Chartered Membership and Associate-Membership Examinations, April 2004

The examiners' reports are to be read with reference to the April 2004 question paper available from the Institution at £3.00 for members and £4.00 for non-members.

Introduction: Chartered Membership

April 2004 saw the introduction of the much publicised new format Chartered Membership examination. The CM questions were aimed at testing the candidate's ability to develop detailed solutions for challenging structural engineering problems.

Successful candidates had to demonstrate a thorough grasp of the principles of structural engineering design and practice. It was expected that several alternative solutions would be considered before the viable solutions were proposed by candidates and that they would make use of annotated sketches when developing their proposed solutions.

Candidates were expected to demonstrate that they could produce coherent, logical and sufficient calculations to substantiate the proportions and form of their structure in accordance with the provision of a robust, stable and buildable solution. In addition to demonstrating their drawing abilities, the drawings would provide the opportunity for candidates to demonstrate their ability to identify the critical elements of their proposed solution. The candidate's knowledge of construction, construction process and temporary and permanent stability was also tested in section 2e.

The examiners once again came across the following common areas of weakness within the 2004 examination scripts: the candidates' lack of ability in conceptualising two distinct and viable solutions in Section 1a, and their inability to 'communicate' adequately. Candidates who struggled in Section 1a were unlikely to be able to produce sufficient quality in the rest of the paper.

Examiners stressed that candidates must grasp the importance of developing two competent schemes conceptually, before developing one of them through the remainder of the question's requirements. They also stressed the need for candidates to grasp the importance of nurturing and expressing their conceptual skills before attempting the CM examination, as this is crucial to communicating ability, engineering judgment and understanding to the marking examiners.

This year's examination was attempted by 855 candidates, 160 fewer than last year. Of the total number, 416 took the examination in the UK and 439 in the rest of the world. The UK pass-rate was 45.3%, an increase of 3.9% compared to last year; with 189 successful candidates out of 416. The overall pass-rate outside the UK was 26.8%: 118 candidates passed out of 439. The two Hong Kong centres provided 344 candidates of whom 70 passed, producing a disappointing pass-rate of 20.3%. The rest of the world centres saw 35 candidates pass out of 95, producing a most satisfactory pass-rate of 40.0%. The overall Chartered Membership pass-rate for 2004 was 34.7% (35.9%).

Candidates for the Friday 8 April 2005 examinations should be aware that there is a Structural Dynamics Question 8 being prepared. Further information regarding this question is published separately on the IStructE website in the Examinations Section.

CM: Question 1

The question called for the design of a new multi-storey building on the site of a 19th century fire station building and adjacent car park. The overall building dimensions were 150m by 30m with six floors to be used for apartments, offices, leisure and car parking.

The masonry façade of the existing building front elevation was to be retained. This wall was supported by a highway masonry retaining wall, which also extended over the whole length of the existing car park.

The candidates were expected to provide the connection detail of the masonry façade to the new structure, taking into account possible differential settlement. They were also expected to consider the temporary works required for maintaining the stability of the masonry façade during the demolition and construction stages. Due to planning restrictions a 2m wide clear zone was required to enable future maintenance to be carried out on the length of retaining wall adjacent to the car park. The candidates were expected either to hang the cantilever section of the building from the roof or provide a cantilever beam at level 3.

An underground river crossed the site under the car park through an existing culvert constructed in masonry. The top of the culvert was 1.1m below ground level and its dimensions were 5.25m wide by 6m deep. The culvert was not capable of supporting any additional loads. The provision of transfer structures within either the superstructure or substructure were the expected solutions for spanning over the existing culvert.

The ground conditions comprised of 2.8-3.7m of made ground over 3m of very stiff clay on a 0 – 5m tapering layer of medium dense sands and gravels, above a weathered rock head, which varied in level from 6 –12m below ground level. Ground water was encountered at 4.0m below ground level and sulphate and pH concentration levels were given for both the ground water and the made ground.

