ice
Institution of Civil Engineers

Membership

Examiners Report Spring 2026

Exam to Assess Master Level Learning

Background

This report is compiled by the ICE Further Learning Examinations Panel. The Examination tests whether BEng graduates (including Hong Kong graduates) have gained through further learning an academic standard of learning and critical thinking equivalent to MEng candidates.

The ICE is required by the Engineering Council to assess academic standards achieved in candidate's technical knowledge alongside management, sustainable development and other syllabus areas covered by the Case-Study Exam. Candidates are required to submit a Part A Technical Statement in advance of the Part B Case-Study Exam. Parts A and B are marked by the same two Script Markers.

The ICE thanks those chartered members who volunteered to mark submitted scripts, and members of the Further Learning Examination Panel who developed the syllabus and learning materials, set the examination, moderated the marking and considered appeals.

Spring Examination 2026

The exam case-study was based on a research article in Maritime Engineering Journal "New Cubipod armoured breakwater in Hanstholm, Denmark: design and construction" that was awarded the prestigious ICE George Stephenson Medal in 2025. Details of the port infrastructure and a storm event were added to enable candidates to demonstrate broad syllabus learning.

Section	Candidates	Pass	Fail	Plagiarised Fail	Pass Rate
Part A	74	42	32	N/A	57%
Part B	94	45	45	N/A	52%
Overall	94	*40	54	N/A	43%
Overall (Part A Resubmission)	23	7	6	N/A	70%

*** 12** passes are the result of previously passed Part A TRS submissions combined with a March 2026 Part B Case Study pass.

The pass rate for Part A is disappointingly lower than the Spring exam although the pass rate for Part A resubmissions is much higher at 70% (73% March '25). Resit candidates have learned from their experience and seem to better understand what is required. Candidates preparing a Technical Report for the first time should read the requirements carefully and base their submission on how they applied higher level learning.

The Part B pass rate is consistent with that of Autumn 2025. It is disappointing that candidates are often ill-prepared and have not studied the syllabus sufficiently well. Candidates cannot pass the exam without the required level of study.

Each paper is marked by two trained Script Markers. In cases where Markers disagree on pass/fail marks an independent Moderation Panel reviews marking before awarding a pass or fail mark.

An experienced External Examiner advises the Further Learning Examinations Panel on the standard of the exam and the questions set, and audits consistency. The standard of the Part B paper and the questions asked was verified in advance of exam day by the External Examiner. The External Examiner reviewed marks awarded and confirmed confidence in the consistency of marking.

Reflection

The high pass rate for Part A resubmissions would indicate that candidates may not fully understand requirements at their first attempt. Feedback from examiners may help them understand requirements earlier. Examiners feel that many candidates are either entering the exam too early and their Part A submission shows a lack of experience. They are often only applying Batchelor level knowledge to a work situation, which is what is expected during graduate training, rather than demonstrating the application of engineering principals at Masters level. This demands further academic learning and not just practical experience.

As they are exposed to the working environment, newly graduated engineers tend to advance their technical knowledge first. It is only when they have proven their technical ability that employers provide opportunity for management and leadership experience. It is logical that candidates may be able to Pass Part A of the further learning exam before being ready for Part B. The breadth of the Part B syllabus demands study to top-up experiential learning.

Candidates will have sat many exams where questions are asked around a subject they have studied. The Part B exam is based on a Case Study for a reason. It requires candidates to place themselves in an unfamiliar work environment, and to think critically about how to apply advanced learning.

