

# Examiner's Report Autumn 2021

3<sup>rd</sup> Pilot Exam to Access Masters Level learning for  
Hong Kong and UK BEng Candidates



## Background

This report is compiled by the ICE Further Learning Examinations Panel comprising engineers and managers from industry together with academics experienced in administering Masters Level examinations. The Further Learning Examination is one of the routes by which candidates progress to Chartered Engineer status through the ICE and assesses the achievement of learning outcomes defined by the Engineering Council. The ICE is indebted to members of the Further Learning Examination Panel who volunteer their time, expertise and experience to develop the syllabus, develop learning materials, set the examination, moderate the marking and consider appeals.

The ICE Further Learning Examination tests whether BEng graduates (including Hong Kong graduates impacted by Washington Accord changes) have gained through further learning an academic standard of learning and critical thinking equivalent to MEng candidates.

This pilot built on lessons learnt in two previous UK pilots and was aimed primarily at Hong Kong candidates. For the first time, candidates were required to submit a Part A Technical Statement in advance of the Part B Case-Study Exam. Parts A and B were marked by the same two Script Markers.

The ICE is required by the Engineering Council to assess academic standards achieved in candidate's technical knowledge alongside management, contractual and other syllabus areas covered by the Case-Study Exam. It is difficult to set exam questions that fairly differentiate the many technical specialisms in which candidates are working. A technical question about foundations, for example, may disadvantage a drainage engineer or traffic management specialist. Instead, the Part A Technical Statement requires evidence of further learning and the application of engineering analysis by drawing on work experience. A good statement may describe a computational technique (calculations or modelling) that the candidate has applied or adapted to solve work-based problems.

The ICE would like to thank the Hong Kong candidates who undertook a course of study and sat the pilot examination in a condensed period. The contribution of the volunteer script markers and the ICE Hong Kong team that supported candidates is much appreciated.

## Hong Kong Pilot Examination 2021

50 candidates volunteered to take part, including 12 resits from previous UK exams. Eleven candidates dropped out due partly to the condensed period available to study on-line modules, compile the Technical Statement and prepare for the exam. 39 candidates sat the exam.

UK resit candidates were not required to submit Technical Statements as they were not required to do so previously. Of the 12 resit candidates who had previously failed the exam three were no shows, four passed (44.4% of those who sat) and five failed their resit. It is encouraging that one of the resit candidate that passed achieved a very good grade in the Part B Exam.

Hong Kong candidates were required to pass both Part A and Part B. Of the 30 candidates who sat both parts, five (16.7%) failed both parts whilst thirteen (43.3%) passed both parts. Three failed Part A (10%) but passed Part B. Conversely, nine candidates (30%) passed Part A but failed Part B. Three candidates that passed (10%) achieved very good grades in the Part B Exam.

Each paper was marked by two trained Script Markers. In 77% of cases the two appointed Script Markers agreed Part A pass/fail marks. Seven Technical Statements (23%) were referred to a Moderation Panel to determine pass/fail grades. For Part B, 90% of pass/fail marks were agreed by the two Script Markers and only 4 papers were referred to the independent Moderation Panel.

A senior academic acted as an External Examiner to advise the Further Learning Examinations Panel on the standard of the exam and the questions set, and to audit consistency of marking. The External Examiner reviewed the decisions of the Moderation Panel and agreed with the decisions reached. Five further papers were reviewed where the two appointed Script Markers agreed pass/fail decisions including some marginal marks. The External Examiner found that in each case where Script Markers agreed pass/fail grades the decision was valid.

Appeals by three candidates judged to have failed were considered by an Appeals Panel.

## Reflection

The first inclusion of the Technical Statement makes it difficult to compare overall pass rates across the three pilots. The External Examiner, and the Further Learning Examination Panel, consider the main learning point from the Pilot is that Part A guidance to candidates, and guidance for Script Markers in assessing the Technical Statement, must be significantly improved. The candidates who passed the Exam but failed the Technical Statement will be allowed to amend and resubmit by following revised and improved guidance.

The Further Learning Examination Panel has agreed to change the name of the Part A submission to “Further Learning Technical Statement” to make it clear that the aim is for a candidate to set out how they have applied to their work further learning in technical areas undertaken since graduation, i.e. how they have subsequently applied advanced technical knowledge.

