

Examiners' reports

Membership (Part 3) and Associate-Membership examinations, April 1990

The examiners' reports are to be read with reference to the April 1990 question papers available from Publications at a price of £3.00 for members and £4.00 for non-members.

Introduction (Part 3)

The 1990 examination was attempted by 1004 candidates, an increase of 173 on last year's candidate figures. The overall pass-rate of 40.3%, while slightly down on last years percentage, compares favourably with most recent years. The total number of UK candidates was 688, of whom 303 passed, a pass-rate of 44%, slightly down on last year's performance. The total number of overseas candidates was 316, of whom 102 passed, a pass-rate of 32.3%, down 5.5% on last year's performance. However, there were 41 extra candidates this year, and it is hoped that the overseas candidate figures will continue to grow during the 1990s.

By far the most popular question was question 5, a multistorey building with integral carparking, where 169 candidates out of 491 passed, achieving a low overall pass-rate for the question of 34.4%.

However, question 6, concerning an octagonal meeting hall extension to a residential home, was the second most popular question, with 120 candidates out of 232 achieving a pass and the highest overall pass-rate of 51.7%.

Question 2, concerning a demountable bulk grain store, was attempted equally well by UK and overseas candidates, producing very similar pass-rates. Of the 84 candidates who attempted the question, 36 were successful, a pass-rate of 45.2% (19 UK candidates and 17 overseas candidates).

The Chief Examiners have once more highlighted the following common areas of failure:

- (1) The standard of drawings and detailing remains of variable quality, with many candidates failing adequately to communicate information.
- (2) The quality of letters suggests that few candidates have experience of writing business letters. Many produced just a list of points.
- (3) Many schemes are difficult to build and some are also unsafe.
- (4) Candidates are not stopping to think about the problem presented to them, but are determined to show a design ability, even if what is offered does not meet the requirements of the question.

(5) Annual comments regarding allocation of time and quality of presentation in terms of both structure and clarity of the written script can all be repeated.

In conclusion on a positive note, candidates need to be encouraged to view the examination not as a 7h period to get as much 'standard' information down on paper, but to address the specific problems asked of them. The 'conceptual design' part of the examination gives the candidate the opportunity to express and convey his or her engineering ability.

Question 1

The question was intended to allow candidates to show their ability to deal with the concept of a tall structure having relatively large cantilever floors and express their understanding of construction problems associated with them.

Generally, the papers were of a poor standard, but several candidates made good attempts showing appreciation of wind-induced stresses. The alternative schemes were generally not well thought out, and most seemed to regard this part of the question as not being worth a lot of effort or thinking time. Many schemes would be impossible to build and were unsafe. Too many ignored the need for access to the restaurant from below, their solutions showing a full slab across the service shaft. There were few good attempts at the letter. Too many seemed to be lost for ideas, and several treated the safety of adjoining property or the public as an incidental item. Many failed to show that they understood the need to consider the wind forces as additional to the dead plus imposed loads. Many candidates indicated curved edge beams in plan at floor level, but very few made mention, or allowance for, the effect of torsion. Most treated these beams as simply supported. There was virtually no mention of, or allowance for, deflection, and only a couple of scripts made mention of the need to check for differential settlement and its effect on peripheral columns. The poor standard of drawing and detail continues to depress all markers.

Question 2

This was a question essentially concerned with the demountable aspect of framed buildings, yet only a minority of scripts considered this point.

Many candidates showed a lack of understanding in the handling of horizontal thrust, and too many got into trouble with the moments around the frame because of their failure to plot moments on the tension face of the frame. Several solutions were offered with a fully welded portal frame. Hardly any arch solutions were submitted, and very little imagination was shown. Many ignored the effect of the dominant openings, and far too many omitted the conveyor loading. The problems of founding such a temporary building on a site that contained a soft clay stratum and the potential of a high

water table were largely ignored by most candidates. The letters to the client regarding the ground floor construction showed a lack of experience in this important aspect of a structural engineers role. Design was generally of a poor standard. Where lattice girders were used, very few considered local bending of the chords, and wind reversal was largely ignored. The standard of drawing and detailing was poor in the main with no discussion regarding tolerance in most details. Those candidates who made time for the final part of the question achieved reasonable marks.