This requires candidates to;

1. Answer each part of a sometimes complex question. This requires cross syllabus knowledge
2. Answer in the context of the practical case study, not by quoting generic text book theory
3. Demonstrate knowledge of the Masters Level syllabus on which the exam is based
4. Demonstrate critical thinking in answering within the context of the question and scenario

Examiners found that a lack of syllabus knowledge was evident in many of the Part B answers of those who fail. It is also evident that candidates are pasting in sections of text either prepared in advance or found online. These inserts are often tangential to the case study, and in many cases the case study is hardly mentioned. Markers were in a number of cases suspicious that AI generated text was included. The Panel is testing AI applications that verify where AI has been used by candidates

ICE members wishing to take the Chartered Professional Review, and who do not yet hold an approved Masters level academic qualification, can bridge the gap between their Bachelor's level qualification and the required standard by:

1. Undertaking a MEng Course (normally one year) and passing associated examinations;
2. Learning through work experience over at least five years and undertaking an Experiential Learning Assessment; or
3. Supplementing learning gained through work experience with a course of study before sitting the ICE Further Learning Examination.

Future candidates who wish to sit the Further Learning Exam earlier than might be the case for the Experiential Learning Route, should consider studying the Online Training Modules developed specifically for the exam, and/or studying the ICE Companion to Engineering Management, which has been compiled specifically to help candidates prepare for the exam.

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.

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 Report*** 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 candidates 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 personal contribution to the work of a team. Writing in the first person helps articulate personal contributions to the team. For example:

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 online further learning modules and the ICE Companion to Engineering Management, the examination is not a test of that knowledge alone. Candidates will be expected to draw on 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	• Management & Leadership
• Project Appraisal & Financial Management	• Health, Safety, Welfare & Risk Assessment
• Sustainable Development	

Candidates are required to apply their learning to an unfamiliar case-study. At the start of the examination candidates should read the scenario and each of the questions carefully. The questions are often connected and together afford the candidate opportunity to demonstrate a broad knowledge. They should plan how to answer each question whilst covering the syllabus breadth and should demonstrate critical thinking when applying their knowledge. Writing three paragraphs of

learned knowledge will not gain marks unless it applies directly to the question and scenario. A seven hour examination provides time to plan, to consider case-study implications, and to demonstrate syllabus knowledge, learning and critical thinking.

Moderation Panel Report

It is disappointing that the pass rate of both Part A and Part B submissions is not improving. Whilst there is the odd good pass, many some submissions were disappointing and evidenced a failure to adequately prepare. The following strengths and weaknesses were seen:

Part A Technical Submissions

Good Features	Poor Features
• Written in the first-person – I did this; • Project worked on; challenge overcome; analysis undertaken; limitations etc; • Details of post BEng further learning • Advanced application of engineering principles clearly evident; • Appendices that are easily read; • Candidate initials on drawings & calcs.	• English difficult to understand; • Use of "we" and lack of candidate initials on appendices casts doubt on authenticity; • Report of graduate experience, not application of further learning • Application of advanced engineering principles not evident; • Appendices cramped and difficult to read;

Part B Case Study Exam

Good Features	Poor Features
• Case study understood and addressed; • Each part of the question answered; • Use of sub-headings aligned with question; • Written in the first person – "This is how I would manage this project"; • Knowledge from across the syllabus that is specifically relevant (question & scenario) • Referencing that is relevant; • Critical thinking and advanced knowledge; • Confident, knowledgeable and articulate; • Good planning and time management.	• Case study not understood & often ignored; • Parts of question not answered; • Long, complex, meandering paragraphs; • Written in the third person and often with long sections of unattributed pasted in text; • Pasted text (e.g. NEC or UNSDGs) which is peripheral and fails to answer the question; • Weak understanding of syllabus elements; • Lack of referencing; • Lack of critical thinking & shallow knowledge; • Poor time management.

The question posed by the Part B exam are not complicated and can be answered by a BEng candidate. Without further learning, the answers are generally superficial and lack critical thinking. Long responses, that may have been produced with the help of AI, still fail to demonstrate further learning aligned with the syllabus. It is clear which candidates have failed to study the syllabus. Candidates seem intent on demonstrating UNSDG knowledge, for example, even though the sustainability syllabus requires broader learning.

