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**Gap Analysis Exercise – CEng**

The criteria against which candidates are assessed are set down by the **Engineering Council** in Competence and Commitment Statements.

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| --- | --- | --- |
| Competence | A | Knowledge and Understanding |
|  | B | Application to Practice |
|  | C | Technical and Commercial Leadership |
|  | D | Interpersonal Skills |
| Commitment | E | Personal Commitment |

**Health and safety, risk assessment as well as environment and sustainability are embedded within the headings above.**

To help highways and transportation professionals relate what they do at work to the generic standards in UK-SPEC, we have produced a gap analysis exercise for eight different specialisms. This exercise should assist your understanding of what is required to succeed at the Professional Review stage.

You will be asked to choose which of the eight specialisms are applicable to you when making your application *(you may choose more than one)*. To determine this, you should measure your engineering competence against the specialisms’ criteria and see which one(s) are relevant to your career. You should be able to cover all the areas listed for your chosen specialism as these will be the areas assessed at the Professional Review stage.

At least one of your reviewers will be an expert in your declared specialism/s so it is important that you choose carefully.

1. Transport planning
2. Materials and geotechnics
3. Traffic management/safety and systems engineering
4. Infrastructure planning, design, construction and/or maintenance
5. Transport related structures
6. Academic background including teaching and training
7. Highways and transportation research
8. Intelligent transport systems

The requirements for Competences A and B are different for each of the eight specialisms, but the requirements for Competences C, D and the one commitment E, are common to all disciplines.

You can use this guidance when completing your Training and Experience Forms as part of your Portfolio of Evidence.

**1 Transport Planning**

### 1A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology.

* Understand trends and the current position with Government policies for the environment, planning and transport; and be able to interpret their significance within a more local application.
* Be familiar with Regional Planning Guidance, the development planning system and Local Transport Plans.
* Be aware of the sources and trends in national environment and transport statistics and be able to interpret their significance.
* Understand the statutory procedures and practices within which transport planning activities operate. Be able to plan and modify such activities to be consistent with the regulatory and best practice framework.
* Have a comprehensive understanding of survey techniques and analysis, data synthesis, calibration, predictive tools, validation, appraisal methods, telematics, audit procedures.
* Be able to extend and develop established methods to new situations and opportunities.
* Understand the capabilities, shortcomings and development of appraisal techniques to identify and interpret the future operational, economic and environmental impacts of a range of multi-modal transport projects.
* Be competent with appropriate statistical methods to plan and interpret data collection/analysis.
* Be able to deepen one’s knowledge base through appropriate research and investigation.
* Be able to promote innovation and creativity in technical areas.

**1 Transport Planning**

**1B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems**

* Be able to identify and describe, in both quantifiable and qualitative terms, complex problems and opportunities, and the significant factors that have a bearing on them.
* Use imagination, flair, and experience to develop solutions to problems and take advantage of opportunities.
* Be familiar with relevant design guidance, advice, and best practice to promote measures that are practical, affordable, and deliverable, and identify the constraints that influence the application of such measures.
* Be able to select, develop and apply the appropriate techniques to assess the future operational, economic, environmental, social and other impacts of suggested measures.
* Be able to make and explain reasoned recommendations about the assessment and selection of measures, and a tactical plan for their implementation including an analysis of the risks involved.
* Be able to assess critically and constructively measures suggested by others, through mechanisms such as safety or user audits.
* Use up to date research to generate and evaluate solutions.
* Demonstrate responsibility for the delivery of transport planning projects, from project feasibility studies and outline concepts, through initial design studies, public consultation and inquiry, detailed design and implementation stages.
* Design and execute methods to elicit reliable opinions from interested and involved parties.
* Design and implement methods of assessing the performance of measures against objectives and targets.