From the ground conditions given, pad foundations were viable for supporting the proposed loads into the stiff clays at 3m to 4m below ground level. However, in sections 1 and 2 of the building the candidates were expected to recognise that to do this they would have surcharged the existing culvert. To avoid this, piled foundations should have been used. Pad foundations could have been adopted in section 3 of the building providing that differential settlement was considered between the two different types of foundations. In this section the candidates were also expected to consider the use of balance foundations to avoid surcharging the existing masonry retaining wall foundations.

After completion of the design the client requested whether an additional floor could be provided along the full length of the building by altering the roof profile. The candidates were expected to recognise that they could no longer use the roof to support the cantilever section of the building or the columns over the culvert in sections 1 and 2 of the building. The additional floor loads would also have affected the design of a cantilever beam at level 3 and transfer structure over the culvert within the substructure.

Although there were a number of aspects to this question that required careful thought, it should have posed few problems to competent candidates. On the whole the quality of the answers were a little disappointing. Many overseas candidates who have traditionally attempted either Question 4 and 5 in previous years attempted this question. Most of these candidates, although adept in the use of concrete, appear unable to propose two distinct and viable solutions in Part 1. The two schemes proposed were generally *insitu* beam and slab, and flat-slab floor arrangements with the stability provided by the cores. The roof structure framing options were not tackled well or ignored by most of these candidates. Some candidates also showed their inexperience by their proposed locations of the cores and movement joints resulting to unstable structures.

Foundations were mostly piled, which mitigated the problems of surcharging the culvert and differential settlement. Some candidates however, did show their inexperience by proposing the use of pad foundations adjacent to the culvert taken down 7.1m.

A number of candidates failed due to non-compliance with the client's brief by proposing the spacing of the internal columns at less than 7.2m centres or located them on floors 3, 4, 5 and 6 less than 6m from an external elevation.

The letter was generally unsatisfactory with many candidates still more concerned about design fees and extra work rather than addressing the client request.

In part 2 the calculations and drawings varied in quality and quantity. Most of the candidates submitted basic floor design calculations and typical floor structural plans. There was limited design carried out for the roof and there was a lack of, or no critical sketch details provided.

The method statement varied from very good, with good diagrams and thought being given to temporary propping of the existing façade either from the pavement side or within the site, to very generic with no consideration given to the retained façade or retaining wall.

CM: Question 2

This question involved the design of a place of worship, consisting of a main worship area with additional facilities constructed around the perimeter. The site was level and located at the bottom of a narrow valley, with a stream passing through a 900mm diameter culvert 4m below ground level. The building was to be masonry clad under a split level, pitched tiled roof, with a 1.5m high continuous zone of glazing between the two levels. No more than five internal columns were permitted within the ground floor area and, to ensure uninterrupted views of the centre of the main worship area, no columns were to be placed within a 10m radius of the centre. In addition, the main worship area was to be kept open to the roof, but no roof structure was to be visible from below.

Ground conditions comprised a variable thickness of silty clays, sands and gravel (0.5-3.5m) over a thin band (0.5-1.0m thick) of more competent clay, above rock (rockhead varied from 1.5-4.0m BGL). Groundwater was encountered at 3.0m BGL in one borehole.

Following completion of design, there was some minor seismic activity in the region.

The question was slightly out of the ordinary, but relatively straightforward provided the candidate took on board all aspects of the client's brief and in particular the limitations on the building's geometry and the requirement for no roof structure to be visible from below.

There were a number of elements that the question sought to test: the ability of the candidate to conceptualise the brief and arrive at a structural form for the building that would meet all the specified aspects; consideration of the impact of the variable ground conditions on the design of the ground floor slab and foundations, and of differential settlement, plus the implications of the culverted stream beneath the site; and an understanding of the temporary works required to safely erect the structure. The introduction of seismic activity into Part 1(b) was to test candidates understanding of this issue.

