Chartered Membership (Part 3) and new Associate-Member (A-M) Examinations, April 2003

The examiners' reports are to be read with reference to the April 2003 question paper available from the Institution at £3.00 for members and £4.00 for non-members.

New examination formats

April 2003 saw the introduction of the new Associate-Member (A-M) Examination, and the encouraging results are described in the second part of this report. This year has also seen the last of the Part 3 examinations in its existing form; in April 2004 the new 'Chartered Membership' Examination will be in place.

Much has been written to prepare candidates for these changes, and reference should be made to the Institution's website for further information. *The Structural Engineer* included details of these changes in the 21 January 2003 issue this is also available to download from the website: (www.istructe.org.uk).

Introduction: Chartered Membership (Part 3) report

This year's examination was attempted by a total of 1015 candidates, which was an encouraging increase of 98 candidates compared to the number last year. Of the total number, 544 took the examination in the UK and 471 in international centres, the two Hong Kong centres accounting for 370 of this latter group.

- The UK pass-rate was 41.4%, an increase of 3.9% compared to last year; there were 225 successful candidates.
- The international pass-rate was far more encouraging than last year: 139 passed from 471 candidates, a pass-rate of 29.5% (c.f. 15.5% in 2002).
- The overall pass-rate was 35.9%, much improved on last year but with, of course, plenty of margin for further improvement!

The Examinations Panel, which includes the Examination Advisers and Chief Examiners, continues to review all matters concerning the Chartered Membership (Part 3) examination and the new Associate-Membership examination on behalf of the Institution.

As in the past, examiners continue to see the same pattern of 'deficiencies' in candidates' papers; despite communicating these common faults to candidates, the fact that they continue is, of course, of great concern to all involved. An overview of some of these issues for the Part 3 examination is given below.

Last year's (2002) results were notably poor, so it is of some encouragement to us all that the pass-rates have climbed back towards their usual levels, but still leaving, obviously, further room for improvement. Candidates should continue to be reassured that the Examinations Panel and the Institution have been considering ways to give even stronger support as they undertake the entire Professional Review process and the examination itself; success at this important juncture in their career is as important to the Institution as it must be to candidates. This support runs in parallel with the need to maintain the Institution's high standards of professional competence and excellence, accepted worldwide, and expressed in the formal routes to membership and the Chartered Membership examination, in particular.

Pass-rate for questions

Q.	Description	Candidates	Passed	Pass Rate
1	Tea production facility building	141	48	34.0%
2	Call-centre building	213	92	43.2%
3	Railway underbridge for new access road	74	19	25.7%
4	Eight-storey youth hostel	462	158	34.2%
5	Lighthouse and helipad	12	7	58.3%
6	Sports science teaching building	106	38	35.8%
7	Single point moored structure	7	2	28.6%
Totals		1 015	364	35.9%

Candidates' lack of ability in conceptualising two distinct and viable solutions in Part 1a continues to be a major concern for the Examination Advisers and the Chief Examiners, as does candidates' lack of ability to 'communicate' their understanding, intentions and structural engineering knowledge and skills. Candidates who fared badly in Part 1a were unlikely to be able to produce sufficient weight in the rest of the paper to recover from this bad start, such is the importance of developing two competent schemes conceptually, before taking one of them through the remainder of the question's requirements. This conceptual skill remains at the heart of being able to communicate ability, engineering judgment and understanding to the Examiners; the importance of nurturing this skill before undertaking the CM (Part 3) examination cannot be over-stressed.

The separate reports on each question also make mention of the well-rehearsed issue of 'two distinct

CM (Part 3) Question 1

Tea production facility building

The question called for the design of a tea production facility. Overall building dimensions were 112.5m by 102.5m, with a full-height production area and adjacent first floor offices, staff room, kitchen and canteen areas.

The external supports of the building were to be widely spaced and exposed as a distinctive feature; to highlight this, the non-structural external wall elevations were to be set back from the edge of the roof. A maximum number of five columns were permitted at ground floor level internally.