**2 Materials and Geotechnics**

**2A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology.**

* Understand trends and the current position relating to Government/International policies for the environment and infrastructure and be able to interpret their significance within a more local application.
* Be familiar with relevant codes of practice and specifications applicable to the nature of the work and environment in which it is performed.
* Be aware of the sources and trends in local, national and international utilisation of material resources, their exploitation and sustainability and be able to interpret the significance of these factors in relation to construction and maintenance of the infrastructure.
* Understand the statutory procedures and practices within which the foregoing activities are undertaken. Be able to plan and modify such activities to be consistent with the regulatory and best practice framework.
* Have a comprehensive understanding of data collection and interpretation, use of predictive analyses and the limitations thereof. Be able to extend and develop established methods to new situations and opportunities.
* Be competent with appropriate statistical methods to plan and interpret data collection/analysis.
* Be able to deepen one’s knowledge base through appropriate research / investigation and monitoring of existing processes.
* Be able to promote innovation and creativity in technical areas.

**2 Materials and Geotechnics**

**2B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems**

* Be able to identify and describe, in both quantifiable and qualitative terms, complex problems and opportunities, and the significant factors that have a bearing on them.
* Use imagination, flair and experience to develop possible measures that will influence problems and opportunities.
* Be familiar with relevant design guidance, advice, and best practice to promote measures that are practical, affordable and deliverable, and identify the constraints that influence the application of such measures.
* Be able to predict the likely consequences resulting from the use and potential misuse of materials,
* Be able to make and explain reasoned recommendations about the procedures to be adopted in construction and maintenance operations including an analysis of the risks involved.
* Be able to assess critically and constructively measures suggested by others, through mechanisms such as safety or user audits.
* Use up to date research to generate and evaluate solutions.
* Demonstrate innovation in the use of such research and its transfer into practical application.

**3 Traffic Management/Safety and Systems Engineering**

**3A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology.**

* Understand trends and the current position with Government policies for the environment, planning and transport; and be able to interpret their significance within a more local application.
* Be familiar with Regional Planning Guidance, the development planning system and Local Transport Plans.
* Be aware of the sources and trends in national environment and transport statistics and be able to interpret their significance.
* Understand the statutory procedures and practices within which traffic management and system engineering activities operate. Be able to plan and modify such activities to be consistent with the regulatory and best practice framework.
* Have a comprehensive understanding of survey techniques and analysis, data synthesis, calibration, predictive tools, validation, traffic engineering, appraisal methods, traffic control systems, intelligent transport systems, design tools and techniques, audit procedures, scheme costing and contract documents.
* Be able to extend and develop established methods to new situations and opportunities.
* Be knowledgeable of engineering solutions to road and rail transport problems.
* Be competent with appropriate statistical methods to plan and interpret data collection/analysis.
* Understand the capabilities, shortcomings, and development of appraisal techniques to identify and interpret the future operational, economic and environmental impacts of a range of multi-modal transport projects.
* Be able to deepen one’s knowledge base through appropriate research and investigation.
* Be able to promote innovation and creativity in technical areas.

**3 Traffic Management/Safety and Systems Engineering**

**3B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems**

* Be able to identify and describe, in both quantifiable and qualitative terms, complex problems and opportunities, and the significant factors that have a bearing on them.
* Use imagination, flair and experience to develop possible measures that will influence problems and opportunities.
* Be familiar with relevant design guidance, advice, and best practice to promote measures that are practical, affordable and deliverable, and identify the constraints that influence the application of such measures.
* Be able to select, develop and apply the appropriate techniques to assess the future operational, economic, environmental, social and other impacts of suggested measures and to design appropriate engineering solutions to road and rail transport problems.
* Be able to make and explain reasoned recommendations about the assessment, selection and design of measures, and a tactical plan for their implementation including an analysis of the risks involved.
* Be able to assess critically and constructively measures suggested by others, through mechanisms such as safety or user audits.
* Use up to date research to generate and evaluate solutions.
* Demonstrate responsibility for the delivery of traffic management/system engineering projects, from project feasibility studies and outline concepts, through initial design studies, public consultation and inquiry, detailed design and implementation stages.
* Design and execute methods to elicit reliable opinions from interested and involved parties and to consult with the public on road transport problems and proposed solutions.
* Design and implement methods of assessing the performance of measures against objectives and targets.