The application of further learning and critical thinking in applying it to the challenge set out in the scenario was demonstrated by a number of candidates that achieved good pass marks:

The core element of **Q1** was "...how will you lead a team to identify the most cost effective, constructable and sustainable solution..." Candidates keen to demonstrate syllabus knowledge, failed to answer the core question. One good response captured the essence of the question in a simple paragraph around which they were able to weave syllabus learning:

"I will lead the team through a Multi-Criteria Decision Analysis (MCDA) to provide a transparent audit trail for the Port Authority. This tool ensures the chosen design is the most cost-effective over its whole life, not just the cheapest to build. By weighting "Construction Risk" and "Carbon Impact" alongside "Capital Cost," we ensure a constructable and sustainable balance. This framework allows us to defend the selection of CAUs over natural rock if the data shows superior durability and lower transport emissions. We also need to consider the maintenance during the analysis."

Another candidate used a bullet point approach that nevertheless demonstrated critical thinking and syllabus learning applied intelligently to the scenario:

- *"Direct team through bottom-up analysis comparing five CAU technology options (Accropode, Core-loc, Accropode II, Xbloc, Cubipod) against traditional rock armour for 400m breakwater*
- *Guide team using reference class forecasting methodology benchmarking against similar Scandinavian port developments, incorporating specialised marine equipment mobilisation costs*
- *Facilitate Monte Carlo analysis for OPEX modelling over 60+ year design life addressing storm damage repair costs, maintenance requirements in >5m wave environment*
- *Orchestrate Value Engineering sessions following five-stage process (Information → Speculation → Evaluation → Development → Presentation) identifying cost optimisation through integrated design*
- *Lead team Multi-Criteria Analysis integrating CAPEX/OPEX evaluation with Port Authority revenue projections from offshore wind servicing capability*
- *Direct stress testing of project reserves addressing Storm 'Knud' type disruptions and potential construction season extensions due to weather constraints*

Through collaborative workshops using SIPOC process mapping, I will ensure coastal engineers, marine specialists, and commercial experts contribute effectively to comprehensive cost evaluation. My facilitative leadership will guide the team's analysis of Cubipod's interlocking geometry maintenance advantages versus specialised replacement costs, local supply chain development potential, and bulk procurement opportunities maximising value for this remote location.

Q2 reversed the approach of previous exams to consider procurement from a client perspective. This time we asked candidates to approach procurement from a contractor's perspective, but few candidates seemed to understand how. Future candidates may wish to talk to their Work Winning teams about how they meet cost and quality elements of a tender in order to win valuable contracts. The appended example answer plan illustrates how an experienced Bid Manager would approach this question. A number of candidates were able to answer the question well. One wrote:

"As the leader of Design and Construct consortium tender, I will first discuss with client the main scope and objective of the project. Design and build contract often associate with fixed lump sum (NEC Option A), however contractors will price excessive premiums for marine ground uncertainties and inflating the cost to client. Given the uncertain marine ground conditions, I will proceed with a NEC4 Option C, target cost with activity schedule to encourage collaborations to collectively identify and manage risk, and focus on outturn cost using the pain/gain mechanism between the client and contractor.

As part of the quality assurance measure, a pre-qualification / pre-tender competition is adopted to identify competent contractor such as contractor with relevant specialised design experience and past project portfolios. I would establish a ISO9001 Quality Management System and incorporate them into the NEC4 framework, adopting X20 and list them as KPI to make quality obligation binds together with contract.

As NEC4 Option C is selected, the target cost is difficult to define. I suggest a 2-stage appointment:
Stage 1 – Development of Design on fee percentage
Stage 2 – Set target price once design supports open book pricing

The cost can first be calculated based on direct work cost, marine-specific cost, subcontractor cost, preliminaries and design cost. Given the risk allowance, contractor can adopt Quantified Risk Assessment to produce P50 risk allowance to in fee. Given example of clients' wish to lower fee to maximise gain share, contractor can show QRA evidence where the fee is the product of evaluating on the basis of P50."