The ground conditions comprised a layer of sand, increasing in depth from 3m along each side of the building to 6m along its centre line; the sand varied linearly with depth from very loose to medium dense. Below this was 2m–3m of soft to firm clay on top of sandstone. Groundwater was encountered at 1.0m below ground level and low sulphate concentrations were measured in each of the boreholes.

After the construction of the superstructure had started the client requested whether the roof loading and lifting load in the production area could be increased by 1.0kN/m^2 and 50kN respectively.

The question was relatively straightforward providing the candidates considered the full implications of the following aspects of the client's brief:

- the distinctive feature external supports;
- the supports to the roof and first floor areas to suit the maximum number of internal columns and the relatively high imposed roof loading in the production area;
- the high imposed ground floor loading in the production area to suit the poor ground conditions at shallow depth.

Generally, the quality of the answers was an improvement on last year but could still have been better.

Most of the candidates interpreted the brief correctly but many failed to see the options offered by the limited number of internal columns. Many candidates chose trussed or portal solutions using the same column layout and hung the first floor areas from the roof; others proposed the use of castellated or cellular beams as an alternative solution to trusses spanning 30m or more.

Most candidates appreciated the need for the external supports to be placed outside the external wall cladding; however, little or no consideration was given to aesthetics in their design. Some candidates did not consider the stability of the first floor areas and failed to provide any bracing or connection to the external supports.

An alternative scheme should have proposed a different arrangement of internal columns and perhaps a different span direction of the principal roof members.

Generally, the ground conditions were dealt with adequately, but some candidates proposed the use of ground bearing slabs, failing to recognise that the sand layer affected by ground water could not support the ground floor imposed load in the production area without treatment. The majority of candidates proposed piled solutions for the main foundations. Some candidates ignored the sulphate concentrations; others specified the use of sulphate resisting cement not recognising that the levels were low enough for class 1 concrete to be used.

In the letter in section 1(b), solutions to the increase in loading were seldom addressed in a precise manner. Many failed to present logical reasoning for the inadequacy of the constructed structure; many candidates still appear to be unable to identify points relevant to the question and then report/comment adequately in letter form.

Most candidates made an effort to produce good drawings this year, which is to be commended; the detail sketches, however, were poor. Many candidates failed to address more than holding down bolts in 2(e) and the architectural/ structural interfaces were not adequately dealt with in the full-height section.

The method statement did not, in general, address the safe erection of the building and the programme periods given for each activity were rarely realistic.

CM (Part 3) Question 2

Call-centre building

This question involved the design of a three/four-storey call centre building, with provision for a future two-storey extension. The call centre was to be built on the side of a hill, with a fall of 12m across the site (including the extension). The building was to be masonry clad with a 1.35m high continuous zone of glazing. Only one line of internal columns was permitted in each longitudinal direction and a minimum column spacing was given for the external walls. A two storey, fully glazed reception area with no internal columns was to be provided to one wing of the building.

Ground conditions comprised 0.25m–1.0m of made ground over a tapering (0-4.0m thick) layer of soft sand and gravel, above weathered rock (rockhead varied from 0.25m–5.0m BGL). No groundwater was encountered.

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

The question was relatively straightforward, provided the candidate took on board all aspects of the client's brief and considered the full implications of the building's geometry and the varying ground conditions. There were a number of elements that the question sought to test:

- consideration of the impact of the tapering wedge of highly variable sands and gravels on the design of the lower ground floor slab;
- differential settlement along the length of the building;
- design of the upper floors to fit into the available structural zone, particularly if the candidates considered deflection and fire protection;
- stability of the fully-glazed two-storey reception area.

It was also hoped that candidates would realise that the construction of Phase 2 would necessitate the introduction of a movement joint. The introduction of seismic activity into Part 1(b) was to test candidates' understanding of this issue.