Question 3

The question called for the design of a new single-span road bridge over a canal to replace an existing half-through girder bridge. It should have been apparent that the design of the replacement bridge was relatively simple and that the main task was to achieve the phased demolition of the existing bridge and construction of the new bridge, while maintaining the traffic lanes which were clearly stipulated.

Nevertheless, a significant number of candidates failed to comply with all the client's requirements and, in particular, chose to ignore the need to maintain one traffic lane in each direction. The geometric constraints in combination with this traffic-flow requirement dictated that traffic would have to use the existing girder bridge with one of its two main girders removed, the bridge being stabilised and supported by temporary works. Indeed, the references in the question to stability and temporary works, and the stringent client's requirements could be satisfied only by the removal of one of the existing girders, while maintaining the use of the deck. It was, therefore, disappointing to see many candidates circumventing the main task of the question by providing traffic lights and one-way traffic working, thus reducing the question purely to the provision of a new single-span bridge of some 18.0 m span. There was a feeling among examination markers that many candidates were not stopping to think about the problem presented to them, but were determined to show a design ability, even if what was offered did not meet the requirements of the question. There was, therefore, a need to give far more thought to the question than just a 'model answer' approach that part 2 and the relative simplicity of the new bridge appeared to invite. Options for the new deck varied from *in situ* concrete, precast T-or M-beams with slab, steel beams with slab, to steel truss and plate girder through-bridges. Some candidates seemed unsure whether precast T/M beams and steel beams constituted two distinct and viable forms. The simplicity of the new bridge implies that these are two 'obvious' forms, and hence were quite acceptable as two options for this particular question.

In part 1 (b) some candidates described what they proposed to do rather than what they had done. The question requested a *letter*, although some candidates offered more

of a report. Good standards of presentation, structure and quality were not much in evidence. On the whole, the preparation of design calculations was satisfactorily attempted, which was to be expected from the simple form of the bridge required. Most candidates made no mention of temporary works, despite being specifically asked to consider these items, and the provision of stability to the existing and new structures. Where candidates allowed themselves sufficient time, the presentation of general arrangement drawings was generally adequate.

In part 2 (e) the first sketch was tackled fairly well. The second, again asking for temporary works, was very poor, which perhaps is a direct result of the comments made in the opening paragraphs of this report. The method statement was reasonably well attempted by those who had allocated sufficient time.

This year's bridge question (more than in previous years) appears to have exposed a 'model answer' syndrome, and candidates need to be encouraged to view the examination not as a 7h period to get as much 'standard' information down on paper, but to address the specific problems placed in front of them. The 'conceptual design' of part 1 (a) is a fundamental part of the question and the opportunity for the candidate to convey his engineering 'thinking' ability, rather than the more mechanical procedures required in part 2 of the question.

Question 4

Most candidates found difficulty in presenting two viable solutions to the problem, with the discussion required in part 1 being inadequate. A number of candidates exhibited a lack of basic understanding of engineering principles.

A frequent criticism was that the load on the existing structure could not be properly assessed or that it exceeded that which was permissible. Some candidates spent too much time on the simple infill light well and insufficient on the stair, core and lifts. Method statements were generally poorly considered, with inadequate thought on the implication of the works on the tenants. The drawings and diagrams which are required in the various parts of the question were generally of a low standard.