Q3 attracted perhaps the best answers from candidates, one of whom wrote:

"As a contract manager, my role governs the commercial, contractual and governance framework which design decisions are made. Early involvement in a project is essential to ensure sustainable targets are achievable and budget is controlled throughout the programme.

I would structure the Early Contractor Involvement (ECI) process formally to ensure the client gain the maximum benefits from it. In the pre-construction stage, contractor is appointed on fee percentage to contribute construction expertise at early stage of design. I would arrange risk and value engineering workshop with ECI to identify and manage risk, challenge design assumption, and identify innovative and cost-effective sustainable option.)

I will evaluate every significant design decision using Whole-Life Cost, comparing its WLC with CAPEX at each design stage, ensuring the option selected is the best-balanced option over design life. Utilising the PRINCE2 Principle 1, continued business justification, business case will be reviewed at every stage to ensure the project is still affordable before moving to next stage. I would also use Earned Value Analysis (EVA) to measure progress, forecast completion date and final cost, analyse variances in schedule and budget as the project proceeds."

The better answers to **Q4,** which was essentially about H&S management, took a structured approach. One candidate opened their response as follows:

"The key hazards and associated H&S risks are listed below:

- *Intense marine environment – varying water depths along new western breakwater; mobile limestone layer; summer/winter storm, sea-level rise due to Climate Change*
- *Heavy lifting of Cubipod operation*
- *Working at water/height for the port expansion works*
- *Electrical hazards*
- *Unauthorized site access by the general public*
- *Inundation of site area and office; Sea-level rise due to Climate Change*
- *Site welfare*
- *Emission of waste and pollutants*
- *Psychological health*

As a Contract Manager, in order to tackle the key hazards of H&S risks, I will employ the following approaches to manage the H&S risk:

Compliance with International Standard
ISO45001 provided a framework to manage the H&S risk based on the framework, Plan-Do-Check-Act. For example, for lifting operation, a lifting plan shall be submitted to me for approval. After approval, the crane operator shall start the work, while the competent person shall be responsible for the supervision during the crane operation and ensure the lifting chain is positioned properly. After the operation, I shall check whether this operation can be improved, e.g. shorter lifting chain is recommended, this recommendation will be documented and adopted in the next operation."

A logical approach gives the marker immediate confidence that the candidate is applying syllabus learning directly to the scenario and is addressing the question. The candidate went on to expand on their syllabus knowledge whilst also demonstrating critical thinking:

"When carrying out risk assessment, qualitative (Risk Matrix) risk analysis can be adopted first to quickly identify and prioritize the critical threats. Below shows an example of risk matrix:

ID	*Hazard/Event*	*Cause*	*Existing Measures*	*Frequency*	*Consequence*
1	*Intense marine environment*	*Weather dependent; Environment-controlled*	*Avoid working under the intense marine environment*	*2*	*5*
2	*Heavy lifting*	*Working under the lifting*	*Lifting Plan; supervision by competent person*	*2*	*4*
3	*Working near water*	*Falling from working platform; Walking to close to the coastline*	*Protective barrier; Edge protection; Rescue*	*3*	*5*
4	*Electrical hazards*	*lack of ground-fault protection; the use of damaged equipment*	*Replacement of damage equipment; Earthing required for apparatus*	*2*	*3*
5	*Unauthorized site access by the general public*	*No proper fencing; weak security protocols*	*Construction site security training; warnings on site entrance*	*1*	*2*

The output of Risk matrix can help identify the control measures of the risks base on the principle of "Hierarchy of Control – Elimination → Substitution → Engineering Controls → Administrative Controls → PPE". PPE is the last resort to protect works from risks. Therefore, The risks shall always be eliminated and reduced to ALARP level."