More candidates attempted the question this year, and generally did better than in previous years. The majority of candidates offered very similar structural layouts with variation in material or flooring system, perhaps reflecting the limitations of the question. However, as is all too often the case, many did not offer two distinct solutions to Part 1(a), but simply variations on a theme, or merely paying lip-service to the second solution. Most candidates used the service cores to brace the building, but few provided calculations to justify stability under wind loading, perhaps relying on the exclusion of 'the detailed design of the service core facilities (e.g. staircases)' from the question. The implications of the continuous glazing zone were missed by many of the candidates, with some proposing to provide bracing, or even concrete shear walls, across the windows. Virtually no-one took on board the need to support the masonry cladding above the glazing, or, for that matter, the design/support of the masonry under horizontal wind loading.

Many candidates adopted piled foundations, even at the end of the building sitting directly on rock, whilst others proposed reinforced concrete pad foundations 5m deep to the lower end of the building. Most candidates did recognise the need to deal with differential settlement, but some solutions were very uneconomic. Very few candidates gave any consideration to the need either to provide retaining walls at the 'steps' between storeys, or to suspend the upper floor and batter the ground beneath. 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 behaviour of a building under seismic forces. Letters varied from bland advice that there wasn't any problem, to full scale scare-mongering! It was also notable that many candidates answered assuming the building was still in the design stage and not already built, as stated in the question.

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.

The drawings were generally poorly presented with far too little detail, some even lacking basic dimensions, and certainly failing to meet the brief that they should be suitable for estimating purposes.

The method statements were generally very poor, with many being little more than a list of activities ignoring aspects of safe construction, and very few would have been acceptable in practice, a serious concern given the increasing emphasis on the designer's role in health and safely matters. The programmes were similarly lacking in many instances, with several showing a lack of appreciation of the time required for operations to be completed.

and viable solutions'; often schemes are not structurally distinct from each other, or one is fully-developed (the candidate's area of skill, perhaps) whilst the other is barely developed at all.

This difficulty is coupled with the increasing evidence of model (or flow-chart) answers. Candidates are often transfixed by working through the methodology they have taken into the examination with them,

CM (Part 3) Question 3

Railway underbridge for new access road

This question called for the design of a railway underbridge for a new access road. The existing railway was on a steep embankment of dense fill above natural ground level; the ground conditions comprised sandy clay to rock with a water table just 2m below ground level.

Candidates were advised that the more acceptable solutions would minimise the disruption to the rail service. The question proved challenging to most candidates as it tested their knowledge of 'fast construction' techniques and fundamental knowledge of geotechnical aspects of bridge design. The structural form could be a relatively simple one but key to the question is how it would be constructed. The question provided many opportunities for the candidates to show a depth of knowledge of construction.

Few candidates recognised that a fill slope of 1:1 is not stable without stabilisation. The wing walls should have been designed to ensure stability of the embankment in the vicinity of the bridge. The candidates had to decide the level of the access road that would provide the required construction depth below the tracks. Some candidates did not appreciate this but most identified that it was preferable to construct above the water table.

In Section (a), the viable structure forms depended on the candidates chosen construction method. So, for example, *in situ* concrete slabs, portals or box structures were suitable if the bridge was slid into position; precast beams, through plate girders and steel composites, could be lifted into place on prepared crossheads / bankseats on piles; trusses were generally permitted unless it caused a significant upstand between the tracks.

Some candidates chose transverse beams almost the same length as the longitudinal edge beams; this was considered uneconomic. Cable stayed or *in situ* concrete box girder solutions were considered inappropriate. Many candidates simply chose to describe two alternative decks and failed to provide two distinct and viable solutions so the available marks were limited. Candidates managed to change the bridge alignment by 90º, diverted the railway parallel to the original alignment and provided a span of 32m far exceeding the requirement. Solutions that involved raising the tracks were not viable due the length of track and embankment that would be affected. Candidates who chose to provide spread footings in the clay needed to justify it. The choice of number and type of bearings often showed the candidates lack of experience.

Section (b) was generally attempted well but none recognised all of the issues. The consequential effects of increasing the clearance are many, e.g. the water table is above the road level so dewatering is necessary during construction and long term pumping from road level will be required, dewatering in clay for a long period may affect the track alignment due to shrinkage so more frequent track monitoring would be necessary, waterproofing the structure may also be a problem, the abutments would be taller and support greater earth pressure but collision loading would be avoided.