Question 5

A large proportion of candidates considered this question within their capabilities, but many were found wanting. The alternative solutions were frequently the same basic structural layout with the option of steel or concrete as the constructional material. Many candidates spent too much time trying to achieve an optimum carpark layout while others totally disregarded the need for access aisles and placed a central row of columns through the parking floors. The question gave a good indication of what was required with regard to column positions and a transfer structure, yet some candidates insisted on having two rows of internal columns within the office floors, which the brief specifically prohibited. Some candidates had difficulty in dealing with the transfer structure, being reluctant to use wide shallow

beams. Many others were quite ignorant of the principles of clay heave. The question indicated that some measures would be necessary to combat heave, but candidates chose to ignore the effects. The design of the principal elements of the question such as retaining walls, foundations, main columns, beams and transfer structure were frequently not properly dealt with, if at all. Many drawings were not suitable for estimating purposes because of a lack of information. The quality of letters suggested few candidates had experience of writing business letters; many produced just a list of points.

Question 6

This question required candidates to have a sound knowledge of the design and construction of small building structures involving a variety of structural materials, including timber, brickwork, concrete, and, if framed solutions were adopted, steelwork. Knowledge of simple foundations and ground slab design in order to deal with the problems of differential settlement on filled sloping ground was also required.

As usual, many candidates failed to demonstrate adequate conceptual knowledge in part 1 in describing two distinct and viable options and deal adequately with the stability and load transfer aspects of their designs. A lot of thought went into the roof design, and solutions involving steel or concrete ring beams supporting sloping rafters were favoured by many candidates. The apex connection details were poorly dealt with by candidates lacking knowledge of how to design and detail such connections. The foundation and ground slab design and the inter-relationship of these elements with the terrace proved difficult in conceptual and detailed design terms for many candidates. Some candidates used commonsense and offered suspended ground slabs obviating the need for a retaining wall and overcoming the problems of differential fill settlement on the sloping site. Many candidates, however, failed to address differential settlement problems and offered foundation and ground slabs founded partly on the fill which would inevitably lead to masonry and plaster cracking problems. The general knowledge of building construction assembly details was poor. The quality of drawings and details offered reflected this lack of knowledge.

The letter to the client required in part 1 (b) was generally written quite well although few candidates realised there would not be a massive cost saving in introducing roof trusses and a flat ceiling, although the roof void space created could be put to storage or plant usage. The design of the link section did not prove difficult for most candidates. The need to ensure lateral stability via portan action or using the roof as a sheer diaphragm between the meeting hall and building was generally appreciated, as was the need to introduce a vertical separation movement joint at one or both ends. The construction sequence was not dealt with seriously by many candidates, indicating a lack of knowledge or lack of time. In spite of the problems noted above, the question on the whole proved popular and was tackled with more success than usual.

Question 7

This year's offshore question related to an offshore bridge 100m in length with a monorail at the top and a walkway with servicing pipes to be incorporated. The question was relatively straightforward and was a fair test of candidates' structural engineering competence. However, few made a reasonable attempt at the question.

A number of candidates did not read the question properly and did not follow the dimensional constraints given. Most of these candidates effectively failed themselves for not answering the question. The conceptual design part of the question was generally answered poorly. Candidates could often show two schemes but found difficulties in setting down in clear English an appraisal of the schemes. Candidates were expected to cover the following aspects:

- the function of the framing scheme
- the detail of load transfer of the framing scheme
- the stability and serviceability of the framing scheme
- the method of load out and installation.

Candidates assumed that a description of the alternatives with sketches was adequate, whereas structural competence needed to be demonstrated in this section.

In part 1 (b), candidates were expected to cover design changes, schedule and cost of implications and practicality and serviceability. Few candidates considered these points effectively. The calculations were often tackled in a haphazard way without clear assumptions, subheadings and conclusions. The majority of the candidates did not consider:

- deflection (span-to-depth ratios) or
 - loading (load combinations) adequately.
- The drawing part was generally attempted reasonably well, although work in other sections was reflected in poor layout or member sizing. The marking examiners frequently noted that:
- calculations and drawings did not conform, and that the
 - walkway clearance/headroom was inadequate.

The sketched details were of a very poor standard, often being totally impractical.

