Chartered Membership and Associate-Membership Examinations, April 2005

The examiners' reports are to be read with reference to the April 2005 question paper available from the Institution at £3 for members and £4 for non-members

Chartered Membership Examination

The April 2005 Chartered Membership examination was the second to be held under the new format introduced in 2004. It also saw the number of questions increased to 8 with the inclusion of a question in which Structural Dynamics was a key factor. The CM examination aims to test a candidate's ability to develop detailed solutions for challenging structural engineering problems. The questions enable candidates to demonstrate their ability to apply the principles of structural engineering design and practice.

This year's examination was attempted by a total of 775 candidates, which was a decrease of 80 compared to the number who sat last year. Of the total number, 331 took the examination in the UK and 444 in the rest of the world. The UK pass-rate was 42.6%, down 2.7% compared to last year; there were 141 successful candidates from the total of 331. The overall Non-UK pass-rate was 28.4%: 126 candidates passed from the total of 444. The two Hong Kong centres provided 329 candidates of whom 91 passed, producing a pass-rate of 27.7%, 7.4% higher than last year. The other Non-UK centres saw 35 candidates pass out of 115, producing a pass-rate of 30.4%. The overall pass-rate for 2005 was 34.5%, just 0.2% down compared to last year.

In collating comments from the examiners, certain themes tend to reoccur each year. Candidates are advised to heed them. This year, the following were prominent:

- Candidates should identify which problems posed by their chosen question must be solved for a successful outcome (e.g. the foundation design and settlement in question 2). They should communicate their understanding of the problems clearly. They should then address the problems in their proposed solution and not ignore them.
- Candidates should avoid neglecting part 2(e) until near the end of the examination, when their work suffers from severe pressure of time. It is preferable to highlight matters of key importance in part 2(e) rather than prepare a list of activities, some of which are trivial.
- Candidates can lose marks by using pre-prepared or 'standard' answers if they are not relevant to the question. At best, such answers may help as a check-list of items to be considered. At worst they give the impression that a candidate has not understood the implications of the question and is unable to find their own words to describe a problem or its solution.

CM QUESTION 1

The question called for the design of an industrial building with overhead cranes to be constructed on a site with 5m variation in level.

Candidates were expected to provide a suspended reinforced concrete sub-structure to support the building ground floor and superstructure over the lower level part of the site. It was expected that a retaining wall would be needed to separate the two parts of the site across the width of the building.

For the foundation design, an option was to treat the fill in the upper level of the site using vibro–compaction techniques to achieve sufficient net allowable ground bearing pressures of 150kN/m^2 and 50kN/m^2, for the column foundations and the ground floor slab respectively. The retaining wall and the foundations of the reinforced concrete sub–structure on the lower part of the site could also have been traditional pads and strips taken into the stiff clays, which were capable of a net allowable ground bearing pressure of 300kN/m^2. A movement joint was required between the two different types of foundations to allow for possible differential settlement. An alternative solution would have been to support the ground floor, column foundations, retaining wall and the reinforced concrete sub-structures using piles taken into the stiff clay over the whole area of the building.

Options for forming the plant and observation areas were to hang the floors from the roof structures (trusses) or to use the clear headroom height to form a transfer structure (vierendeel girder) to span across the bay.

To comply with the client's requirements for lifting, it was expected that two cranes would work in tandem in the outer bays and the remaining crane in the central bay.

A solution for the roof structure could have been to provide primary structures spanning 20m in the longitudinal direction to support secondary structures spaced at 5 or 10m centres transversely. Different internal column locations could have been achieved by altering their distance from the end elevations. As the external columns were to be spaced at 10m minimum centres, the crane beam could have been hung from the internal primary roof structure. Consideration however, should have been given to the lateral restraint of the crane beams at these locations.

In the design of the supporting structure to the large sliding door, candidates should have considered both the vertical and horizontal loads acting. Health and safety issues regarding the door installation should have been addressed in part 2e.

