Answers

1. (a) This question gives scope for the candidates to outline what they know of planning guidance and procedure — if relates to the lectures by Sillery and to a lesser extent Guthrie. Mention would be made of government planning guidance, regional and district structure plans, application for outline and detailed planning permission, public consultation, appeals etc.

The Combs strategy must be long-term, to influence consideration of district plans, zoning for development, need for housing / new villages etc — before putting in application for planning approval — to try to "soften up" the local population and planning authorities. The actual plan would need to consider impact on traffic, wild life, agriculture etc — and might need improvements to transport, drainage and flood defence (in low-lying Combs) as well as architecture, landscaping etc [all needing engineering design, and perhaps covered by a Section 106 agreement]. [50]

(b) Response here could cite the Centre for Molec. Science in Cambridge (site visit during course) and/or the new Arsenal football stadium. In Cambridge, for CMS, could mention the split into seperate pavilions, to preserve sight

1 (cont'd)
lines and reflect scale of adjacent houses; the 'sinking' of the whole site by one storey to meet concerns about scale relative to adjacent houses [more expense: engineering of basement: concerns over excavation/long movement]; the "green roof" to preserve 50% green space; special arrangements to prevent light pollution etc. etc.

[50%]

2. This question gives scope for outlining and discussing the talks on design given by Liddell. Stages:
- preliminary conception (very early on) with "hand" engg. calculations, rule-of-thumb for member sizes, costs based on historical rates/m^2 for similar construction etc.
- scheme design (for planning permission): prelim. computer calculations for the harder/innovative aspects, some refinement of costings based on thoughts about how construction done etc.
- detail design (e.g. for tender documents, or negotiations on costs for first stage of a 2-stage tender): full studies of the special situations, and typical details; advice from QS on costings
- drawings and spec. (e.g. for traditional tender, or as result of a design-and-build contract) full design to Codes in every detail (except any left to specialist sub-contractors); full list of quantities and bill - building method + preliminaries

2 (cont'd)

Difficulties — keeping various parts / engineering disciplines together, so that they all contribute to the scheme as a whole. Need regular meetings, and arrangements to get all the specialists "buy-in" to overall decisions, see how they fit in, and perhaps accept non-optimal design in their own area, in interests of overall scheme (e.g. steelwork sub-contractor on Arsenal football stadium).

Buildability — partly depends on experience of designers themselves (training, varied sites / jobs); also, possibly bring in main contractor early [via design-and-build contracts, or 2-stage procurement e.g. NEC]; or appoint preferred specialist sub-contractor [steelwork, Arsenal] to interact with designers on erection schemes, planning, details etc.

Illustrations from outside Cambridge (to rule out working about CMS again) could come from millenium dome, glass bubble museum building in Osaka (Lecture by da Silva) & Arsenal football stadium (Westbury / Miller). Note that the Osaka bubble took long time, special problems on building physics (solar gain), layout of members, and on tsunami — not clear how it really fitted into the standard design sequence.

[100]

Q3. 7/1/03

This question gives scope for drawing together the various treatments of procurement and forms of contract which were given during the course e.g. by Liddell, Clarke and Westbury.

Current environment : traditionally a rather adversarial industry, criticised for performance on price and quality — now a move to promote "partnering" following Latham and Egan reports : better teamwork : contractor(s) "on board" earlier ; different forms of contract. Recent developments EU rules for public sector clients, competition from outside UK ; PFI and PPP often mean contractors have to design and maintain buildings as well as build them, leading to long perspective, more emphasis on reducing maintenance costs etc. Private clients not bound by EU, so 2 different environments. Choice : integrated or separate teams for design

Forms of contract :

① Traditional tender by contractor, to design produced by others i.e. separate teams
Advs: price certainty (? but claims for any changes wealth) — well known. (OK for one-off jobs, etc)
Disadv: — adversarial. Emphasis on price not quality

② trad : design and build : first design team prepares brief only, contractor (with integrated team) does whole of detailed design Advs: — simpler for client "one stop shop", buildability
Disadv: — design function downgraded somewhat

③ trad: <u>management contracting</u>: design team design, while contractor appointed for fee, to control package sub-contractors acting for him

Adv: sometimes thought to help by bringing managing contractor on board early, but without design responsibility.

variant: <u>construction management</u>: where sub-contractors are employed directly by client. JCT/ICE forms for each.

