

UNIVERSITY OF BOLTON

**FACULTY OF ADVANCED ENGINEERING AND
SCIENCES**

**BSc(HONS) IN QUANTITY SURVEYING &
COMMERCIAL MANAGEMENT**

SEMESTER ONE EXAMINATION 2011/2012

CONSTRUCTION PROJECT ECONOMICS

MODULE NO: BLT2006

Date: Friday 20 January 2012

Time: 10.00 am – 12.00 noon

INSTRUCTIONS TO CANDIDATES:

This paper contains **FOUR** questions.

Answer **QUESTION ONE** and **ANY
OTHER TWO** questions.

ALL questions carry equal marks.

Marks for parts of questions are shown
in brackets.

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Scenario

The University of Redland based exclusively in Milton Keynes has recently engaged your practice to act as cost consultants for the development of a new teaching facility at its city centre campus.

The scheme includes the construction of a new teaching facility, which will house the School of the Natural and Built Environment. The new building will provide the university with 6,500m² of highly flexible and purpose built teaching space and 800m² of state of the art research laboratories.

University of Redland wish to commence teaching in the new facility from the 2014/15 academic year, to facilitate this, the project manager has suggested a two year build period will be required, therefore he advises that tenders should be invited in mid February 2012 with a six week tender period.

Questions

1. The project's architect has provided two initial sketch designs for the client to consider, whilst both meet the employer brief, the two designs vary considerably. The first design proposes a simple rectilinear building, constructed over three storeys, with laboratories at the ground floor. Whereas the second, more complex four-storey design, includes the provision of a central atrium open to the floors above and covered with a glass roof providing social learning space and cafeteria for the university's students on the ground floor.

Advise the design team of the economics of the design.

20 Marks

Please turn the page

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2. Your employer (University of Redland) has asked your practice to provide an initial appraisal of the development costs for the scheme.

From an initial search of your cost databases, the following data has emerged:

Mean	Median	Range	Standard Deviation	Sample
1681	1743	353 - 2571	503	39

Notes:

Price per M2 gross internal floor area for the building, excluding external works and contingencies and with preliminaries apportioned by cost. Rebased to a Tender price Index of 230 (1st Quarter 2012 (Forecast: 230)) and adjusted using a location index of 95 (Milton Keynes (Index 95, Sample 146))

- a) Using the above data and assuming a 95% confidence interval compute the budgetary limit for the project.
 (8 Marks)
- b) Explain the use of confidence intervals in this context.
 (12 Marks)

Total 20 Marks

3. The employer has decided to commission the second scheme. Looking at the potential structural solution for the design the structural engineer has suggested a steel framed solution may provide a more economical alternative to in-situ concrete.

Using the tables in appendix one and the BICS cost data in appendix two of this examination paper; appraise the relative **economic merits** of using a steel frame.

20 Marks

4. Your practice will shortly be issuing formal cost plan one to the University of Redland. Due to the client's inexperience, your Senior Quantity Surveyor feels a letter of explanation should accompany the document.

Draft a suitable letter, explaining in basic terms, the purpose of the elemental cost plan and how it fits into the wider context of design cost control.

20 Marks

END OF QUESTIONS

Please turn the page

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Appendix One

Tender Price Indices Data:

2006

Date	Index	Sample	On Year	On Quarter
1Q2006	228	76	3.2 %	0.9 %
2Q2006	231	85	1.3 %	1.3 %
3Q2006	228	75	3.2 %	-1.3 %
4Q2006	232	61	2.7 %	1.8 %

2010

Date	Index	Sample	On Year	On Quarter
1Q2010	209	63	-6.3 %	-1.4 %
2Q2010	218	45	0.9 %	4.3 %
3Q2010	219	42	1.4 %	0.5 %
4Q2010	220	46	3.8 %	0.5 %

2012

Date	Index	Sample	On Year	On Quarter
1Q2012	230	Forecast	2.7 %	0.4 %
2Q2012	231	Forecast	2.2 %	0.4 %
3Q2012	232	Forecast	2.2 %	0.4 %
4Q2012	235	Forecast	2.6 %	1.3 %

