • Attendance at learned society meetings, professional seminars, courses • Internet searches • Technical journals and papers 	<p>You may be able to demonstrate this through design calculations and reports because of opportunities that have arisen. If those opportunities did not exist then you will be able to demonstrate this outcome in your further learning report and through interviews. Evidence includes:-</p> <ul style="list-style-type: none"> • Integral reports • Design reports incorporating advanced materials and products • Reports on technical papers and meetings • Published papers

Employer-Managed and Self Managed (Technical) Programme (CEng) - Specific Learning Outcome (Engineering Practice) (xvi)	
Ability to apply engineering techniques taking account of a range of commercial and industrial constraints.	
This is an essential (level 1) outcome and candidates must show an ability (Category A) to demonstrate an understanding of the knowledge gained through practice, courses and private study	
Activity Examples	Evidence Examples
<p>Commercial and industrial constraints include economic, technical and environmental issues; often know as the triple bottom line. However, there are also ethical issues to consider. Activities include:-</p> <ul style="list-style-type: none"> • Knowledge of law, sustainability, H&S • Design quality indicators • Knowledge of what is available and the cost • Low carbon accounting and construction • Appropriate communications with other built environment professionals, clients and the community 	<p>This is what distinguishes learning as a student and learning in the workplace since workplace learning is constrained by commercial and industrial pressures. Most pieces of evidence you submit will show the constraints to which you are working to. Therefore the evidence will be included in your portfolio. You will need to highlight this in your reflective statement and through interviews that monitor your progress. Thus the evidence will be in:-</p> <ul style="list-style-type: none"> • The portfolio of evidence • The reflective statements