Section (c) was generally attempted adequately but few considered any extra items such as seismic or deflection checks for lightweight structures. Few candidates allowed for dynamic effects, imposed loading on the embankment or the adverse effect of braking in the abutment design. Often the heavy point load was ignored. Foundations were sometimes massive and section sizes too large for the construction depth provided. Some omitted to design basic elements of the substructure.

Sections (d) and (e) were mostly disappointing with many not providing enough details for estimating and little specific information on the sketches. Freehand sketches were poorly presented and not to scale. Few presented any reinforcement information. In the details few candidates addressed the provision of space for inspection, temporary jacking points for replacement of bearings, provision of drips and location of joints clear of bearings to prevent water and salt damage. Most of the parapet drawings were standard highway bridge details.

In section (f), some innovative methods of construction were received but most were disappointing and impractical and some candidates failed to attempt this section. As usual most seem to have left this section until last so it was treated in a rushed manner and cadidates often failed to consider the disruption to the rail or the substantial temporary works required. The few candidates who showed a construction programme benefited from additional marks.

Candidates were not expected to know the details of bridge sliding, rail operations or dewatering techniques but were awarded marks for identifying the problems and proposing solutions that were generally feasible. Candidates are reminded that a key skill for an engineer is the ability to recognise structural problems and marks were awarded for this even if the candidate was unable to develop an ideal solution. This question challenged many candidates who were not familiar with railways and a variety of construction techniques.

CM (Part 3) Question 4

Eight-storey youth hostel

This question comprises the design of an eight-storey youth hostel, involving two 'buildings' (the access core and the blocks). The question is straightforward and structurally simple, the major constraints being the high standard of sound insulation and an 8.0m wide clear strip at the ground floor.

By not specifying the minimum clear headroom and without constraining the overall height of the building, the question gives ample scope for a large range of structural forms. A large number of the failures was attributable to candidates not taking on board the brief (e.g. the clear zone at ground floor), or lack of information in the answers. The question is still not being read carefully by a notable number of candidates.

The central access tower is linked to three residential blocks. The tower and blocks should stand alone with respect to lateral load resistance and thus a joint should be provided between them. Many candidates seem to think there is only one material – *in situ* concrete. In this case, *in situ* concrete with screeds and sound deadening measures could be easily incorporated into a steel-framed solution.

Two distinct solutions for Part 1(a) were difficult for many candidates to identify. The answers to this part of the question were, as usual, lacking in inspiration and most, not distinct. Many candidates did not provide supporting calculations, resulting in outrageous solutions being proposed. Candidates concentrated on the residential blocks, offering only a single solution for the access tower, in some cases the presence of the tower was ignored completely.

A significant number of solutions offered for the residential block frame were grossly uneconomic; there was evidence of lack of preliminary appreciation of size and proportion. The residential block was mostly tackled as a reinforced concrete slab-beam-and-column rigid frame, sometimes with shear walls at the four corners. The upper stories were supported on a transfer structure that straddled the 8m-wide clear zone at ground floor or spanned onto the outside walls. For the central access tower, only a few candidates appreciated the structural considerations and proportions in cantilevering the 3m wide access area from the circular service core.

A considerable number of candidates relied on column frame action to sustain the lateral loads on all schemes and did not consider the introduction of shear walls around the perimeter of the residential block, or they assumed that the service core would be able to sustain all lateral loads. Certainly the use of the central core would not be appropriate for transverse loading on the three wings of the hostel. A notable number of candidates did not understand 'longitudinal centreline', either offsetting the area to one side or providing two transverse areas.

The letter was not very well prepared by a large number of candidates. They rarely attempted to show or size an outline scheme for the pool. Sketches illustrating spatial implications would have been useful. The seriousness of introducing heavy loads from a swimming pool located on the top floor of the hostel was generally not appreciated. Very few suggested locating the pool in a basement. The programme implications were not mentioned and the statements on the impact on the building were very broad, with not much said about the more detailed effects. Some answers appeared to be 'universal answers' that might have been copied out of the personal notebook of the candidate. The letter should be specific to the problem set in the question and refer to a viable solution.