In part 1(b), in considering the increased lifting capacity, candidates were expected to recognise that an additional crane or cranes capable of lifting 100kN were required to work in tandem with the existing crane. Furthermore, there would be an increase in the vertical load acting on the existing column and foundations in the order of 1500kN. The crane beams and stability frames/bracing would also require checking for supporting the additional lifting and surge loads respectively. A solution to accommodate the client's requirements would have been to provide additional columns between the existing columns at 20m centres supported by new foundations. Placing restrictions on crane movements was another option for consideration.

Most candidates interpreted the brief correctly but many failed to see the options available in dealing with the split-level site. Few candidates proposed a suspended ground floor with an undercroft over the lower level of the site. Most candidates proposed filling the lower level of the site, with some ignoring the need for a perimeter retaining wall. Furthermore, some candidates introduced a movement joint along the change in level to deal with differential settlement without due consideration on the effect this would have on the crane operations.

In part 1(a), most candidates proposed the alternative options of braced frames and portal frames. Many candidates ignored the crane loads in their proposals, with greater emphasis being placed on dealing with the enclosure structure. Some candidates proposed the crane beam as a truss spanning 20m without providing lateral restraint to the top chord. The plant and observation areas were ignored by some candidates.

In part 1(b) Several candidates did not consider the introduction of additional intermediate column supports or the possibility of managing restricted crane operations. Letters which followed a recognised business correspondence format scored higher marks.

Calculations in part 2(c) were generally competent although some candidates did not check deflection for long-span elements of structure. The exposed nature of the site was also ignored by a few candidates in calculating the wind loads acting.

Drawings and details could have been better both in quality and quantity. Drawing to scale was lacking. Many candidates also ignored the need to show critical details.

Method statements in 2e were generally acceptable, although in some cases the programme was omitted.

CM QUESTION 2

This question involved the design of a new five-storey office building with a curved roof to be constructed on reclaimed land adjacent to a tidal river estuary. Only one line of internal columns was permitted, with constraints. The original ground comprised a significant but variable thickness of silt and silty sand with rockhead being encountered at 20.0m in one borehole and not at all in the other, despite the borehole being taken to 60.0m depth. The ground had settled 1000mm since the reclamation fill was installed and further long-term settlement of 300 to 400mm was expected.

The need to limit the ground pressure caused by the weight of the building, at the level of the geotextile membrane, required candidates to consider the overall weight of the building as part of their design. Candidates were expected to create a structural form for the building that would take forward the limitations imposed by the ground conditions into the design of the whole structure, and it was anticipated that candidates would appreciate the need to design the floors down to a pre-determined weight.

It was expected that candidates would appreciate that piled foundations were unlikely to be suitable on this site, both due to economic considerations, given the depth of the silt, and also because of the variable nature of the fill material. If piles were proposed the design would need to take into account the lack of restraint provided to the pile shaft by the silt and also the large negative skin friction loading to which the piles would be subject. The design would also need to consider the effects of providing a rigidly-supported building on a site platform that was continuing to settle. Whilst pad foundations might have appeared to be a suitable solution, the variable nature of the fill material should have cautioned candidates as to their use, due to the possibility of differential settlements. Successful candidates proposed raft slabs as the most appropriate form of foundation to cope with the constraints.

The requirement for full-height glazing to most of the front elevation required the provision of bracing to the narrow end bays, or the use of a sway frame construction. The use of the service cores for bracing and cantilevering of the floor plate was also possible but this would need to be justified by calculation. However, the height-to-width ratio of the possible bracing bays was high, and the design of the bracing system needed careful consideration. The bracing of the end elevations would necessitate the use of portalisation to avoid cross-bracing passing through the bands of continuous glazing.

The letter in Part 1(b) required candidates to respond to a proposal to raise the ground floor slab to avoid flooding. Candidates were expected to realise that this would increase the overall load from the building acting on the underlying ground. Possible solutions included the provision of a suspended ground floor slab, or the use of lightweight fill, such as polystyrene blocks, beneath the floor.

Few candidates appreciated that the ground conditions, and in particular the bearing pressure limit on the interface between the fill and the original ground, were a key aspect of the question. Many simply opted for piled foundations and then designed the superstructure without further reference to the ground constraints. It may be that candidates lacked the experience of designing an entire building with difficult ground conditions: there may be too much segregation between disciplines in some design offices, with one team designing the building from the ground up and another dealing with the substructure. However, it may be that candidates have been led to see piling as an option which will always be satisfactory without understanding that, in this question, piling was not a good solution. Candidates are advised to spend some time considering the practical and economic implications of their proposed solution before proceeding. A brief explanation as to why the proposal has been adopted can often show the examiners that the candidate at least understands the issues, even if their final selection, made under examination conditions, may not have been the best.