In answering **Q5**, some candidates concentrated on site management practicalities but neglected the responsibilities a Contract Manager holds under the contract. Better answers addressed both:

"As Contract Manager, the risk of summer storm "Knud" presents an unforeseeable risks. Life shall be

protected in the priority.

Immediate suspension of work: I will inform the Contractor to stop the lifting work immediately and request them to dismantle the Cubipod from the crane, secure the plant and loose material to avoid striking harms to any personnel, evacuate non-essential personnel from the site area and ensure that the marine barges for construction works are safely berthed and sheltered.

Issue an early warning notice: Under the NEC4 Option C Contract Clause 15, I will notify the Contractor that the approach of Storm Knud will damage the work done of constructed breakwater in the spirit of trust. This will allow the Contractor to assess the compensation event in terms of time and cost under Clause 60 and encourage the Contractor to take responsibility to rectify the work without dispute.

Post-storm Site Inspection and Safety Checking: Before resuming the work, I will request the Contractor to carry out a thorough site inspection and safety checking with the Client and Contractor. We shall record the damage done for the construction site, inspect the temporary works such as working platforms and scaffolding if they are still robust to use, check the flooded area is any cautions and warning shall be made immediately. The scope of damage shall then be assessed and agreed with both the Client and Contractor Programme and Cost Estimate Update: When assessing the compensation event, The Contractor shall also update the program and cost estimate in order to adjust project time and cost. For the program, I will look into the proposed sequence of construction activities. If the activity of lifting the Cubipods is under the critical path, I will justify the additional effort, while exploring the possibility of shifting it on the critical path as the same time after rearranging.

Cost implication: the Contractor shall provide the detailed cost breakdown for work recovery and Earned Value Analysis (EVA) for review. CPI shall be allowed to provide an overview whether it is still greater than 1 if the damages work is incorporated. If it is smaller than 1, there are several approaches to minimize the cost overrun such as revising alternative construction consequences with cost-reducing measures, adoption of alternative materials while the work can be done within a budget or applying LEAN thinking to accelerate project completion with less work involved. BIM update can also be required if necessary for visualization of new construction sequence or new material used"

Such an approach give the marker clear confidence that the question is answered in full, syllabus learning has been applied to the scenario, and critical thinking is evident.

-

Appendix A contains example Answer Plans provided to Script Markers to illustrate how each question might be answered. These are example frameworks of how a question might be answered by drawing on further learning from across the syllabus. They have been developed by the same experienced Chartered Civil Engineer that set the questions. Future candidates may find it useful to see how a good answer could be developed but are not expected to have the same depth of knowledge. They are not in essay form so lack critical discussion.

Marks are not deducted if an answer varies from this guidance, indeed some candidates provide better answers. The coloured squares relate to syllabus modules:

M1 Procurement, Contracts and Project Management;
M2 Management and Leadership;
M3 Project Appraisal and Financial Management;
M4 Health, Safety, Welfare and Risk Assessment; and
M5 Sustainable Development.

Appendix A

1. As Project Manager for preliminary design, how will you lead a team to identify the most cost effective, constructable and sustainable solution for the Port Authority client?

EXAMPLE ANSWER PLAN

Project Manager for preliminary design

- Meet client to confirm project scope & discuss any known stakeholder concerns M1
- Agree monitoring/reporting arrangements including target date for final recommendation M1
- Develop Project Execution Plan re strategy, scope, schedule, budget & resources required M1
- Assemble a team with the necessary skills for surveys, assessments & optioneering M1