The biggest problem candidates had with the question was the foundation solution. A majority of candidates were aware of the ground water and avoided it by providing bored piles. Good candidates displayed their knowledge by quickly checking the total building load applied to the weak clay at 12m depth after allowing for spread of load through the gravel. Poorer candidates calculated 30m plus piles of extraordinary size to try and achieve a solution. On occasion candidates proposed to use pile lengths up to 80m which would involve more arisings than a raft at a depth of 6m, and there was no discussion of the need for further ground investigation. Only a few candidates considered rafts on improved ground or at 6m, or a piled raft with piles driven into the dense sand.

Many calculations tended to be poorly presented with no clear indication of how numbers were derived. The calculations commonly ignored the deflections of the structural elements and in many cases did not consider lateral stability adequately. Overall, most calculations lacked quality and quantity. There was a lack of appreciation of member sizes, usually larger than required sizes were specified leading to high project costs. Also the need for openings in the core of the access tower was ignored by many candidates.

The drawings and details were of a variable standard of presentation, but with the majority not being very good. The quantity of reinforcement for estimating purposes was often left out, and ignoring the ground floor construction was common. Sketching is an important aspect of an engineer's communication; it shows how his/her thought process works as well as being a method of transferring ideas to other members of the design team; the drawings have become progressively worse over the years and attention needs to be given to this area.

Method statements were generally not thoughtful. The method statements could have better addressed propping during casting of floors and strength gain before formwork removal. Any need for cranes and their foundations was usually ignored in the method statements. Only a few discussed slipforming or precasting to achieve rapid construction, but some of these candidates failed to apply the method to the details of (e).

CM (Part 3) Question 5

Lighthouse and helipad

Candidates were asked to design a lighthouse with helipad, founded on rock in shallow water. The structure was essentially a vertical cantilever; the major lateral loads to be resisted were those caused by wind and wave actions; the magnitude of the loading was proportional to the width of the structure, which was left unspecified for candidates to propose.

Successful candidates offered as alternative solutions:

- a solid shaft of massive construction relying on gravity for stability, and
- a slender shaft or lattice presenting a much reduced cross-sectional area with consequently reduced lateral loads, but making the provision of accommodation and storage rooms more difficult and increasing the proportionate effect of the helipad offset loading.

Sensible choices of material included concrete (cast *in situ*, or precast and post-tensioned), and steel for a lattice frame solution.

Successful candidates viewed the question as a project to be constructed rather than a design in isolation, and had a clear idea of feasible temporary works by proposing, for example, installation of a temporary causeway to produce a working platform above high tide level, using a jack-up platform set up over the site, or using a floating barge with shallow draught to be removed at low tides.

The implication behind the client's request to relocate the lighthouse was that it became 10m taller, and wind and waves would have an increased overturning effect. The use of a temporary causeway for construction would become impractical, but use of floating pontoons would become more feasible.

Unfortunately calculations were often poorly executed, with numerical errors frequently made in the calculation of overturning moments.

As in previous years, some candidates gave stock descriptions and phrases in section 1, apparently without thinking whether they applied to the particular structure being designed. Comments were made regarding lateral loads and load transfer that might be appropriate for a framed office building but had little relevance to a lighthouse.

Candidates should remember that the examiners are experienced engineers who search the candidate's script for evidence of awareness and understanding of the structural problems to be solved. Reproduction of standardised but irrelevant text wastes the candidate's time and creates a poor impression for the examiner.

rather than focusing on the specific requirements and challenges of the actual question. The central requirement, to communicate your ability to the experienced examiner, means that those candidates following 'developed systems of answer' are as transparent as those able to communicate their experience and engineering judgement. Of course, proper preparation is fundamental to passing the Part 3 test, and this will involve checklists of topics that are likely to warrant attention, but only within the context of the question and responding to the client's brief and requirements, and of communicating your own skill and understanding.