**4 Infrastructure Planning, Design, Construction and/or Maintenance**

**4A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology.**

* Be aware of, and able to implement the forward planning process for transport infrastructure projects in economic, social and environmental terms.
* Understand the current design and construction standards for new transport infrastructure projects and the maintenance of existing transport infrastructure.
* Be aware of and be able to undertake and/or commission the assessment techniques available to establish the condition of existing transport infrastructure and be able to interpret the results obtained.
* Be aware of emerging techniques and options for the design, construction and maintenance of transport infrastructure projects.
* Be able to extend and develop established methods to new situations and opportunities.
* Be competent with data collection and interpretation.
* Be able to extend one’s knowledge base through appropriate research and investigation.
* Be able to promote innovation and creativity in technical areas.

**4 Infrastructure Planning, Design, Construction and/or Maintenance**

**4B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems**

* Be familiar with the processes required to progress a new transport infrastructure scheme through the forward planning, legal order, design, contract and construction stages.
* Be able to select and apply appropriate current standards, techniques and statutory requirements to the process.
* Be innovative in progressing solutions to non-standard situations.
* Be able to explain the rationale behind decisions taken.
* Be able to undertake a risk assessment of options being evaluated.
* Demonstrate responsibility for the delivery of new transport infrastructure projects through part of the process from forward planning, legal order, design, contract and construction stages.
* Demonstrate responsibility for the assessment of the condition of elements of existing transport infrastructure and the evaluation and commissioning of appropriate maintenance solutions.
* Demonstrate the use of project management techniques.
* Demonstrate experience of good practice in cyclic, routine and emergency highway and rail maintenance.

**5 Transport Related Structures**

**5A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology.**

* Understand trends and the current position with relevant Government or International policies for the environment and infrastructure and be able to interpret their significance within a more local application.
* Be familiar with relevant codes of practice and specifications applicable to the nature of the work and environment in which it is performed with particular reference to Structural Safety e.g. SCOSS reports and advice.
* Be aware of the opportunities and problems associated with the creation and maintenance of sustainable structures.
* Understand the statutory procedures and practices within which the foregoing activities are undertaken. Be able to plan and modify such activities to be consistent with the regulatory and best practice framework.
* Have a comprehensive understanding of data collection and interpretation, use of predictive analyses and the limitations thereof. Be able to extend and develop established methods to new situations and opportunities.
* Be competent with appropriate model and other analysis techniques to predict behaviour of structures under expected and exceptional loading configurations.
* Be able to deepen one’s knowledge base through appropriate research / investigation and monitoring of existing processes.
* Be able to promote innovation and creativity in technical areas.

**5 Transport Related Structures**

### 5B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems

* Be able to identify and describe, in both quantifiable and qualitative terms, complex problems and opportunities, and the significant factors that have a bearing on them.
* Demonstrate the use of imagination, flair and experience to develop possible measures that will influence problems and opportunities.
* Be familiar with relevant design guidance, advice, and best practice to promote measures that are practical, affordable and deliverable, and identify the constraints that influence the application of such measures.
* Be able to predict the likely consequences resulting from change in environment or utilisation of structures.
* Be able to make and explain reasoned recommendations about the procedures to be adopted in construction and maintenance operations including an analysis of the risks involved.
* Be able to assess critically and constructively measures suggested by others, through mechanisms such as safety or user audits.
* Use up to date research to generate and evaluate solutions.
* Demonstrate innovation in the use of such research and its transfer into practical application.

**6 Academic background including Teaching and Training**

**6A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology**

* Be able to evaluate and review the current development of policy and practice in relation to the fundamental principles of transport and related theory.
* Be able to develop and implement a programme of study to meet teaching and learning objectives in the field covered by the programme, having regard to the health and safety of students and teachers.
* Underpin teaching and training, whether in engineering or multidisciplinary programmes, with engineering principles and mathematical and statistical competence.
* Understand and apply appropriate academic standards and principles of equity and justice in the selection, tutoring, assessment and qualification of students and trainees.
* Conceive, lead and contribute to systematic investigation at the frontiers of knowledge and communicate the resulting findings effectively.
* Supervise project work giving students and trainees the experience of original investigation.
* Understand the importance of moving towards sustainability and be able to take account of its implications for the application of technology.
* Be able to extend and develop established methods to new situations and opportunities.
* Be able to deepen one’s knowledge base through appropriate research and investigation and by monitoring existing situations and processes.
* Be able to promote innovation and creativity in technical areas.