In part 1(b), few candidates appreciated the impact of raising the ground floor on the bearing stress at the level of the geotextile membrane. Candidates are expected to write letters in an appropriate business format.

Many candidates did not undertake enough calculations in part 2(c), and there was a tendency to design the easier parts of the structure while neglecting the important but more complex elements, such as the foundations. Part 2(c) also revealed that some candidates had a poor understanding of how the structures they were designing actually worked, with confused thinking over stability and no clear over-riding logic to the stability systems proposed.

The drawings were generally poorly presented with far too little detail, some even lacking basic dimensions, and certainly failing to meet the requirement of being suitable for estimating purposes. Drawings often failed to include details of critical connections, such as those between beams and columns where sway-frame action had been assumed. Many of the method statements and programmes presented were little more than a list of activities, ignoring aspects of safe construction or the temporary works needed to erect the structure. Whilst the general standard has improved, still far too few would have been acceptable in practice which is a serious concern given the increasing emphasis on the designer's role in health and safety matters.

CM QUESTION 3

The question called for a structure to carry an existing dual carriageway road over a new dual carriageway road. The main design problem was how to construct the abutment and wing walls below existing ground level. The water table was in porous rock and was above the formation level of the lower carriageway, so the temporary and permanent solutions required consideration of de-watering. Few candidates fully addressed this problem though many suggested temporary techniques for lowering the ground water level and the provision of a permanent pumping solution. Very few candidates chose to construct a base slab or proposed other methods of preventing water ingress from under the new road construction up to the highest level of the water table, which necessarily included the approach ramps. Few candidates considered checking the buoyancy of the structure, although this was unlikely to be a problem.

Most candidates assumed that traffic diversions had to be minimal and many chose to build the bridge in two parallel sections. The question did allow candidates to discuss traffic management options and propose diversions, but these were not expected to be complex: as the road was to be constructed below existing ground level the provision of a temporary diversion to the side of the proposed bridge would only have required temporary road surfacing without temporary structures. Diversions of services may have been more complicated but could also have been minor with adequate protection from construction damage.

Successful candidates generally chose a top-down construction solution with diaphragm or secant piled abutment walls which could be constructed with no major excavation or de-watering required. The deck could then be cast *in situ* at or near ground level without the need for heavy lifting or working at height. The deck could also serve as a permanent prop to the top of the abutment walls. Traffic could be diverted back on to the bridge as soon as the deck was completed and before any major excavation was carried out. This method would dramatically reduce the cost of dewatering since the walls would effectively bar water from entering from the sides. It would also avoid the health and safety risks involved with deep excavations and working at height. The provision of a central pier, suggested by some candidates, was not excluded but would slightly complicate this solution.

Some candidates chose to design truss-type decks which resulted in a transverse span similar to the longitudinal span. Support to the top chord in compression was often ignored by these candidates. Sheet piles were not appropriate as they cannot be driven into the rock. Many candidates chose traditional abutments with spread footings that required extensive excavation. Where the bridge was built in two halves to allow traffic management candidates often did not consider the substantial temporary works required to support the soil under the remaining half carriageway.

Alternative solutions included *in situ* concrete box structures built off-line and slid into place. This is feasible, particularly where traffic management is a major restriction, but it also requires significant additional excavation during the slide and to provide the working area for construction. Generally the load transfer and stability aspects were well described though many candidates limited their discussion by choosing to describe similar solutions.

Candidates were asked to consider how their design might be modified if the new bridge were to be changed to make a 45° angle with the existing road. Construction of a skew deck would increase the span and depth of construction, cause twisting and uplift forces in slab decks, and would be outside the recommended limits for integral-type construction. The loading from the abutment walls would also be eccentric. An alternative would be to provide a wider orthogonal deck to accommodate the skew carriageway, but this would become more like a tunnel and would require adjustment of the longitudinal alignment, more lighting and possibly ventilation. Changing the shape of the planters from rectangular to triangular was also a possibility to reduce the skew of the deck.