There was also little improvement in the answers to the section of the paper introducing an unexpected problem or change in client brief – many still invented problems that are not part of the question or, conversely, decided that the change in brief made negligible difference. The examiners have long-accepted that formal drawing skills are no longer a part of many engineer's function or skills, but the need to communicate in neat sketches approximately to scale must remain an inherent part of communication within working practice and, particularly, in the Part 3 Examination.

The Examinations Panel commends the following to potential candidates and to those responsible for training and sponsoring them:

- learn and practice the skills of conceptual design;
- understand the demands of the Part 3 Examination for you to communicate your experience and ability in engineering design, drawing, problem solving and coherent writing;
- prepare thoroughly – use past papers and enlist the help and advice of colleagues around you in discussing your answers, particularly in meeting the client's brief and in Part 1(a);
- preprepared and reproduced elements in the answer do not communicate innate ability.

CM (Part 3) Question 6

Sports science teaching building

The question was based on the construction of a new, low-rise, sports science teaching building on a part-filled site. Candidates had the opportunity to demonstrate their skills in providing a structural solution to what appeared to be a simple problem, but on further deliberation revealed a number of difficulties which needed to be overcome. Candidates were expected to take account of a sloping site with an increasing depth of fill containing groundwater at depth.

Most candidates offered loadbearing masonry and steel, some concrete, framed structures as two viable alternatives, with masonry generally taking second place in the final choice of schemes.

The difficulty with the loadbearing masonry scheme noted by many was that upper and lower walls did not generally line up, resulting in a requirement for a supporting beam within the first floor depth. This beam was also required to support significant roof loads. The use of a hybrid scheme i.e. a steel- or timber-framed roof supported on a loadbearing masonry ground floor structure was rarely used. First- and ground-floor construction in reinforced or precast concrete was acceptable and the use of beam-and-block floor units by some candidates showed an appreciation of buildability.

Discussions for the choice of final scheme were often adequately presented by candidates, but there were some who were unable to describe the functional framing, load transfer and stability aspects. As in previous years, unnecessary time was wasted by the use of long descriptions of loadpaths rather than the more succinct use of sketches, which would have allowed more time to describe the significant aspects of alternative schemes.

The selection of suitable foundations seemed to present problems, especially for a second viable proposal. Many were not able to come up with a solution other than the use of piles, ignoring the difficulties that would be presented by the shallow depth of the good ground on the west side of the site. Some chose a combination of piles and strip footings, but failed to mention any considerations of differential settlement, or to discuss the need (or otherwise) for a movement joint to accommodate such movement. The trend for foundations to be designed by the specialist contractor should be reason enough for the Chartered Structural Engineer to have an overall knowledge of these techniques, with the ability to choose the appropriate solution prior to detailed design and to check the specialist's design when prepared.

Foundation options for the deep footings to this building include pad-and-beam, (concrete filled manhole rings supporting reinforced ground beams) combined with strip or trench fill on the shallow side; again consideration of differential settlement should have been discussed. Other options for consideration/discussion included raft and/or wide strip foundations on improved ground. Any problems due to the water table were generally ignored.

A few candidates thought that a groundbearing slab on the filled ground would be acceptable and some risked severe cracking/failure of the superstructure with strip footings and slabs supporting internal walls supported on the fill.

Examiners remarked on the weakness of candidates who were able to produce a more than acceptable superstructure only to be let down by their obvious lack of knowledge of foundation options and design. Removal and replacement of the fill and the use of 5m deep trench fill were proposed as practical solutions on more than one occasion.

Letter writing skills and calculations were generally acceptable to achieve the minimum pass mark. Some were untidy and muddled, many focussed on minor structural elements at the expense of establishing the size and form of the principal elements.

The drawn element of the exam is considered by examiners to be of vital importance, the ability to communicate by sketch and drawing being a necessary part of the structural engineers' skills. Drawn information was generally mediocre and candidates with ability in this part were able to shine, showing up the deficiencies in those lacking sufficient skills. Thankfully, these skills can be learned and much practise is needed by candidates when preparing for the exam to produce acceptable general arrangements and workable details in sections 2d and 2e of the paper.

