DR A AL-TABBAA

TRIPOS IIB/IIA 2011
4D16 CONSTRUCTION AND MANAGEMENT 2011

1 (a) Stages should include Brief, Concept, Schematic, Design development, Construction documentation.
Brief, a written description of the clients requirement. Would also include info on site and siteing, access points, restrictions on planning.
Concept design; verbal descriptions, sketches, drawings and renderings, physical models
Schematic design, outline drawings of the whole project, basic calculations, models. At this stage the project could be handed over to a D&B contractor or to a specialist subcontractor in which case the engineer may change.
Design Development, final computer analysis of the structure, 3D CAD models of the whole project, integration of the building services installations.
Construction Documentation, Shop drawings, data files for component fabrication. [35%]

(b) The main parties would include the client, possibly represented by the project manager, architect, structural and building services engineers. The usual criteria would be functionality vs requirements, cost/budget, construction period, design quality, inspection and maintenance. [30%]

(c) The impact of good or bad design decisions will emerge later in the design process. Bad decisions will cause back-tracking of design work or at the construction stage will result in tenders being over budget which will cause redesign and retendering causing delays and on-going difficulties in controlling costs.
The engineer can assist decision making by being realistic about technical difficulties. The aim should be to be confident about the ability to avoid ongoing pitfalls. One also wants the design to be efficient, elegant, iconic, etc and this may lead to innovations which one wants but not at excessive expense. [35%]

Examiner's comment:

A question on integrated design: main design stages, main parties in the decision process and the role of the engineer. One of the two less popular questions and with the lowest average mark. Many of the answers contained a lot of waffle and not much substance.

2(a)

1. Reduced construction periods: Steel frames are much faster, 50% or more, leading to reduced preliminary costs, quicker return on investment and less interest payment.
2. Steel frames can achieve longer spans, hence office floors can achieve up to 18m spans, reduced area lost due to internal columns, produces better quality spaces, long spans provide flexibility for future change of use.
3. Steel frames are lighter than concrete: they are around 40% lighter than equivalent reinforced concrete, reduced foundations at 70% less concrete, hence saves time and cost in groundworks.
4. Ability to integrate services into structural zone:
5. Steel columns take up less space: [30%]

(b) Brings first hand experience and expertise.
Actual construction method is developed along side the design.
The design can be tailored to suit the latest manufacturing technology and practices.
Use of latest market intelligence regarding cost and availability of materials and sections.
The design can be done once and right the first time.
Contractor will have a much greater degree of cost certainty.
Less chance of programme overruns.
Client has a much better chance of getting his job on time and on budget. [30%]

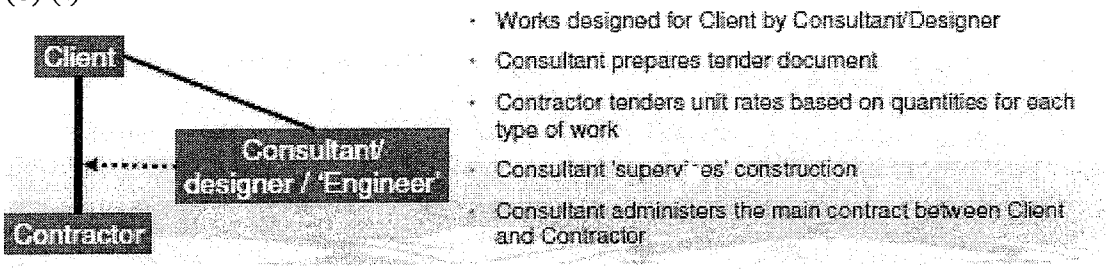
(c) In complex structures, design is influenced by: fabrication process, construction method, sequence, and temporary works. Design team needs input from contractor, but there is no design to tender and make selection, so use two stage procurement.
Complex structural steelwork requires specialist contractors who need to be involved at an early stage in the project. Added value of specialist contractors include: Experience, Knowledge of current market conditions, Engineering expertise, Construction ability and innovation, Service, Proposed team. Contribution of specialist contractor: reduce out-turn costs, simplify construction, reduce programme, reduce design time and help to build correctly, first time!
Benefits of early contractor involvement: Brings first hand experience and expertise, actually construction method developed along side the design, design can be tailored to suite the latest manufacturing technology and practices, use of latest market intelligence regarding cost and availability of materials, design can be done once and correctly, contractor will have greater degree of cost certainty, less chance of programme overrun. Client has much better chance of getting his job done on time and on budget. [40%]

Examiner's comment:

A question on structural steel work construction: benefits, early contractor involvement and relevance to either Arsenal Emirates Stadium or East London Olympics stadium. The least answered question but with generally good performance. Mark reductions were mainly due to partially completed answers. Good answers on the stadia part.