Calculations in part 2(c) were generally well presented. When simplifying the structure for hand calculation, candidates are recommended to explain the significance of the simplification. The provision of simple force/bending diagrams would demonstrate candidates' understanding. Some candidates ignored the longitudinal loads in the deck in the abutment design or failed to explain the load transfer fully.

In part 2(d) candidates were required to decide which areas were critical, and to provide sketch details of them. It was expected that these would include: abutment supports showing bearings, waterproofing, joints and drainage, and the base slab connection showing sump and pumping provisions.

Part 2(e) was often treated as a list without much attempt to point out the significant items of temporary works to maintain stability and safety. Service diversions were usually not well described and the programming implications of excavation through rock were not appreciated. Candidates discussing the types of plant with respect to environmental and access issues gained marks in this section.

CM QUESTION 4

The question called for the design of a multi-storey building with two levels of basement storage, offices in the upper floors and printing in the lower floors. Vehicle access for delivery and collection of newspapers and equipment was needed on the ground floor . Limits were imposed on the positions of columns to facilitate vehicular circulation on the ground floor and equipment installation on lower floors.

The building had to be built quickly and economically. It was expected to comprise a simple structural form such as a beam-slab-column system. As there were no specified constraints on the positions of the columns at level 5 and above, it would have been simple and economic to have an internal row of columns at and above level 5 supported by a transfer structure at level 5.

Ground water was encountered at a high level. Waterproofing treatment for the basement walls and base-slab had to be provided. The buoyancy of the structure, in particular before completion, was potentially a problem and checks on it were expected to be made.

Sound rock was encountered at a relatively high level. It was consequently not necessary to employ deep foundations for the building.

Candidates who passed showed good experience and knowledge in designing and constructing buildings of this type. In part 1(a) successful candidates proposed two schemes, both of which were sufficiently distinct in structural concept, rather than 'variations on a theme', and were both described specifically and in detail rather than generically or with irrelevant information. Candidates who propose schemes that do not meet the client's requirements, or which are difficult to understand because of poor presentation or illegible writing, are unlikely to pass.

While the letter required in Part 1(b) is expected to be presented in a businesslike format, its structural advice needs to be pertinent and accurate. Successful candidates undertook brief calculations to investigate the effects of a column being removed, and some provided sketches of the provisions to be implemented.

In part 2(c) candidates are expected to identify the fundamental structural items critical for the design and focus on them. Marks were lost because too much time was spent on designing minor elements.

In part 2(e) the method statement was often incomplete, and presented as a sequential list, without focus on the critical features of the design that needed to be conveyed to the contractor.

It was apparent, particularly in candidates' scripts for this question, that some candidates bring to the exam and use 'standard answers' such as sections of descriptive text which they have obtained, perhaps from an examination preparation course, with which they attempt to answer the question. Candidates should understand that 'standard answers' might be of use as a checklist of points which may need to be addressed when answering a question. However, if such answers are used where they have no relevance to the question, they simply highlight a candidate's inability to provide an appropriate answer and are likely to lose marks rather than gain them.

Chartered Membership Examination 2005

Part of the World	Pass	Fail	Total	%Pass
United Kingdom	141	190	331	42.6
Hong Kong	91	238	329	27.7
Rest of World	35	80	115	30.4
Total	**267**	**508**	**775**	**34.5**

Pass rates per question attempted

Structural Material	Pass	Fail	Total	%Pass
Steel 1	15	20	35	42.8
Steel 2	23	53	76	30.3
Bridge 3	27	36	63	42.8
Concrete 4	39	145	184	21.1
Concrete 5	136	192	328	41.5
General 6	25	56	81	30.8
Offshore 7	1	3	4	25
Structural Dynamics 8	1	3	4	25
Total	**267**	**508**	**775**	**34.5**

CM QUESTION 5

The question called for the design of a 5-storey laboratory building constructed adjacent to an existing highway and over a canal. The building comprised two wings respectively containing office/seminar facilities and laboratories, separated by a full-height atrium with a pitched glazed roof. Circulation within the building was provided by link bridges and balcony walkways in the atrium at the upper levels. The external walls were to be clad in masonry. Ground conditions comprised 16m of sand/clay over rock. Restrictions on column spacings meant that a transfer structure was required at level two in the seminar rooms.