Those candidates who tackled the method statement did it reasonably well but few candidates considered inspection in the fabrication yard or the frequency of inspection they recommended. An overall impression of the scripts was that the majority of candidates have insufficient engineering experience to make a reasonable attempt at the paper. One script was so bad that the marking examiner requested the Institution to discuss the matter with his sponsors.

Introduction (Associate-Membership)

The 1990 Associate-Membership examination was more than satisfactory, producing an overall pass-rate of 76.5%. The number of candidates who sat this year was 119, a welcome increase over the 95 entrants last year and the 101 for 1988. This increase in numbers occurs solely with UK candidates; this year's overseas candidates were down to 11 compared with 13 last year. The most popular question was the concrete question attempted by 56 candidates, with 39 achiev-

ing a pass. The steel question was attempted by 49 candidates, with 43 achieving a pass. Somewhat disappointingly, only 14 candidates attempted the general question, with nine achieving a pass. No overseas candidates attempted the general question, and the pass-rate was lower than expected.

As in previous years, candidates performed better in part 'A' than in part 'B'. Of the number of candidates failing to reach a satisfactory standard (28 candidates), 12 failed in both part 'A' and 'B' and the chief examiners commented that it was evident from the scripts that these candidates were not properly prepared for the examination.

The encouraging observation drawn from this year's scripts by the chief examiners was the marked improvement in the standard of detailing. Four candidates obtained over 80% in both parts 'A' and 'B' and one of these was awarded the Denis Matthews Prize for his efforts.

The Associate-Membership examination continues to run successfully from year to year, often producing overall pass-rates in the 65-75% range. It is hoped that the number of entrants will increase, especially overseas, as the examination continues to prove to be a good test of competence for anyone seeking Associate-Membership status in this Institution.

Question 1 (structural steelwork)

The question related to an entrance canopy for a hospital building. The self-supporting two-part canopy had a horizontal flat portion and a separate pitched area. In part 'A' candidates were asked to prepare a general arrangement drawing, design all main roof members to both the flat and the pitched areas, design supporting columns ensuring structural stability, and to detail various joints and connections.

Part 'B' was concerned with the construction work for the roof timbers and concrete foundations, together with a method of erection. The candidates were also questioned about a programme of work and alternative systems for prevention of corrosion.

The overall design and detailing work submitted for this question was of a reasonable standard. Weaknesses were evident, however, in part 'B' especially as regards the programme of work and the times involved for site operations.

Question 2 (structural concrete)

The question concerned a self-supporting reinforced concrete mezzanine floor that was to be constructed inside an existing warehouse.

Part 'A' required candidates to obtain floor and beam loadings, design the floor slab, supporting beams, columns and foundations. The candidates were also asked to produce sketches, together with general arrangement and detail drawings. As with the steelwork question, the design and detailing work submitted in part 'A' was generally of a good standard.

Part 'B' included programming, in bar chart form, written specification for the concrete construction, falsework and formwork details and a written statement on construction. In part 'B', two areas caused problems

for all candidates, the programme of work and the written statement on construction. Those candidates who failed exhibited a complete lack of understanding of sitework.

Question 3 (general construction)

The question concerned an existing open-air swimming pool and adjacent changing-rooms. The pool area was to be covered using plywood supported by RHS columns.

Part 'A' required candidates to prepare plans and elevations, design timber roof members, supporting columns and block walls.

Part 'B' related to foundations for both the steel columns and the block walls, underpinning of existing changing-rooms and programming for the works.

Both parts of this question were poorly answered by all candidates, and the standard of work presented by those who passed was considerably lower than that of candidates answering questions 1 or 2. Those who failed to complete this question did not indicate that they would have passed had they had more time.

In part 'A' the understanding of basic design of structural elements was very poor, especially concerning lateral restraint. In part 'B' many candidates exhibited a lack of knowledge concerning foundations and underpinning.

Associate-Membership oral examination

The Associate-Membership oral examination was attempted by two candidates in January and five in July this year, and all of them achieved a pass. This is very encouraging news for all mature students who have the appropriate qualification and are eligible to enter by this route.