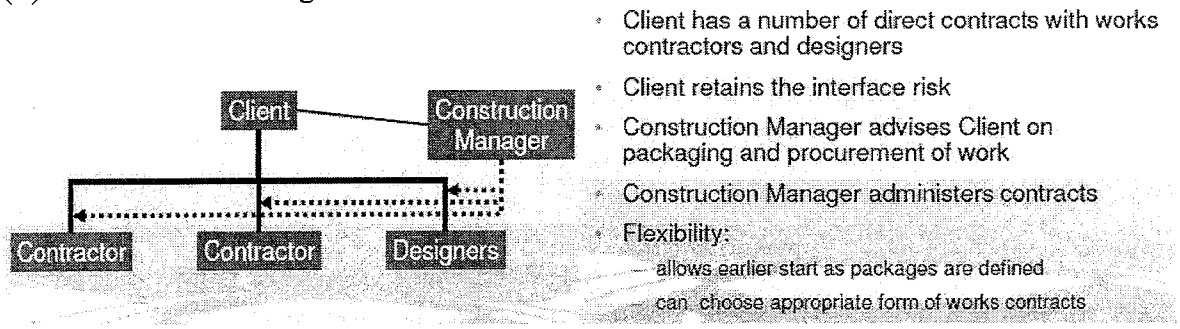
3 (a) In terms of energy challenges there are three common issues: supply reliability, energy prices and environmental acceptability.
Utility customers focus on cost and risk: Plant capital cost – as low as possible, regulatory risk – will they get all approvals to build and operate, construction risk – delays are very expensive, operational risks – shutdowns are very expensive, revenue risk – driven by fossil fuel and carbon prices and political risk.
Customers want: Improved designs, but no new as it needs to have been tested. Latest technology but needs to be already proven, inspective but not done 'on the cheap', create UK jobs but use the global best practice, quick delivery but not a rushed job and standardised but the best one can get.
There is always tension between: design to secure a regulatory licence, design for low capital cost, design for ease and speed of construction and design for ease of maintenance. Also design for high power output, design for reliable operation and aided/hindered by use of the latest technology.
Significant challenges in the design of the reactor. A single reactor would generate enough electricity to power around 2 million UK homes. Hence safety, reliability, affordability and with minimal CO_2 emissions is the target. The key features of the reactor are: standardisation, passive safety and modular design and construction.
Public opinion. [40%]

(b) (i) Traditional



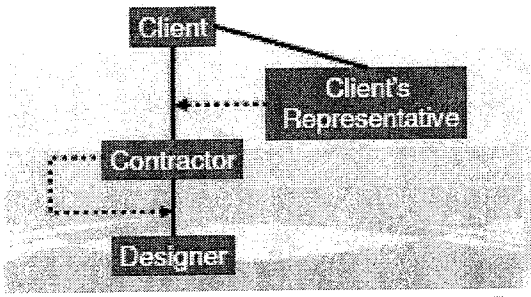
Client enters into separate contracts with design team and contractor.
Most design work is completed by the design team prior to appointment of the contractor
Success is reliant on quality and completeness of tender documents. [20%]

(ii) Construction management



The project is packaged into discrete elements/trade contracts.
Employer enters into direct contracts with the trade contractors.
Construction manager is a member of the professional team. [20%]

(iii) Design and build



- Clients sets his:
  - Employer's requirements and
  - constraints on how Contractor meets these requirements
- Contractor uses his own designer
  - own ('in-house') designers or
  - a consultant

- Design/construction interface risk is carried by the Contractor
- Better certainty of outturn price (can be target or lump sum)
- Specification of required performance - leave scope for Designer/Contractor innovation
- Better consideration of 'buildability'
- Can sometimes get Contractor to guarantee operational costs based on performance tests

- Need to be able to write good performance specification
- Risk transfer to Contractor raises price
- Generally less flexibility for Client after award of contract
- Control of finished product may be more difficult

Client specified the project requirement – 'employers requirements'
Contractor provides contractor proposals
Contractor takes full responsibility for design and construction
Design team can be 'novated' to reduce client risk. [20%]