The key elements to be addressed were the transfer structure, the balcony and link bridges and the implications of the canal. The letter in Section 1b was intended to test the candidates' understanding of the susceptibility of structures to vibration.

The two schemes in Part 1a were often poorly communicated with inadequate sketches and untidy, in some cases illegible, writing. The alternative schemes proposed by many candidates were not sufficiently distinct. A change in material alone is not adequate; candidates are also expected to change the structural system or grid to one which suits the properties of the chosen material. Many candidates' alternative schemes consisted simply of a change from beam and slab to flat slab with no change of grid and these candidates did not gain high marks.

Most candidates' solutions complied with the brief and there were few violations of column spacing restrictions. Most candidates also recognised the need for both halves of the building to be independently stable. The walkways, bridges and glazed roof were generally inadequately addressed and some candidates appeared to take the erroneous view that they were only required to consider the primary structures of the two wings. Some candidates failed to mention the canal at all in section 1 of the paper, while others proposed eccentric foundations in order to avoid the canal lining but then failed to justify them in the calculations.

There is a tendency for some candidates to adopt the use of a standard format answer, presumably obtained from an examination preparation course and including standard phrases which were repeated word for word on a number of papers. One of the aims of the examination is to test the candidate's ability to think independently and creatively, and it is noted that papers which include the 'standard answers' often have the least imaginative solutions and the least distinct alternative schemes.

Candidates producing good letters recognised the best positions for locating equipment, i.e. close to columns, on the lower floors and generally away from sources of vibration. Others, less successfully, discussed expensive strengthening schemes or complicated vibration analysis.

It is recognised that there is insufficient time to carry out calculations for all members and candidates are therefore expected to focus on the critical elements of their proposed structures. It was disappointing to see repetitive calculations for slabs or simple beams at the expense of designing key elements such as transfer structures or cantilevers.

Drawings were often unclear and too limited for the purpose of estimating. Some candidates attempted to draw all levels on a single plan which resulted in confusing and incomplete information. The question called for the provision of critical details but these were often ignored or limited to reinforcement details.

Method statements on the whole were poorly attempted. Candidates tended to produce generic lists of construction activities rather than being site specific. Many failed to consider the presence of the canal or the proximity to the highway. The programme was frequently poorly done with candidates often demonstrating a lack of experience in this area.

CM QUESTION 6

The question required candidates to design a two-storey building with constraints on structural positions on the ground floor. Distinct options were possible in different arrangements of columns and beams. The structure could be considered as a box supported on transfer beams at level two with transverse cantilevers at the perimeter. The transfer beams could be supported on columns spaced to accommodate the car parking requirements. Longitudinally, primary structural frames coinciding with the partitions, with transverse secondary beams, would provide the required column-free areas to the training rooms. Overall stability could be provided by vertical bracing at the staircases for both the longitudinal and transverse directions, or by portal frames transversely and bracing longitudinally. The roof member could be a truss spanning between columns or could form part of the top member of a portal frame. Foundations could be spread or raft foundations to suit the column spacings. Conventional piled foundations would be uneconomic unless mini-piles were used.

The question divided candidates into those who had designed similar structures in their everyday work and who produced workable proposals of a high standard, and those who had not previously encountered buildings of this type and who struggled to produce even one viable scheme. The majority proposed steel and concrete superstructures. Very few candidates dealt with the large cantilevers and fewer followed this aspect through into the design calculations treating them as key members.

Some candidates realised the complications associated with building near a railway line, and extra marks were gained for good proposals to eliminate possible vibration transmitted to the building.

In part 1(b) many candidates were unable to provide a coherent and reasoned explanation on how a single storey basement could be provided. A car parking basement was feasible in view of the distance from the railway retaining wall, and the ground conditions would not make excavation difficult. Many candidates seemed over-concerned with fees and planning applications instead of providing structural advice to the client.