The Pilot was used to test the practicality of using the online exam system to accommodate both UK and Hong Kong candidates in one sitting, despite a 7-hour time-zone difference. We are grateful that Hong Kong candidates agreed to start the exam in mid-afternoon and finish in the late evening. However, feedback suggests that this may have disadvantaged some candidates, particularly those who suffered technical difficulties (IT). We will revert to separate exams in the two time-zones each year in order to give all candidates similar exam conditions. This will mean that candidates who fail may have to wait a year before resitting (allowing additional study time) or will have to sit an earlier exam timed for candidates in another time-zone.

Overall, the reduced number of questions and training offered to candidates prior to the exam resulted in improved exam technique, allowing Script Markers to see where each part of a question had been answered and syllabus areas applied.

The distribution of word-count across the five questions was consistent with fewer candidates running out of time (compared to previous pilots). The average word-count was around 2500 (500 words per question). The word-count for those who failed the exam was below average (circa 1300 overall). Those candidates who passed submitted average or higher word counts but the exam should not be regarded as a test of typing speed. Some candidates who failed submitted a higher word-count giving well-developed answers of over 500 words to some questions but failing on other questions where their answers were shorter and less well developed.

Candidates who fail the exam will be disappointed and may wish to re-sit at the earliest opportunity. The exam is, however, a test of whether candidates are able to demonstrate and apply an MEng level of learning gained through further study and practice. Candidates should consider whether they need to undertake further study in some syllabus areas before resitting the exam.

The External Examiner and Further Learning Exam Panel agree that some questions broken into a number of parts were overly complex. The intent of sign-posting syllabus areas may have been counterproductive by reducing flexibility to answer questions holistically. Future questions will be less complex leaving candidates free to evidence critical thinking that draws on knowledge across the syllabus.



## Rationale behind Part A and Part B

The Engineering Council defines Learning Outcomes to be achieved through academic study. The Exam assesses whether Master level learning outcomes have been achieved.

The **Part A Further Learning Technical Statement** requires candidates to demonstrate how they have continued to learn post qualification to achieve Masters level technical learning outcomes. The submission comprises: *“A 500-word Technical Statement and supporting Appendix based on one or more appropriate project(s) or activities that demonstrate Masters level technical knowledge in a civil engineering context. It should demonstrate a candidate’s ability to integrate prior knowledge and understanding of the discipline and engineering practice with the development of advanced level knowledge and understanding, to solve a substantial range of engineering problems, some of them complex or non-routine.”*

The Further Learning Technical Statement is not simply a report describing a candidates work on recent projects. The purpose is to demonstrate academic learning gained since graduating, and to evidence how a candidate has applied knowledge in an innovative way to overcome a particular challenge. It is a test of academic learning alongside practical experience.

A good statement may describe a computational technique (calculations or modelling) that the candidate has applied or adapted to solve a particular problem. It is important to describe the candidate’s contribution to the work of a team. For example:

An engineer supervising piling operations may explain how unexpected ground conditions and underground structures at one corner of the site caused them to question the validity of the piling design. Drawing on previous structural design experience and CPD courses undertaken on finite element software, they were able to use this software to consider alternative solutions. Calculations and software outputs might be appended.

A drainage engineer might explain how a lack of flooding during an intense rainfall event had caused them to question the validity of modelling outputs. By commissioning CCTV surveys and observing overland flows during heavy rain they were able to recalibrate the model by applying further CPD learning gained on Micro-Drainage software courses, and by learning from experienced colleagues. Modelling outputs could be appended.

It important that candidates understand the purpose of the **Part B Case-Study Exam**, which is to demonstrate that Masters level learning outcomes have been achieved across the syllabus. Whilst ICE has provided further learning modules, the examination is not a test of that knowledge alone. Candidates will be expected to draw on the recommended reading list, experiential learning developed over their career, knowledge gained through CPD, and to apply that learning through critical thinking in relation to a specific scenario.