**6 Academic background including Teaching and Training**

**6B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems**

* Be able to identify and describe, in both quantifiable and qualitative terms, complex problems and opportunities, and the significant factors that have a bearing on them.
* Use imagination, flair and experience to develop possible measures that will influence problems and take advantage of opportunities.
* Be familiar with relevant design guidance, advice and best practice to promote measures that are practical, affordable and deliverable, and identify the constraints that influence the application of such measures.
* Be able to select, develop and apply the appropriate techniques to assess the future operational, economic, environmental, social and other impacts of suggested measures and to design appropriate engineering implementations.
* Demonstrate the use of media for oral, audio and visual presentation, printed and guided activity to provide students and trainees with effective learning experience.
* Implement procedures of assessment through coursework, project work and written and oral examination.
* Develop contacts with employers of students and trainees and understand their requirements.
* Be aware of sources of, and where necessary, seek funding for teaching and training initiatives for student support and for research.
* Carry out original investigations leading to achievement of stated objectives and reporting of findings to sponsors and clients and by publication.
* Use up to date research to generate and evaluate solutions and update content of teaching and training.
* Demonstrate innovation in the use of such research and its transfer into practical application.

**7 Background in Research**

**7A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology**

* Be able to ascertain and summarise the current state of knowledge on any relevant topic and identify the need and scope for further investigation.
* Be able to conceive practicable and effective ways of addressing questions that have been identified for investigation.
* Lead and contribute to systematic investigation at the frontiers of knowledge.
* Communicate the resulting findings effectively to employer, client or sponsor and by publication.
* Recognise limitations in one’s own skills and knowledge, and when effective investigation depends on additional skill or knowledge either acquire this or seek help from those who possess it.
* Understand the importance of moving towards sustainability and be able to take account of its implications for the application of technology.
* Be able to extend and develop established methods to new situations and opportunities.
* Be able to deepen one’s knowledge base through appropriate research and investigation and by monitoring existing situations and processes.
* Be able to promote innovation and creativity in technical areas.

**7 Background in Research**

**7B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems**

* Be able to identify and describe, in both quantifiable and qualitative terms, complex problems and opportunities, and the significant factors that have a bearing on them.
* Use imagination, flair and experience to develop possible measures that will influence problems and take advantage of opportunities.
* Be familiar with relevant design guidance, advice and best practice to promote measures that are practical, affordable and deliverable, and identify the constraints that influence the application of such measures.
* Be able to select, develop and apply the appropriate techniques to assess the future operational, economic, environmental, social and other impacts of suggested measures and to design appropriate engineering implementations.
* Be able to specify, plan and execute lines of investigation that will confirm or refute stated hypotheses and/or measure or estimate unknown quantities to a required accuracy.
* Be able to carry out programmes of measurement or other data collection and the appropriate mathematical and statistical analysis of the resulting data.
* Be able to apply sound judgement in interpreting the results of investigations by oneself and others.
* Use up to date research to generate and evaluate solutions.
* Demonstrate innovation in the use of such research and its transfer into practical application.

**8. Intelligent Transportation Systems (ITS)**

**8A: USE A COMBINATION OF GENERAL AND SPECIALIST ENGINEERING KNOWLEDGE AND UNDERSTANDING to optimise the application of existing and emerging technology.**