Far fewer candidates attempted Question 2 this year, generally preferring Question 1, but those few generally did better than in previous years. The majority of candidates opted for either steel trusses or portal framed solutions, although a number put forward schemes involving the use of cable stays, laminated timber and concrete frames. This had the effect of ensuring that, for the first time in many years, the majority of candidates did actually offer two distinct solutions to Part 1(a). Unfortunately a number of candidates failed to register the clearly stated requirement in the brief for no roof structure to be visible from below and spanned elements through the centre of the main worship area. The implications of the continuous glazing zone were also missed by a number of candidates.

Several candidates adopted piled foundations, even to the end of the building sitting almost directly on very competent rock, and some failed to deal with differential settlement. A few simply ignored the variable ground conditions.

The letter in 1(b) was generally poorly addressed, with far too many answers demonstrating an ignorance of the behavior of a building under seismic forces. However, there did seem to be more of a tendency to try and deal with the problem, rather than to simply ask for additional fees as in recent years!

Once again, there was generally not enough design in 2(c), with a tendency for many candidates to look at the easier parts of the structure but not to design the more complex elements. There were also concerns that some candidates demonstrated a poor understanding of how the structures they were proposing actually worked.

The drawings were generally poorly presented with far too little detail, some even lacking basic dimensions, and certainly failing to meet the brief to be suitable for estimating purposes. Drawings often failed to include details of critical connections, such as those between the high level roof and the supporting hip rafters.

The method statements were generally poor, with many being little more than a list of activities ignoring aspects of safe construction or temporary works needed to erect the structure, and few would have been acceptable in practice, a serious concern given the increasing emphasis on the designer's role in health and safely matters, as noted last year. The programmes were similarly lacking in many instances.

Table 1: Pass/Fail per question

Question	Pass	Fail	Total	% Pass
Steel 1	105	304	409	25.7
Steel 2	55	74	129	42.6
Bridge	34	52	86	39.5
Concrete 4	34	17	51	66.7
Concrete 5	48	89	137	35.0
General	18	18	36	50.0
Offshore	3	4	7	42.9
Total	**297**	**558**	**855**	**34.7**

Table 2: Pass rates UK/Rest of World

	Pass	Fail	Total	% Pass
United Kingdom	189	227	416	45.3
Hong Kong	70	274	344	20.3
Rest of World	38	57	95	40.0
Total	**297**	**558**	**855**	**34.7**

CM: Question 3

This question called for the design of a bridge to provide access for a dual carriageway through an existing canal embankment.

The depth available in Section 3a was deliberately generous to allow a range of possible solutions and encourage some innovation. The candidates often chose two very similar schemes and wasted the opportunity to gain easy marks by describing alternative structural behaviour. Candidates should appreciate that repeated text/ elements do not gain marks. The two-span restriction in the question was unnecessary and candidates who proposed a single-span second solution were not severely marked down. Possible solutions included:

- Twin box culverts (possibly slid into place). This has the benefit of avoiding any disruption to the canal and avoids the problems associated with the canal waterproofing and horizontal pressures.
- Prestressed box girder with footways over a box on either side and transverse slab under the canal. The prestress has the benefit of reducing crack, so is beneficial for water retaining concrete. Examples of this construction are the A331 Basingstoke canal/ Falkirk wheel aqueduct.
- Steel plate girders – needs particular consideration of waterproofing and the durability.
- An arch was also feasible, though it might have been difficult to demonstrate sufficient calculations for a masonry arch had it been selected. A discussion of how to design this type of structure, particularly if in traditional masonry would have scored marks.

Consideration of how the lateral water pressure loads were supported was expected for structures that directly supported the canal. This could involve a footpath slab as a horizontal beam if provision for restraint at the supports was included. U-frame action or an overhead support would also be viable alternatives. Most candidates supported the footway cantilever with bracing, or designed for the cantilever moment, but few described how the water pressure was supported. A number had provided a bolted steel connection or joint at the base of the canal without identifying that this is a critical location.