The exam syllabus aligns closely with the attributes required for the Chartered Professional Review:

- Procurement, Contracts & Project Management
- Project Appraisal & Financial Management
- Sustainable Development
- Management & Leadership
- Health, Safety, Welfare & Risk Assessment

Candidates are required to apply their learning to an unfamiliar case-study. At the start of the examination candidates should read the scenario and questions carefully. They should plan how to answer each question whilst covering the syllabus breadth. Writing three paragraphs of learned knowledge is unlikely to gain marks unless it applies directly to the question and scenario.

Providing candidates with a full day for the examination provides time to plan, to consider case-study implications, and to demonstrate syllabus knowledge, learning and critical thinking.

### **Moderation Panel Report**

Successful Part A candidates were able to demonstrate application of further learning in a work environment. Their role in the project they described was clear. Those candidates who failed tended to provide a commentary of their work rather than explaining how they had applied a higher level of knowledge gained through further learning. Improved guidance should help future candidates understand expectation.

The essay format of the Part B exam may be different to papers sat at BEng level. As it may be some years since they wrote essays under exam conditions, future candidates should practice essay writing technique.

The first rule should be to read the paper fully, ensuring that each part of a question is understood. Time spent reading the case study, deconstructing the questions (understand each part) and planning the essays is time well spent.

There may be a number of unknowns within the Case-Study: candidates are encouraged to make informed assumptions upon which to base their answer. It may also be beneficial to assume a role, e.g. Project Manager or Project Director in order to assume leadership and to articulate “this is the approach I would take.”

Examples of strong and not so strong responses to questions posed in the Victoria Station Upgrade case-study are outlined below. In general, successful candidates used sub-headings to clearly identify their responses to each element of the question and ensure that each part was answered. Unsuccessful candidates often failed to answer one or more parts of one or more questions:

## Question 1

**How will the client's vision and objectives influence procurement decisions? Which form of contract is best suited to these objectives? How might this affect supply chain development?**

Good responses began by discussing client vision and objectives. Candidates demonstrated an understanding of how these objectives might influence feasibility, design and construction phases and payment mechanisms. Objectives regarding social value and sustainable development were used to demonstrate understanding of the sustainability module and Vision Zero was linked to health and safety elements of the syllabus. Strong responses linked project objectives to ISO9001 and other management systems and discussed Project Execution Plans to guide delivery. Discussion on procurement decisions referred to risk allocation and common objectives within procurement processes and development of a collaborative, vision focussed approach.

Discussion of NEC contracts included the inclusion of SMART targets against which performance can be measured and rewarded. Another response discussed Option C Target Cost with Activity Schedule and milestone payments. The benefit of collaboration and the use of NEC4 to encompass BIM and CDE was also discussed to demonstrate critical thinking. One candidate referred to the Pay for Safety Performance Merit Scheme to link a target cost mechanism to the Vision Zero objective.

In discussing supply chain development, strong responses continued the link between vision, objectives and performance. The need to encourage supply chain expertise and the development of the local economy were intelligently discussed. References were made to Construction Excellence and CIB papers on subcontractor competence. Management initiatives such as a 'Coordination and Interface Team were discussed to enable collaboration across the supply chain. Professional integrity was evident in the better responses.

## Question 2

**The Client's initial budget is based on a Performance Specification and a fixed programme. What else should be considered in developing the final Project Estimate? How can BIM and digital transformation help achieve cost, time, and quality targets?**

Good answers began by discussing risk factors such as unforeseen ground conditions, the complex nature of the site and the differing demands of stakeholders, before addressing the final project estimates. Value engineering was discussed for engaging stakeholders and assessing risk. Reference was made to the procurement module which refers to 73% of projects being delivered over budget, and 70% delivered late. Realistic budgets based on costed risk assessments were advocated, as was sensitivity analysis to consider different scenarios to ensure both budget and programme can accommodate identified risk. Better response referred to the inclusion of insurance costs and to benchmarking projects of a similar scale and scope on the TfL network.

Stronger responses discussed the benefit of BIM and digital transformation and demonstrated personal knowledge. The benefits in time, cost and quality were outlined together with spatial awareness to avoid servicing conflicts on a complex site. The differences between 3, 4, 5, 6 and 7-D modelling were explained (the latter embracing facility management and lifecycle coordination). Benefits during design and construction were separately explored to include visualisation, communication and improved health and safety.