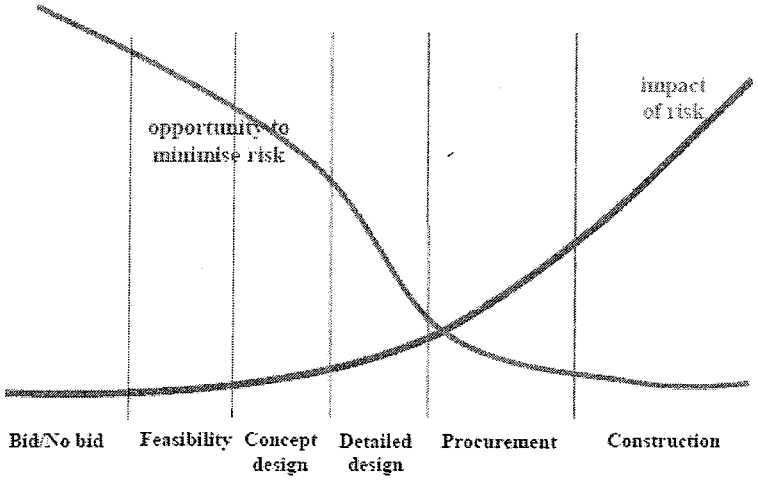
Examiner's comment:

A question in two parts: the first is on challenges of the design and construction of nuclear power plants in the UK and the second is on contracts: compare and contrast of three forms. A popular question and answered well. Generally OK performance, with better performance in the second part of the question.

4 (a)

Procurement	Project Specific	Client Specific	Environment	External Influences
Complexity of contract	Design complexity	Inadequacy of business case	Public relations	Political
Late contractor involvement in design	Environmental impact	Funding availability	Permits/ consents/ approvals	Legislation
Dispute and claims				Technology
Supply chain failure				

(b)



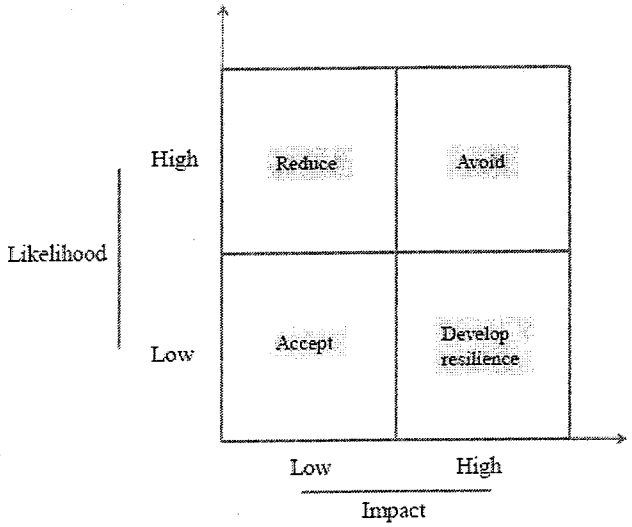
(c) A risk register is a record of risks for each project giving us a unique ID and includes details such as risk owner, risk status, risk description, cause and consequences, start and expiry dates, % liklehood and a 3 point estimate of impact, risk/opportunity and mitigation strategy and action owner.

A risk register is a tool commonly used in project planning and organisational risk assessments. It is often referred to as a Risk Log. It is widely used within Risk Management for identifying, analysing and managing risks. In this context a project risk is essentially an uncertain event that, should it occur, will have an impact on the project (this could be positive or negative). It contains the information on the identified and collected project risks that the project team identifies when estimating and adjusting the activity durations for risks. A wide range of contents for a risk register exist and recommendations are made by the Project Management Institute. In addition many companies provide software tools that act as risk registers. Typically a risk register contains:

- A description of the risk
- The impact should this event actually occur
- The probability of its occurrence
- Risk score is multiplication of Probablity and Impact
- A summary of the planned response should the event occur
- A summary of the mitigation (the actions taken in advance to reduce the probability and/or impact of the event)
- The risks are often given a ranking with the highest priority risks clearly identified to all involved.

(d) Risk is evaluated both qualitatively or quantitatively. Common risk measures inclue time, cost and environment which are usually evaluated quantitatively while aspects such as safety, quality, relationships, reputation and job satisfaction do not lend themselves to quantitative evaluation and are hence evaluated qualitatively. Qualitative evaluation involves an assessment of the probability of occurrence and impact on the project. Unsually involved 1, 2 or 3 point estimates,

(e) Responding to risk: reducing risk is usually done for high likelihood, low impact risk.
Does every risk require mitigation? Prioritisation (20/80), Cost-benefit ratio.
What about residual risk? What about secondary risk?
Business continuity planning
Risk monitoring.