Leading preliminary design team

- Leadership style e.g. autocratic/democratic/transformational/transactional/laissez-faire M2
- Bring together internal design/construction partners to build common culture and goals M2
- Develop relationship with external stakeholders e.g. university researchers, environmental agencies, local council, port managers etc to understand needs & expectations M2
- Leadership & motivation - mentoring, empowering, encouraging improvement M2
- Monitor progress against Project Execution Plan re time/cost/deliverables M1
- Chair team meetings, report to senior managers, client liaison etc M2

identifying the most cost effective, constructable and sustainable solution

- Delegate environmental specialists to develop Environmental Impact Assessment (EIA) in consultation with Environmental Agencies and local nature groups M5
- Coastal engineering experts to work with Local University to test options for western breakwater in coastal engineering basin to determine best hydraulic solution
- Contractor partners to advise on constructability of each option
- Commercial team to advise on costings (CAPEX & OPEX) M3
- Determine objective evaluation criteria for option analysis:
  - CAPEX M3
  - OPEX (discounted cash flow over design life) M3
  - Economic/social/environmental impacts M5
  - Constructability
  - Project risk analysis M3
  - Comparison of H&S risks M4
  - Carbon accounting (e.g. compare import of granite to concrete manufacture) M5
  - Cost Benefit Analysis M3
- Agree evaluation criteria with client prior to analysis (adjust if necessary) M1
- Analyse each option against evaluation criteria M3

Recommendation to Port Authority (client)

- Compile Draft Feasibility Report providing:
  - description of each option
  - discussion of pros & cons including stakeholder & environmental impacts
  - tabular comparison of options against evaluation criteria
  - Cost/Benefit ranking of options M3
  - Analyse objective evaluation scores & subjective pros & cons to recommend solution M1
- Present draft report verbally to client, answer questions and provide clarification M1
- Amend & finalise report. Submit to client for decision M1
- Team de-brief meeting: agree lessons learnt & disseminate learning for future projects M2

2. As leader of a Design & Construct consortium tender, how will you assure the client re quality & sustainability, and negotiate contract cost/KPI targets? (Assume a form of contract)

EXAMPLE ANSWER PLAN

Leader of a Design and Construct consortium tender

- Responsible to parent companies (designer/contractor) for tender success M1M2
- Assemble two teams with experience of pricing and writing technical bids M2
- Provide clear objectives, targets and motivation for both teams & coordinate M2
- Align project/bid plan with tender schedule and report progress to parent companies M3

Assuring the client re quality & sustainability

- Assume tender assessed on quality and price (good procurement practice) M1
- Develop quality submission to include
  - Organogram of management team with CVs demonstrating experience and collaborative behaviour traits M2
  - Assume NEC Option C Target Cost: Evidence experience & savings achieved M1
  - Details of quality, H&S and Environmental Management Systems compliant with ISO9001, ISO45001 and ISO14001 with evidence of certification M1M4M5
  - Method statement for constructing breakwaters, quays, paved areas etc with evidence of similar successful projects and client testimonies
  - Method statement for manufacturing Cubipods in factory conditions to ensure quality control of fabrication and using low carbon concrete M1M5
  - Method statement for implementing EIA & evidence of minimising impacts elsewhere M5
  - Detailed programme to provide confidence in delivering to time including phasing to avoid winter working on weather dependent activities M1
  - Clarity of who will be responsible for delivery of each method statement M1
- Ensure commercial team price the tender in accordance with quality submission M3
- Combined tender team to agree tender stage cost estimate and KPI targets. M3

Negotiate contractual cost & KPI targets.

- Assume NEC4 Option C (Target Contract with Activity Schedule/Bill of Quantities) M1
- Assume Pain/Gain Share Mechanism (Clause 54) – negotiate how cost savings (gain) or overruns (pain) are split between the client and contractor M1
- Focus on setting a realistic Target Price based on accurate estimate M1M3
- Negotiate to agree "Defined Cost" (actual cost) vs. "Disallowed Cost," essential for determining the final price. M1
- Agree which risks to be covered by the Contractor's fee, and which remain "client risks". M1
- Encourage collaboration so both parties aim to keep actual cost below the target price M1
- Negotiating specific targets (Option X29) for sustainability or greenhouse gas reductions with associated financial incentives M1

3. As Contract Manager, how will you contribute to design to ensure constructability and make the most of design expertise for sustainable and affordable construction outcomes?