* Understand trends and current position with Government policies for the environment, planning and transport and be able to interpret their significance within a more local application.
* Be familiar with National, Regional and Local Transport Plans.
* Have an understanding of the key UK ITS organisations and the relationships between them.
* Be aware of the EC ITS Action Plan and be able to use and propose extensions to the ITS standards.
* Have an understanding of system architectures in all forms and how they are used as system design tools.
* Be able to establish ‘User Needs’, interpret them as system requirements and evaluate the extent to which a proposed systems meets the stated requirements.
* Be able to identify the appropriate communications and communication architecture for a system or function, including identifying where there are potential issues that need to be resolved or managed.
* Be able to identify systems, sub-systems, methods or techniques and technology that will meet system requirements and ensure that the complete system will function as designed for all relevant modes of transport.
* Understand the capabilities and shortcomings of the ITS systems and services and undertake measures to maintain benefits under abnormal conditions.
* Be able to identify emerging techniques and technologies and understand the conditions under which they are applicable.
* Be able to deepen one’s knowledge base through appropriate research and investigation.
* Be able to promote innovation and creativity in technical areas.
* Understand the principles of cost-benefit assessment, including determining the business case and economic viability of a proposal.

**8. Intelligent Transportation Systems (ITS)**

**8B: APPLY APPROPRIATE THEORETICAL AND PRACTICAL METHODS to the analysis and solution of engineering problems**

* Be able to identify and describe, in both quantitative and qualitative terms, complex problems and opportunities and the significant factors that have a bearing on them.
* Understand and be able to describe the main building blocks of ITS including sensors and actuators, computing and memory, positioning technology, communications technology and human interfaces.
* Use innovation to develop methods and measures that will influence problems and opportunities, with particular reference to the human element.
* Be able to select the appropriate systems and functions to deliver the required services which will enable the delivery of policies, whether social or environmental.
* Be able to make recommendations for ITS functions and explain the reasons and facilities to stakeholders.
* Be able to assess critically and constructively measures suggested by others and develop them into viable and deliverable services.
* Use up to date research and development to generate and evaluate solutions and system requirements.
* Demonstrate responsibility for delivery or management of ITS systems at feasibility study, outline design, system requirements, system testing and commissioning and system operation.
* Demonstrate the ability to involve stakeholders and other network managers in co-operative development of operational procedures.
* Develop and implement valid performance measures.
* Be able to design and perform evaluations of an installed ITS system.

**C: Provide Technical and Commercial Leadership**

* Plan, negotiate, resource and secure agreement to the development of a project, using appropriate contractual arrangements where necessary.
* Plan, budget, organise, direct and monitor tasks and resources that contribute to the delivery of a project. Plan and take corrective action when the need arises.
* Exercise leadership over the contribution of other technical staff.
* Identify the training needs of others; help to develop and review the training plans for subordinates.
* Contribute to the implementation of quality systems and help gain the acceptance of subordinates to them.
* Help to develop working practices that promote safety and secure the compliance of subordinates.
* Understand how continuous improvement in service delivery can be secured and implement measures to help bring this about.
* Be aware of the implications of the management imperatives and systems of the organisation and be able to apply these in the team environment.
* Understand the ingredients of effective teams, apply and monitor some measures in the workplace that improve performance.

**D: Demonstrate effective Interpersonal Skills**

* Communicate fluently in written and oral expression with a wide range of other people, in English.
* Participate in focussed discussions about technical matters.
* Prepare and present technical reports to senior personnel and to the public.
* Present, listen and discuss ideas using a range of communication methods.
* Understand the principles of client and customer care.
* Understand negotiation skills and have experience of their application.
* Be able to resolve conflict in the workplace.
* Understand the motivation of others, and the factors that influence your own performance.
* Be able to counsel others in a sensitive manner.
* Play an active part in building and maintaining an effective team environment.
* Identify collective goals and responsibilities.
* Issue clear and accurate instructions to subordinates.
* Assist with the resolution of conflict in the workplace.

**E: Demonstrate a personal commitment to professional standards recognising obligations to society, the profession and the environment**

* Understand and comply with CIHT’s Code of Conduct.
* Work constructively within all relevant legislation and regulatory formworks, including social and employment legislation.
* Understand and comply with all obligations of current health and safety legislation.
* Help to develop, manage and apply safe systems at work.
* Undertake technical work in a manner that complies with the codes of practice on risk and the environment.
* Undertake engineering activities in a way that contributes to sustainable development.
* Undertake and record professional development to a minimum of 25 hours a year, in accordance with a current Personal Development Plan covering the next two years, and monitor output.
* Participate in the affairs of the CIHT at national and/or regional level and encourage subordinates to participate in its work.