④ new: 2-stage, develop and construct: e.g. NEC
design team 'gets on for ride' as scheme design
- then main contractor appointed, fee, quality, experience
either (a) works alongside design team, towards new sub-contracts
or (b) design-and-build from then on.

Adv: — early involvement contractor, better practical design
— less risk of complaint once it late information
— less adversarial
— possibly can overlap design and construction somewhat

Disadv: — cost certainty (? but fewer claims).

<u>Choice of route</u>: estimated risks to programme and cost: risk of late information from design team; likelihood of design changes; need for speed of construction; complexity of design; need for monitoring of contract by design team etc.

<u>Illustrations</u> CMS: first phase trad. tender: second phase, 2 stage but using trad. JCT contract (the Alpine): third phase, 2 stage using NEC; main contractor (Laing) on board early, to give advice on buildability, overall design and programme etc.

<u>Abroad</u>: different conditions, fewer main contractors with expertise, need for single-point responsibility, and cost certainty, familiarity of local contractors with different/new forms of contract may be limited. (b) see later

Q4. This question refers to the lectures by Clarke and Craddock, on CDM, risk assessment, risk management etc.

(a) HASWA 1974/99: does away with special Acts for particular jobs or premises, in favour of law applying to all workplaces all the time. Expresses all involved to have responsibility for own and others H+S: safe workplaces, practices, handling, experienced and competent staff, adequate resources and training. Prescribes risk assessment for all potentially hazardous situations, with steps then taken to reduce or if possible eliminate these risks.

(b) CDM 1994/2001: under HASWA, application to construction industry, and in particular designers — who also have responsibility to do risk assessment of their design as it develops, and apply control measures to reduce/eliminate design risks. "Designer" include anyone who makes decisions about what should be done on site — not only trad. design team of architects and engineers, but also contractors (for temporary works etc), specialist sub-contractors, possibly QS's (if estimates they make imply decisions e.g. about materials used). In assessing construction risks emanating from design, designers need consider only things not likely to be foreseen by an experienced contractor. "Design risks" with implications for health and safety might include alteration to brief/

standards, inadequate design, poor co-ordination within team, innovative engineering / materials (beyond the 'experienced contractor')

Planning supervisor is professional, appointed at a fee, to check that risk assessments have been done, results on safety plan in existence, generally keep documents on safety etc.

(b). Risks often assessed simply on scale 1 → 5 for frequency (5 pretty likely), 1–5 for severity of consequence (5 catastrophic, adds from or 1 year + several public deaths, 1 negligible) — multiple is then taken as ranking of risk. Assessment form or register would include one line for each risk, assessment before control measures, suggested control measures, assessment after. Consider risk to safety, programme and cost.

Next steps: control measures? If risk still high afterwards, decide what to do — transfer (insure), redesign to reduce further, share and control. Decide who 'owns' that risk, and is responsible for implementing and monitoring the control measures.

Professionals: would mainly cover risks arising from, or related to, their own activities — QS not interested in engineers' design risks. But designers might need to consider risks to entire project, as a result of their decisions. Brainstorming sessions could be held.

Q5.

(a) This refers to the lecture by Guthrie.

1985 European directive on environmental impact assessment, implemented by Town and Country Planning Act of 1987 - wide range of projects covered in Annexes, but essentially covers all major construction, infrastructure or industrial projects.

EIA describes project in non-technical terms; assesses impacts (compared with not doing the scheme, not just compared with present day), considers alternatives, proposes mitigation. Aim to deliver projects Not Environmentally Worse Than (NEWT) - consider several time horizons, subject to public scrutiny.

Areas: noise, air quality, water quality, landscape, heritage, ecology, agriculture, impacts during construction (lorries, dust) as well as traffic.