EXAMPLE ANSWER PLAN

Contract Manager Role

- Build a co-located, integrated team focussed on achieving common outcomes M2
- Promote vision/goals focussed on constructability, sustainability, affordability & zero harm M2
- Encourage collaborative behaviours that foster teamwork: active listening, open communication, transparency, mutual respect, willingness to share knowledge etc M2
- Empower innovation and a no blame culture M2
- Embed performance management, value engineering, risk management, cost control and quality management as core processes to drive efficient & effective delivery M2M3

Constructability in design

- Integrate experienced contractor staff into design teams to contribute to design, risk workshops, value engineering workshops, safety by design etc. M2M3M4
- Examples include constructing Western Breakwater from barges or along the crest from land: compare cost & safety & accommodate methodology in design (e.g. wider crest) M3M4
- Constructability to include H&S by identifying construction hazards (lifting, working over water, exposure to weather etc) so risk can be eliminated through alternative design M4

Sustainable Construction

- Environmental Management Plan identifying environmental aspects, legal compliance, setting objectives, operational controls (noise, waste, ecology), and staff training M5
- Design informed by EIA to eliminate activities that cause environmental harm M5
- Engage & involve environmental agencies and local nature experts in workshops to develop design features and construction techniques to minimise harm M5
- Select construction plant that minimises emissions & consider CO2 footprint along supply chain (e.g. compare CO2 in excavating & transporting granite to concrete batching) M5
- Develop Site Waste Management Plan aimed at managing, reducing, reusing & recycling. Appoint a waste champion, start the plan at the design phase, segregate waste on-site, use certified sub-contractors, and regularly audit waste figures to improve efficiency M5
- Work with local council to employ local people, train young people, rehabilitate offenders etc (UNSDG8), minimise impact on marine life (UNSDG14), reuse recycled dredged materials & crushed materials from local sites (UNSDG12) M5

Affordable Construction

- Whole team engagement in value engineering workshop to analyse planned activities to substitute/eliminate/modify unnecessary expenses – develop & implement alternatives M2M3
- Inform the client of savings & log in accordance with NEC4 Pain/Gain Share (Clause 54) M1
- Focus on lean construction to reduce wasted time/ resources. Map value stream, create materials/information flow, empower workers to work smarter. Pursue continuous improvement (Kaizen) M1M2M3
- Use 5D BIM to create detailed workflows & cost analysis from design into construction M3
- Build/maintain detailed cost model & continually monitor expenditure against model M3
- Use Earned Value Management (EVM) to integrate scope/schedule/cost to objectively measure performance. Compare planned work against actual work completed and its cost to provide early warning system for budget overruns and schedule delays M3
- Use EVM to keep the client informed of forecast budget overruns and delays, and propose measures to get the project back on track M3

4. What are the key hazards and associated risks, and through your leadership, how will you deliver industry leading safety outcomes?

EXAMPLE ANSWER PLAN

Key Hazards Risks and Mitigation M4

Hazard	Risks	Mitigation
Deep water	Hyperthermia and drowning	Eliminate work alongside deep water by design, construction planning, toolbox talks etc.
Storms	Injury from falls, blown material & exposure	Plan work to avoid storm season, monitor weather & delay activities
Exposure	Illness & hyperthermia	PPE, short working window, warm sheltered welfare facilities
Heavy materials	Injury from swinging/falling loads, skeletal injuries from lifting	Trained operators, banksmen, toolbox talk focus on safe working
Contaminated materials	Environmental pollution and illness caused by contaminants	Surveys of dock bed to identify contaminated material for dredging
Hazardous materials	Environmental pollution and illness caused by contaminants	Hazardous material awareness during design -eliminate/reduce
Uneven & wet working area	Trips/slips/falls e.g. working on rocks (Western Breakwater)	Avoid wet weather work, suitable footwear, training, briefing
Heavy plant	Injury caused by swinging or reversing plant	Trained operators, banksmen, toolbox talk focus on safe working

Health & Safety Leadership.