Use of prepared scripts was evident in some papers including finding the bedrock from a previous aqueduct question. This resulted in failure to spot critical elements to this particular question.

Section B was generally attempted with the minimum effort and some candidates (usually from Hong Kong) are still signing their names. A number of possible options could be discussed including: sloping the abutments or providing corbel support (with reduced headroom over the footway), increasing the span lengths or number of spans, or the addition of separate subways behind the abutment. Most solutions would involve additional earth moving time and cost.

Section C was generally less extensive than previous years with candidates failing to design all significant elements. The substructure was often poorly attempted with a few candidates being unable to apply lateral earth pressures correctly. Some candidates chose to put bank seats on the fill without any evidence to justify that it would be suitable bearing.

Section D The drawings were generally better than last year but a number still failed to provide a basic plan elevation and section with enough details for estimating purposes. The candidates were expected to provide details of the critical locations on the structure.

Section E This section was generally disappointing as there is a wide range of issues that could be discussed. These include joints, bearings, parapets, footway surfacing, waterproofing, painting, external prestressing tendons, provision of safe access to elements for inspection, etc. A description of how the design avoids maintenance or facilitates easy/ safe maintenance where it can't be avoided was expected. Dewatering the canal should only be necessary for major repair works and not routine inspections. Designing out maintenance costs and health and safety risks (for construction and operation) is now a key part of the design process for all structures.

Candidates were not expected to know the details of aqueduct construction particularly with regards to waterproofing but were awarded marks for identifying the problems.

CM: Question 4

This question was for the design of a flood alleviation tank. It was quite a straight forward design of a typical underground water tank with the following limitations:

- maximum protrusion above existing ground is 4.5m;
- maximum embedment into existing ground is 4.0m;
- full water level is 3m above existing ground level;
- the tank has to be divided into two equal compartments;
- the tank roof is covered by topsoil and the external tank walls have to be concealed by earth embankments.

Only 51 candidates (6%) attempted this question, but there was a high pass rate of 66.7%. The paucity of candidates who chose the question suggested that few of them had good experience in designing a water tank, particularly large one. The high pass rate demonstrated that most of those choosing the question had a good idea of how to answer it.

Those who failed did not seem to appreciate how the tank should be waterproofed, be it utilising an external waterproof membrane or the use of waterproof concrete. Generally, the failed candidates did not include water bars within the construction, or design the tank for crack control. Some candidates concentrated only on the maximum upward load on the base slab due to full dead, imposed load and water content but omitted the buoyancy stability when the tank was empty.

A few candidates adopted uneconomical large-span structural arrangement without making use of internal column supports. Some candidates had no clear idea about how the ground should be dewatered; while some ignored the fact that dewatering would be required to stabilise the ground before construction commenced. A number of candidates did not fully consider that one compartment of the tank might be full while the other one could be empty.

Regarding the observation of client's requirements, a few candidates did not take into account the space of minimum clearance in estimating the tank dimensions, providing an undersized tank.

Relatively few candidates made use of annotated sketches to assist their description of the schemes and the functional framing and load transfer in answering Part 1a. Many calculations tended to be poorly presented with no clear indication of how numbers were derived. Generally, most calculations lacked quality and quantity. The drawings and details were of a variable standard of presentation, but with the majority not being prepared by competent detailers.

Method statements were generally not thoughtful enough, demonstrating a lack of adequate experience in construction. Many candidates had little idea about the timescale for the construction programme.

A couple of candidates were weak in understanding and read the client's brief carelessly, ignoring the the basic requirement for two compartments.

CM: Question 5

Candidates were asked to design an underground valve chamber for a reservoir. The chamber was to be 8m deep, 7m x 5m in plan, with a covered access room at ground level. The design was complicated by a high water-table, which made the buoyancy of the structure of fundamental concern, and the requirement for a large area of removable flooring in the control room floor, which prevented the use of the floor as a diaphragm to support the walls.