Engineers: contribute by putting numbers to all this, especially to what is likely to happen after their scheme has been constructed. How much noise is in fact generated, and where distributed - by measurement, calculation etc. What effect on river etc. will there be by building, affecting run-off, influence of balancing ponds etc.

50% Examples: ems traffic: runaway extension at Liverpool airport etc.

(b) Sub-contracting : this refers to the talk by Peter Miller on specialist steelwork, and some aspects of the visit to CMS Cambridge.

Main contractors do not always have expertise right across board — so may need to bring in specialist sub-contractors (e.g. who put up just the steel frame for a building) who does just that and goes away. Or there may be a need for a special piece of kit (e.g. specially cast pin-joints for the green roof at CMS) from a supply-only sub-con. Or, rather than apply labour direct, and have problem of keeping them occupied at all times, the main contractor may use domestic sub-contractors to come in and do fairly ordinary work (carpentry, say) only when needed. So, planning and supply drives towards sub-contracting — and some advantages (tax) for domestic sub-con also — hence prevalence (but some problems e.g. responsibility for safety — as employer).

Expertise by appointing a preferred specialist early (as done with Watsons for steel at Arsenal), consult over detailed design / get input on programme (Watsons thought of several erection schemes — chose one best suited to overall scheme not just their own narrow purposes.

Control : by main contractor, programmes, supervision etc.

(c) "Risk management" — refers to the talk by Craddock, and also to earlier mention in the lectures on procurement.

Essentially the concept involves assessing (by brainstorming?) all the different ways in which a project can go wrong — not just from the Health and Safety view but also to the project more generally. Examples: unexpected site conditions, changes of law/standards part way through, the client changes mind on some aspect(s) of the job, the design team is late with information so the contractor is held up, specialist labour is suddenly difficult to obtain etc.

To manage, need to identify all these risks, decide who bears the cost, decide on mitigation/control measures, decide whether to insure: Avoid, Transfer, Reduce, Control. This is "risk management" — with risk assessments, registers, safety and contingency plans etc.

Different contracts allocate risks differently. E.g. in traditional tender, contractor takes risk of unexpected site conditions / weather etc (but may have a claim if exceptional). In design-and-build, the client has no risk of claims for late information, because design team and contractor are same organisation etc.

SY

(d) Insurance : Notes refer to the final two lectures, by Lord and Craddock.

Contractor's all risks is the policy type normally taken out (often required by contract itself) by contractors — against loss or damage by any risk not expressly included. Covering client, finance lenders, contractors, sub-contractors — and sometimes supplier & professionals for site activities. Risks covered typically fire, theft, accident on site etc. — anything which might cause damage to the Building / project. Lasts duration.

Professional indemnity — insures a professional (engineer, architect) against liability to meet financial consequences of any professional negligence or breach of duty — including covering costs of any legal action. Usually has a limit of indemnity (depending on business size) and covers claims notified during the period of insurance (maybe arising from many years back). Important for client to know that the prof. has insurance — and gives peace of mind to prof. himself. Essentially a business requirement.

Recent case : employer/insurer could not sue the contractor or subbies (although they had largely caused fire) because they were insured under CAR and so not liable to pay the insurer. But consulting engineer were not

insured under the CAR, but instead under a PII with a limit. So they could be sued although only slightly to blame — and anyone even slightly to blame is liable for whole cost. (and can normally sue others to blame, for appropriate contribution to cost — but could not in this case because parties not liable at all cannot be sued for contribution).
Remedy — negotiate to be insured under CAR (but Lord not keen on this, wrong sort of insurance) or try to extend PII cover to deal with this case too.

Q3(b) on contracts to permit parallel design and construction.

Must bring main contractor in early: (a) design-and-build, where client's team merely sets the main parameters, allowing D+B team to get on; (b) 2-stage, develop-and-construct: mentioned above. Pitfalls are, how to commence construction if design not finished? — must have confidence that detailing of e.g. structure will not require modification to foundations which are already under construction. Confidence may be misplaced.

[20%]

CM 2.1.11