In part 2(c) good candidates appeared well-versed in using section tables in arriving at member sizes. However far too many candidates either did not tackle the cantilevers or did not treat them as part of the structural frames. The stability of the building was not adequately covered by many candidates.

In part 2(d) good candidates carried through their selected scheme into the design calculations and drawings. It was expected that critical details selected would include the cantilever beam and its connection to the column below.

In part 2(e) method statements were often generic without conveying the critical structural aspects for the safe erection of their chosen scheme. Programmes were also unrealistic indicating a lack of adequate construction experience.

CM QUESTION 7

The Offshore question required candidates to design a new offshore Utilities Module to be located on an existing production platform; a common scenario in the mature offshore industry where operators are upgrading relatively old platforms to receive new oil and gas tie-ins and changing production requirements.

Offshore structure designs do embrace a variety of design situations with explicit design methodologies and it is clear some candidates lack sufficient practical design experience. The standard of presentation was generally disappointing. Candidates are reminded that they have to convince the examiners they fully understand the issues, most successfully accomplished by a clear and well-organised submission.

The question required a trussed or plated module solution, with consideration given to the requirements for the support of a crane and the provision of a blast wall to provide protection from an adjacent process module.

In part 1(a), very few candidates adequately illustrated the functional framing and load transfer for all the design phases of the module as requested. There was insufficient demonstration of understanding of the load paths for the various installation and in-place conditions. Candidates are advised that sufficient detail at this stage significantly helps identify the critical structural component designs that need to be presented later in the calculations and sketches.

In the letter in part 1(b), several candidates did not recognise the benefit the additional live load supports would offer and made speculative impact statements which provided no value to the client.

Candidates did not perform sufficient member code checks to size the module and prove their ability to derive member forces. Items expected to be included were consideration of the lift design case, pad-eye designs, the crane pedestal support structure, connections to the pedestal and the blast wall restraints, and connections to the main structure.

Good candidates allocated sufficient time to the general arrangement and detail sketches section of the question. This is an important part of the submission where clear understanding of the more complicated detailing issues can be demonstrated.

In the description of the final installation procedure, there was limited recognition of the requirements for installation bumpers and guides and no recognition of the requirements for sea-state monitoring. Most candidates appear to have left insufficient time to answer this question, where an opportunity to achieve high marks was available.

CM QUESTION 8

Question 8, including a requirement to consider seismic or dynamic activity, was a first this year. The question concerned a hotel – a 15-storey bedroom block rising above a two-storey general area with a larger floor plan on a remote seaside location. Ground conditions did not present difficulties, with 25m of dense sand overlying bedrock and groundwater encountered at a depth of 5m. Candidates selected concrete as the structural material, which given the remoteness and potential aggressiveness of the site was appropriate, and favoured a system of shear walls to provide the lateral load resistance. Most realised that the stair and lift shafts provided obvious locations for these elements, but not all grasped that these had to have adequate shear area and stiffness in each direction; very slender walls (in terms of height to base width ratio) were suggested in some cases which would not have given sufficient lateral resistance.

A distinct structural alternative would have been the provision of an unbraced frame without shear walls. This could have been viable, giving a more flexible structure detuned from the earthquake motions, less restriction on circulation and views and more distributed foundation demands. However, care would have been needed to avoid a soft storey forming in the general area, the cladding would have had to accommodate greater deflections and there would have been more demanding requirements for seismic detailing for both concrete and steel solutions. Most candidates offered variants on the concrete shear wall scheme, with minor alterations to the gravity frame, which were not generally sufficiently distinct.

The gravity load-path was provided in all cases by concrete slabs supported by a concrete beam and column frame, which was appropriate. Columns in the bedroom areas were forbidden; this was respected and most candidates also realised that the requirement to keep the general area as unrestricted as possible could be met by stopping off some of the columns in the tower block at second floor level. However, the elements providing lateral resistance through the bottom two storeys had to be sufficient to prevent soft storey formation within the general area, and not all candidates achieved this.

Most candidates selected pad foundations. Piled foundations were inappropriately proposed by a few.