Monitoring risk

- Top 10 risks and opportunities (by EMV)
- Realized and expired risks
- Emerging risks (amplification of weak signals)
- Project Exposure (aggregate view of all risk exposures)
- Progress and impact of mitigation actions (post mitigation exposures)
- Cost of risk/ risk burden (cost of exposure, realized risk and mitigation)
- Risk profile (and relationship with management's risk tolerance)

Examiner's comment:

A question on various aspect of risk managements in construction. The most popular question and generally answered ok, again with mark reduction being mainly for incomplete answers; many answers were too brief.

5 (a) Insurance clause 1: *"[The Insurer] will indemnify [the Insured] in respect of any loss arising from any claim for any legal liability or alleged legal liability arising out of the conduct of the Business first made against the Insured and notified to the Insurer during the period of insurance which may be made against you and which is notified to us during the period of insurance... [subject to a Limit of Indemnity]"*

A Insured

1 Covers the engineer not the client or the claimant. Cover is for the benefit of the engineer not the engineer's client

2 The limited company or the partnership (including former partners) or individual employees

B Legal Liability

1 Not moral or commercial liability

2 Legal liability either by breach of contract, in tort (e.g. negligence) or breach of statute

3 Can be extended to Worldwide if necessary

4 Includes defence of criminal proceedings arising in connection with breach of professional duties (insurance clause 6) because often a criminal prosecution is precursor to a civil liability

C Limit of Indemnity

Cover is subject to LOI – your 'sum insured' - the maximum amount insurers will pay in damages.
Minimum £250k - up to £100m plus - norm is £2m to £5m
LOI is normally each and every claim
Defence costs are usually in addition to LOI - defending a claim can be very expensive (even when you win you don't recover everything)

(b) 1 Maintain your cover - You cannot abandon your PII cover once your involvement in a project is complete - a claim may not arise until sometime after a project has been completed maybe up to fifteen years later.

2 Maintain your Limit of Indemnity - If you are required to have a large LOI then you will need to maintain it for several years after the completion of the project.

3 Requirement to notify circumstances which might give rise to a claim - All PI policies have similar clauses requiring prompt notification to enable insurers to control the handling of the claim and to prevent insured from prejudicing their position by, for example, conceding liability.

(c) Majority of claims are for breach of contract (either express or implied)

- Design errors
  - underestimating depths of foundations
  - misinterpreting site investigation reports
  - ignoring British Standards
- Drawing errors
- Over–design
- Acting out of experience
- Going beyond your brief
- Surveys
  - ignoring warning signs e.g. subsidence
  - failing to warn
  - going beyond brief
- Budget problems – underestimating project costs, cost overruns and cost reporting
- Delays in design information, delays in responding to RFI causing delays on site
- Inspection/Supervision - normal apportionment is 75% to the contractor and 25% to the engineer
- Fee recovery disputes

(d) **Admission** - probably with independent corroboration of liability and quantum
Mediation - a quasi-judicial form of negotiation – a mediator acts as a facilitator
Adjudication - a recent statutory right granted under Housing Grants Construction and Regeneration Act. Fast-track rough justice primarily intended for fee recovery disputes however it can be used for any contract dispute. It is generally accepted that many PII claims are too complex for adjudication
Arbitration - where a requirement in the contract then either party can insist upon its use but not very popular – whilst confidential it is expensive. Good for international disputes
Litigation - rare that a claim actually gets to court – less than 1% - because the process of preparing for trial means that true liability can be determined at an earlier stage. Trials are very expensive and public. If it does end up in court it is either because there is a good defence worth running or a principle that needs to be tested. Thus PI insurers are the driving force behind the legal evolution of the profession

(e) Practical implications of PII for Engineers

- Treat it seriously – PII is expensive therefore give it due priority
- Check your cover
  - do I have cover in place?
  - is the LOI sufficient?
  - all firms covered, subsidiaries, JV's?
  - overseas projects?
- Keep your cover confidential - don't brag about your LOI
- Check insurances of your sub-consultants

Risk Management - Steps taken to prevent the incidence of claims and to minimise or reduce their cost

1 Don't make mistakes – checking designs, training engineers, supervision
2 Document control
3 Do we want this client?
4 What is the client expecting?
5 Can we do this job?

6 Contracts and Agreements
  - Does it reflect what you intend to do?
  - limit your liability to a sum within your LOI
  - Is there a fair dispute resolution clause?
  - Avoid fitness for purpose warranties
  - Don't create contractual obligations to more parties than necessary
  - Avoid Indemnities
  - Restrict length of time you owe a liability (ideally no more than 6 years)

- Notify claims promptly

Examiner's comment:

A question on five aspects of professional indemnity insurance. A very popular questions and generally answered well. The low marks were due to students only answering only some of the question parts.