Concrete was a sensible material for the permanent works, and it was expected that different structural solutions would result from different methods of construction. Options included the use of sheet steel driven piles or secant bored piles to create a cofferdam, excavation in the dry using ground freezing or pumping to control water inflow or excavation in the wet placing the chamber base using tremmied concrete underwater to obtain a seal, and counteracting buoyancy using additional concrete as deadweight or installing tension anchors. Candidates who appreciated the important constraints described above and who proposed reasonable alternative solutions were successful.

As in previous years, a large proportion of candidates offered alternative solutions in which the differences were trivial and irrelevant in the context of the question: for example, proposing beam-and-slab versus flat-slab options for the upper floors. This suggests to the examiners that the candidate's experience is limited to structures where such alternatives might be sensible, or perhaps that the candidate has not understood that 'distinctness' must be related to the question and is not an arbitrary concept.

An alarmingly high number of candidates appeared to be unaware of buoyancy and the need to check the buoyant stability of the entire structure, not just for the completed work but also during construction. Those who ignored buoyancy and proposed an unstable structure failed. The letter to the client emphasised the point: the main effect of increasing the volume of the structure was to increase the buoyancy by 40% and candidates were expected to appreciate this and suggest ways in which the increased buoyancy could be counteracted.

It was expected that candidates would supply calculations for (in decreasing order of perceived importance): the overall buoyancy of the chamber and the uplift to be resisted, with a sufficient factor of safety; the lateral pressures and the uplift on the base producing bending and shear in the chamber walls and floor; the upper floors with high imposed loads; and the above-ground structure. It was hoped that the 'critical details' drawn by candidates would include the connection between the base slab and the walls and possibly between upper floors and the walls. The primary requirement for the method statement was that the stability of the structure should be maintained at all times throughout the construction.

CM: Question 6

The question involved the design of a community building on a remote site. The geometry of the building may have deterred some candidates, but in reality the plan shape allowed a straightforward approach to a simple steel or timber post and beam framed solution.

Candidates were asked to take account of problems in addition to the functional framing, including the remote location, the adaptability of the design for other sites, a hot humid environment requiring natural ventilation, a sunken pool located on a probable column position and limited availability of power, plant and materials.

Successful candidates chose a suitably framed superstructure and were able to provide distinctly different framing options in two different materials, thereby satisfying the brief. The favoured material for the frame was structural steelwork but some chose inappropriately heavy *insitu* concrete construction. The obvious choice of an easily adaptable, simple to erect timber frame was overlooked by the majority, but the few who chose this option provided eminently satisfactory solutions. All too often, the two schemes were not sufficiently distinctive in either materials or functional framing and little justification was offered for the chosen solution.

Foundation options were often not discussed, demonstrating a lack of knowledge in this area. Suitable foundations included a concrete raft or piles. Impractical proposals to use shallow strip footings or trench fill to depths in excess of 3m featured on more than one occasion. Groundbearing slabs on deep fill over loose sand were often proposed, with no discussion of possible ground improvement techniques to reduce the likely settlement.

Many well reasoned responses to the brief were put forward, but a significant proportion had difficulty in succinctly conveying their schemes without much repetition and restating of the question. The better scripts featured well-ordered deliberations, sketches of alternatives and well reasoned solutions.

Many candidates recognised that the superstructure was unlikely to be significantly affected by the client's request for a design to accommodate a sloping site and that site specific ground conditions and topography would dictate the appropriate solution. The letter was expected to notify the client of potential additional works required in connection with earthworks and some minor retaining structures. Some letters were very poorly written and did not address the problem posed, reflecting a lack of planning and forethought.

The quality and quantity of design calculations varied greatly, those which were sparse and poorly presented failed to pick up the marks available. A number of scripts omitted to provide sufficient output for the given task of sizing all the principal members.