The letter to the client (section 1b) asked for the structural implications of building the same structure on a site with much poorer soil, and groundwater at 5m depth. Most candidates realised that there would be an influence on foundation design and, in particular, a risk of liquefaction, and some realised that piling would now be required. The changed site conditions would also have increased the seismic input motions at longer periods, and reduced the stiffness of lateral and rotational restraint of the foundations, which could potentially increase the structural period, but this was not generally noted.

Associate-Membership Examination

This year's Associate Membership examination was attempted by 13 candidates – 10 from UK centres and 3 from overseas centres. This is a slightly smaller number than last year – 16 in 2004. Six candidates passed the examination, which is a pass rate of 46%. This is lower than in the previous two years, when the pass rate was around 75%.

Two candidates took the oral examination route to Associate Membership – both were successful. These were the last two candidates to take the oral examination, which has now been withdrawn.

This was the third year of the new format Associate Membership examination. The new format was presented in article in *The Structural Engineer* on 21 January 2003. This article is recommended reading for all future AM candidates.

In the Associate Membership written examination, candidates were asked to answer one of six questions. With only 13 candidates sitting the examination some questions were not attempted. Specific feedback on each question is not, therefore, possible. However, set out below is general feedback on the various sections together with the key features of each question.

Section 1a
Most candidates offered a reasonable structural solution. However some did not indicate the functional framing of their proposed structure, as required in this section of the question. Functional framing is probably most effectively described through diagrams and future AM candidates are encouraged to consider techniques for showing these. It should be fully understood that candidates are specifically asked to 'indicate clearly functional framing, load transfer and stability aspects of the scheme'. By adequately dealing with each of these aspects, candidates will be more able effectively to demonstrate their understanding of structural behaviour.

It was noted by some examiners that the design appraisals were difficult to follow or confusing. It is recommended that future AM candidates practice questions under time-limited examination conditions and seek feedback from others on the clarity of their scripts.

Section 1b
In each question this section introduces a specific client change that involves an additional structural engineering challenge. It is important that candidates recognise the challenge and deal with the structural engineering implication of the client change.

Section 2c
Some candidates incorporated insufficient calculations to establish the form and size of all principal structural elements, including foundations. AM candidates should consider how their proposed solution is sub-divided into principal structural elements.

Section 2d
Some candidates did not include sufficient information to show the dimensions, layout and disposition of structural elements for estimating purposes. To meet this requirement it is important that sufficient views be included. Details must be similarly comprehensive.

Section 2e
Method statements appeared to be inadequate because candidates leave insufficient time for this section. Candidates are reminded that marks can be gained by ensuring that this final section is given appropriate attention. se

Associate-Membership Examination 2005

Part of the World	Pass	Fail	Total	%Pass
United Kingdom	6	4	10	60.0
Hong Kong	0	1	1	0
Rest of World	0	2	2	2.0
Total	**6**	**7**	**13**	**46.1**

No prize awarded for the Associate-Membership examination

AM QUESTIONS

Question 1
This question called for the design of a new hotel development. There were a number of key challenges which included:
- Developing a column arrangement for the building, based on the required bedroom layout.
- Modifying the column layout between the first floor and ground floor.

Question 2
The design of a steam generator support frame formed the basis of this question. It included several challenges:
- Designing a permanent supporting frame for the steam generator.
- Designing a temporary supporting frame for the steam generator.
- Understanding the impact of time on ground deformations.

Question 3
The key feature of this question was the design of a cyclist-pedestrian bridge in a rural/ forest location. The design challenges included:
- Developing an unusual split level arrangement between the cyclist and pedestrian levels on the bridge.
- Assessing the implications of deformations of the structure under new loading conditions.

Question 4
The design of the retirement villa in this question essentially entailed the design of a suspended slab structure. The question included a number of challenges:
- Incorporating an existing retaining wall into the new basement structure.
- Dealing with the unusual layout and complex geometry of the building

Question 5
This question called for the design of a motorway control tower. Key design challenges were:
- Designing a major 30m high tower structure and associated foundations.
- Designing an unusual cantilever superstructure and considering the implications of a high helicopter landing load.

Question 6
This question entailed the design of a building extension to provide a stairway for fire escape and access. Key challenges included:
- Considering how the new extension would impact upon the existing building
- Designing the foundations for the extension so as not to impact upon existing services.