### Question 3

**A crane servicing an access shaft collapses and falls through the compound fence to block a highway. A pedestrian is injured by flying debris and fuel is spilled. What actions are needed to permit safe working to continue? How should the accident be investigated? How might stakeholders be reassured?**

Many responses progressed to investigating the accident without first making the site safe. Good responses included as a first step making the site safe and attending to the injured parties. One response recognised that anyone involved in the accident may require further support through counselling. The importance of preserving the site and taking photos/video for subsequent investigation was discussed together with keeping the public safe.

Candidates referred to general processes such as ERIC principles of risk mitigation and specific issues such as crane operation procedures. Good responses referred to reporting the accident (HSE & RIDDOR) and evacuating the tunnel. Analysis of events leading up to the accident, interviewing witnesses and reviewing documentation including safe working procedures and training records were discussed. One response included a table to illustrate analysis of failure modes and risk reducing measures. The Safety Plan and associated standards were referred to in the better responses including the Environmental Management Plan because of the fuel spill. Only a few responses drew a connection to the Vision Zero aspiration and its impact on the resulting Action Plan. One response referred to SMART objectives being included in the Action Plan developed in response to the accident to ensure implementation could be monitored.

Good responses recognised that good communication was key to reassuring stakeholders. RACI analysis was discussed as a means of prioritising stakeholder engagement. Changes to safe systems of work should be part of the information communicated to stakeholders to provide reassurance.

### Question 4

**How might TfL's economic, social, and environmental objectives be translated into a VSU Social Value Charter? Which United Nations Sustainable Development Goals might be accommodated? How would these goals influence project management, design, and construction?**

Good responses generally began with a discussion of social value objectives and the link to UNSDGs. The positive impact on jobs to the local economy was understood and one response referred to current unemployment statistics for London. The importance of wellbeing (social) was referred to by some, as were the environmental benefits of public realm improvements. One candidate mentioned using Maslow's hierarchy

of needs (motivational theory) to prioritise what is included in the social value charter without explaining how or why – such a reference adds little value without further discussion.

Better responses linked the Social Value Charter to TfL objectives and to UNSDGs. They looked at economic, social and environmental goals and linked them directly to the case-study. One critical discussion referred to current Covid restrictions on transportation and the consequence for the project. The ethical consequence of decisions was included in better critical discussions.

Good responses referred to key UNSDGs linked to TfL objectives and the previous discussion of the Social Value Charter. Cut and paste description of UNSDGs added little value to responses.

Candidates who linked UNSDGs to project management covered two elements of the question in one. Good responses linked jobs, training, and the local economy (Goals 8 & 10) to procurement, project goals, supply chain management and overall management and leadership. Environmental goals were discussed as a driver for innovation in reducing the amount of cement in construction and including SUDs in public realm improvements.

## Question 5

**Who are the key stakeholders and how might their conflicting needs and aspirations be managed?**

**You are the nominated Engineer for the project and the Project Manager asks you to come up with a suitable value engineering plan. How would you go about setting the Process, Objectives and Value Indicators, and then manage implementation of the plan?**

A number of good responses began by using a RACI and/or SIPOC tables to consider relative responsibilities of both internal and external stakeholders and went on to discuss how each might be impacted by the project and the consequent impact on stakeholder management. Better responses aligned clearly with the Case study by referring to specific local stakeholders – TfL, Taxis, Network Rail, local hotels, and businesses etc.

Better responses took the stakeholder discussion forward into the value engineering plan while there was a disconnect in weaker responses between these two question elements. Good responses discussed pre-briefings to stakeholders at the value planning stage and extended engagement to add value throughout the design stages. In better responses value engineering was broken down into stages (information, speculation, evaluation etc) with discussion specific to the project (tunnelling, public realm, operation etc.) Good responses also included a value analysis stage by which learning could be captured for the benefit of future projects.

## Our vision

Civil engineers at the heart of society, delivering sustainable development through knowledge, skills and professional expertise.

## Core purpose

- To develop and qualify professionals engaged in civil engineering
- To exchange knowledge and best practice for the creation of a sustainable and built environment
- To promote our contribution to society worldwide

## Diversity statement

As a membership organisation and an employer, we value diversity and inclusion - a foundation for great engineering achievement

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