Poorly presented plans and sections generally resulted from those candidates who did not produce a satisfactory scheme in section 1a of the question. It was all too apparent that insufficient time had been allowed for this important part of the exam, resulting in a lack of enough general and/or specific detail to allow a technician to produce a preliminary drawing and estimate. The better scripts impressed the examiners, scoring well in this important skill of communication by drawn detail.

The method statement was often too generic, without conveying the critical structural aspects required for safe construction and any requirements for temporary works during erection. Many candidates had obviously left insufficient time to provide a satisfactory answer to this part of the question.

The overall recommendation from examiners is to advise candidates to prepare for the exam by reading the readily available published information on time management, to practice their written and drawn communication skills under exam conditions and not to attempt the paper until confident with their ability in the conceptual design process.

CM: Question 7

The question asked candidates to design the steel support structure for an offshore wind turbine generator. The generator hub is 85m above sea level and the water depth at the site is 45m.

There is a growing number of offshore wind turbine support structures in UK and European waters. Although all existing installations are in shallower water with less lateral reaction than in the question, there is a trend towards deeper water locations and larger turbine capacities. The design of such structures is due to a combination of aerodynamic and hydrodynamic loads for both extreme conditions and fatigue conditions. Although these structures are typically sized by natural frequency and fatigue considerations, candidates were only required to design the structure for extreme aerodynamic and hydrodynamic loads.

Several distinct and viable solutions are available for this structure including:

- A main 'mast' comprising a large diameter tubular structure with braces subsea to form a tripod or quadpod base at the seabed.
- A space-frame jacket type structure with three or four tubular, legs and tubular braces.

Driven piles, suction piles or a gravity base (steel) are potential foundation solutions.

There was a large variance in the standard of candidates' two viable solutions. Some addressed the question well, responding to the request to indicate functional framing, load transfer and stability aspects of the two schemes. Others did not attempt to demonstrate an understanding of these aspects. There was also a large variance in presentation. Some candidates need to give greater consideration to the presentation of their paper so that their design appraisals and discussions which substantiate the recommended solution are clear and their structural understanding of the schemes is demonstrated.

Some candidates had an option for design appraisal and a recommended scheme that was concrete, despite the brief specifically stating that the client's requirement was for a steel structure. Candidates need to demonstrate to the examiner that they understand how a member or structure behaves to resist applied loads. Several solutions did not seem viable to install or were unstable in place.

Candidates were asked to write a letter responding to the client's request to raise the turbine unit by 10m. Several candidates did not identify in their letter the possible impact on the lift height for installing the generator unit, despite being asked to do so. A large proportion did not attempt to calculate the impact on the supporting structure. The percentage increase was in fact relatively small. However many candidates made speculative and grossly overestimated impact statements which provided no value to the customer. Some dwelt on the increase in the design fees!

Some candidates did not perform credible code checks in their design calculations to size the principal structural elements and one candidate did not reference or use a design code. Some calculations were so poorly laid out that they were impossible to follow.

Some candidates did not manage to allocate sufficient time to this section of the question. One candidate's drawings did not make sense.

Some of the candidates did not produce sketches of the installation that were both practical and incorporated sufficient positional tolerance.

Associate-Membership 2004 (written exam)

This year's Associate Membership (AM) examination was attempted by 16 candidates, 15 from UK centres and 1 from an international centre. This was the second year of the new format AM examination and whilst the number of candidates taking the examination was smaller than last year (26 in 2003), the pass rate of 75% is similar (76.9% in 2003).

(There were three candidates who took the Associate-Membership Oral route examination in April 2004, all proved successful. This route to Associate-Membership, first introduced in 1986, has now been withdrawn following the end of the 2003-2004 session.)

The new format AM examination was presented in an article in *The Structural Engineer* on 21 January 2003. It includes guidance and example questions and is recommended reading for future AM candidates.