- Embed H&S culture and make Zero-Harm a core organisational goal M2M4
- Clarity of responsibility/accountability for key H&S personnel, Accept personal responsibility
- Provide the resources & funding necessary to work safely and provide for staff welfare M3M4
- Promote active worker participation in safety processes M4
- Empower workers to raise safety concerns and stop work if concerns remain M4

Process for delivering industry leading safety outcomes.

- Adopt ISO45001 Occupational H&S Management System M4
- Safety management plan following "Plan, Do, Check, Act" framework to ensure legal compliance and effective risk management (safety policy, risk assessment process, training, emergency procedures & monitoring performance through auditing) M4
- Proactive risk management to identify/assess hazards before they cause harm M4
- Consider both physical & mental wellbeing to reduce fatigue and workplace stress M4
- H&S induction briefings to everyone starting work on the project to communicate objectives and embed safety culture. Tests to check information understood before entering site M4
- Use probabilistic risk assessment to identify hazard, score likelihood and impact of injury prior to mitigation and after. Maintain Risk Register M4
- Communicate residual risk on drawings or BIM outputs to inform construction M4
- Method statements to take account of identified risk and articulate safe working method M4
- Toolbox talks and walk-throughs to communicate hazards & safe method of working M4
- Mandatory PPE appropriate to task M4
- Post construction operating plans to inform maintenance/decommissioning of residual risk M4

5. As Contract Manager, what should you do as Storm Knud approaches, and once it has passed how will you assure the client regarding cost, time and quality impacts?

EXAMPLE ANSWER PLAN

Contract Manager role & responsibility

- Lead co-located, integrated team focussed on achieving common outcomes M2
- Lead contact with client for contract compliance and performance M1
- Attend monthly Contract Meeting providing progress reports & forward programme M1
- Responsible for contract compliance; managing Defined Costs (actual costs), submitting interim payments via Activity Schedule, managing design/construction & correcting defects M1
- Maintain a log of Cost Savings achieved & of any cost overruns for pain/gain sharing M1M3
- Accountable to parent companies for successful project completion M2

Actions as storm approaches

- Monitor weather reports and in event of approaching storm take action to protect the works and the safety of site personnel M1M4
- Suspend work as the storm approaches. Remove personnel, plant and equipment from the Western Breakwater, Eastern Breakwater revetment works & other exposed working areasM4
- Suspend dredging work until the storm passes M4
- Alert the client. Submit NEC4 Option C Early Warning Notice (Clause 15) M1

Actions once storm has passed

- Assess storm damage and evaluate remedial action to repair damage recover lost time M1
- Recommence work, including repairs to the filter and core of the Western Breakwater M1
- Use EVM to advise the client of budget overrun implications and schedule delays M1M3
- Under the pain/gain mechanism, work collaboratively with the client to minimise impact M1
- Submit Recovery Action Plan to accelerate remaining breakwater work whilst controlling cost

Assurance re cost, time & quality

- Submit Action Plan to accelerate remaining breakwater work whilst controlling cost M1M3
- Undertake Quality Audit checking compliance of materials/workmanship prior to the storm M1
- Review design and construction methodology to reduce impact of future storms both during construction and after completion M1
- Check the specification of materials for the filter & core layers M1
- Assess cost implications and programme delays and undertake the following:
  - Update 5D BIM detailed workflows & cost analysis M1M3
  - Update detailed cost model for ongoing expenditure forecast M3
  - Update EVM re planned work v actual work completed and its cost M3
- Keep the client informed of actions re cost, time & quality as the work proceeds M1M3
- Disseminate report of incident and remedial actions within parent companies to help drive continuous improvement M1M3

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

Institution of Civil Engineers
One Great George Street
Westminster
London SW1P 3AA
UK

–