Part 2f required a detailed method statement, which was often poorly attempted. The key words in the question 'safe construction' were often ignored, with inappropriate use of standard method statements obviously culled from preparation courses. Outline construction programmes were often unrealistic in terms of timescale and omitted to include for things other than structure, e.g. mechanical and electrical fit out, finishes etc.

CM (Part 3) Question 7

Single-point moored structure

The question asked candidates to design a SPM (single-point moored) structure to allow gas to be flared at an offshore site. The structure's stability was provided by a buoyancy tank, the lateral wind and wave loading being resisted by the structure rotating about a universal joint (UJ) at the base inducing a righting moment due to the lateral deflection of the buoyancy tank. A ballast tank at the bottom of the structure (just above the universal joint) reduced the tension on the UJ bearings caused by the buoyancy tank, thus making the UJ virtually frictionless.

There are several SPM structures currently in-service in the international oil and gas industry as remote flare structures or tanker offloading and mooring structures. The natural periods of these structures are well in excess of the wave periods and their rotational response is thus dominated by mass inertia rather than stiffness. However, the information provided in the description of the question was such that no knowledge of dynamics was required to produce a satisfactory design. (i.e. the maximum rotation was provided and the net lateral load was defined thus making the determination of bending moment and axial tension statically determinate).

Two distinct and viable solutions comprised a truss space-frame tower (triangular or square in plan) and a single large diameter tube with internal stiffening; these two solutions were proposed by some candidates, although the majority proposed both triangular and square truss designs – this was also acceptable.

Some candidates did not demonstrate a knowledge of the buoyancy induced stability of the structure (i.e. the fundamental principle of how the structure functions) and consequently their calculations for member sizing were either completely omitted or were incorrect. Several candidates did not consider the temporary conditions of transportation and installation sufficiently and of those who did some produced an unstable installation method.

Some calculations were good, neat and logical but others were less so, making it difficult for the markers to evaluate the candidate's competency; the drawings were of a similarly varied quality. Very few candidates produced sketches of details that were either practical or capable of transferring the significant loads.

Most candidates allocated their time appropriately to each part of the question although, as in previous years, some candidates did not allow sufficient time to complete sections 2e and 2f.

Associate-Membership Examination 2003

This year's new format AM examination was attempted by 26 candidates, 23 from UK centres and three from international centres. Whilst this number is slightly lower than in previous years, the pass rate of 76.9% is a significant improvement. This could be due to potential candidates being less inclined to sit the new format exam in its first year but those who did being better prepared.

The new format AM exam, which has much in common with the CM exam, was described in an article in *The Structural Engineer* on 21 January 2003. The article included guidance and example questions.

Under the new format examination, candidates were given a choice of answering one of six questions. Each of the six questions was attempted by at least one candidate. With relatively few candidates attempting any one question it is not possible to provide specific candidate performance feedback on each question. However the following general feedback was noted by the examiners:

Section 1a

The examiners were pleased to see that most candidates were able effectively to communicate their ideas for their proposed solutions through well illustrated design appraisals. This was particularly significant as it is this part of the question which represents the main departure from the previous format for the AM examination.

Examiners noted that candidates recognised the importance of including commentary on functional framing, load transfer and stability as specifically required in each question.

Whilst only one viable structural solution was required to be described in the appraisal it was disappointing that there was not always discussion of the reason for selecting the particular solution.

Section 1b

Each question had an important structural engineering change to be described. It is important in this section to focus on the specific engineering issues. 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

A-M Question 1

Candidates were asked to develop a solution for a five-storey town centre office development. The question included a number of challenges, including:

- developing a column layout which would accommodate the required number of spaces in the car park at semi basement level;
- constructing the new building structure close to two existing buildings;
- provision of a column free third floor;
- understanding and describing the implication of changing the column layout between ground and first floor in Section 1b.