Candidates were given a choice of answering one of six questions. With only 16 candidates sitting the examination this year not all of the six questions were attempted, and it is not possible, therefore, to provide specific candidate performance feedback on each question. However the following general feedback was noted by the examiners.

AM: Question 1

Candidates were asked to develop a solution for a country park visitors' centre comprising three adjoining octagonal buildings. The question included a number of challenges:

- Developing a suitable framed structure for the distinctive geometry of the buildings.
- Developing a framed structure with appropriate aesthetic features so that the structure could be exposed internally.
- Recognising the impact of introducing a basement below one of the octagonal buildings.

AM: Question 2

This question called for the design of an extension to an existing office to create a reception area. The key challenges were:

- Supporting the extension from the existing building.
- Developing a solution for the foundations which took account of the basement of the existing building projecting beyond the existing building envelope.

Section 1a

The examiners were again pleased to see that most candidates were able effectively to communicate their ideas for their proposed solutions through well illustrated design appraisals.

Examiners stressed the importance of including diagrams and a commentary supported by diagrams to describe the functional framing, load transfer and stability aspects of the proposed design, as specifically required in each question. The absence of this information was a feature of the scripts of several of the unsuccessful candidates.

Section 1b

Each question contained an important structural engineering change to be

AM: Question 3

For this question candidates were required to design a pedestrian bridge to provide access between the balconies of two existing hotels. Key challenges included:

- Designing a bridge which does not impose loads on the existing hotel balconies.
- Accommodating the restrictions on the locations of supports to the new bridge.
- Understanding the implications of torsions when the client asks for the bridge to be changed so that it is curved in plan.

AM: Question 4

This question required candidates to develop a design for a precast concrete railway station platform. Candidates were expected to focus on rapid methods of assembly using prefabrication and preassembly techniques. Other challenges were:

- Ensuring the stability of a structure which is an assemblage of prefabricated components.
- Adapting the design when the platform is located either at the top of an embankment or at the base of a cutting

considered. It is important in this section to focus on the specific structural engineering features of the change. Generic answers referring to delay and increased fees are not appropriate.

Section 2c

To attain the maximum marks in this section the calculations need to cover the principal structural elements, including the foundations, as stipulated in each question. As the calculations are intended to establish only the form and size of the principal structural elements it is important that candidates do not become too involved in the detailed aspects of one element at the expense other elements.

Examiners noted that the foundations were not being given sufficient attention. In each of the questions the foundations included some important design challenges.

Section 2d

Drawings and details were generally clear and neatly prepared. Some examiners noted that drawings did not contain sufficient information for estimating purposes. Future candidates are advised to consider carefully the types of information typically required by a quantity surveyor in preparing an estimate e.g. all key dimensions and material specifications for works constructed *in situ,* serial size/weight /reference and material specifications for prefabricated elements.

AM: Question 5

This question required candidates to propose and develop a structural design solution for a sculptor's studio and workshop. The key design challenges were:

- Designing the floors for an exceptionally high live loading to allow for the production of monumental concrete sculptures (similar to highway live load on bridges).
- Identifying the structural implications of providing a roof to the open quadrangle.

AM: Question 6

This question called for the design of a three-storey building to accommodate three shop units at ground level with six two-storey flats located above. The question was attempted by the majority of candidates. As a general question it was set to give candidates the opportunity to design a building in concrete, steel, masonry or timber, or any combination of these materials. This range of potential structural engineering materials was reflected in the candidates' proposed solutions.

Key features of the question included:

- Determining a suitable location for the columns at ground floor level to meet two client criteria.
- Describing the impacts of increased loading arising from a proposed change of use for the first and second floors of the building.

Section 2e

Some method statements were considered to be too generic and did not adequately cover the specific features of the proposed design. Future candidates are reminded how important it is that designers identify a safe method of construction for their designs.

A brief commentary on each question is given in the panels. se