Location Data

Location	Index	90% Confidence Interval	Standard Deviation	Range	Sample
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Milton Keynes	102	101-104	10	86-134	85
Nottingham	95	93-98	12	75-132	64
Waveney	102	97-107	11	83-124	17

Appendix Two

BCIS *Online* - Elemental analysis number 26712

B - 4 - 8,224

Building Function :	722. - Colleges		
Type of Work :	New build		
Gross Floor Area :	8,224 m ²		
Job Title :	6th Form College, Lowestoft		
Location :	Lowestoft, Suffolk		
District :	Waveney		
Grid Reference :	TM5393		
Dates :	Receipt : Feb-2010 Base : Feb-2010		
Project Details :	4 storey 6th form college together with external works including landscaping, tree surgery, block paving, walls, services, drainage, cycle shelter, signage, alterations to lambing barn and demolitions.		
Client :	Suffolk County Council		
Contract :	JCT design and build contract 2005 edition		
Contract Period (mths) :	Stipulated : - Offered : - Agreed : 16		
Cost Fluctuations :	Fixed		
Tender List :	£ 18,003,644 -		
	Contract Breakdown		
Measured Work	£ 15,551,962		
Provisional Sums	£ 329,945		
Prime Cost Sums	£ 0		
Preliminaries	£ 1,323,536		
Contingencies	£ 563,603		
Contractor Design Fees	£ 234,598		
Contract Sum	£ 18,003,644		
Accommodation and Design Features :	4 storey 6th form college. Piling. Concrete foundations and slab. RC frame, upper floors, stairs. Walls with cladding, curtain walling and windows. Aluminium clad steel flat roof. Brise Soleil. Undefined partitions, doors, wall finishes; folding door. Tile, soft, sprung timber and access flooring; suspended ceilings. Fittings. Sanitaryware. Gas HW central heating, ventilation, electric light/power. Lift. Fire alarm. External works, services, drainage, site lighting, alterations to lambing barn and demolitions.		
Basement	0 m ²	Area of External Walls	- m ²
Ground Floor	2,056 m ²	Wall to Floor Ratio	- %
Upper Floors	6,168 m ²	Average Storey Heights	
		Basement	- m

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Gross Floor Area	8,224 m ²	Ground	- m
		Upper	- m
Usable Area	- m ²		
Circulation Area	- m ²	Internal Cube	- m ³
Ancillary Area	- m ²		
Internal Divisions	- m ²	Spaces Not Enclosed	- m ²
Gross Floor Area	8,224 m ²	Number of Units	1
Stores as % of Gross Floor Area:			
		4 storeys	100.00%

Analysis

Element	Total Cost	Cost per m ²	Element Unit Quantity	Element Unit Rate	Percentage
1 Substructure	£ 186,890	£ 22.72			1 %
2A Frame (Costs include other elements)	£ 1,686,645	£ 205.09			9 %
2B Upper Floors	Included in element 2A				
2C Roof	£ 1,337,854	£ 162.68			8 %
2D Stairs	£ 260,501	£ 31.68			1 %
2E External Walls	£ 1,039,670	£ 126.42			6 %
2F External Windows and Doors	£ 988,469	£ 120.19			6 %
2G Internal Walls and Partitions (Costs include other elements)	£ 2,081,857	£ 253.14			12 %
2H Internal Doors	£ 41,079	£ 5.00			
2 Superstructure	£ 7,436,075	£ 904.19			42 %
3A Wall Finishes	£ 184,900	£ 22.48			1 %
3B Floor Finishes	£ 652,996	£ 79.40			4 %
3C Ceiling Finishes	Included in element 2G				
3 Finishes	£ 837,896	£ 101.88			5 %
4 Fittings and Furnishings	£ 2,000	£ 0.24			
5A Sanitary Appliances	Included in element 5F				
5B Services Equipment					
5C Disposal Installations	Included in element 5F				
5D Water Installations					
5E Heat Source					
5F Space Heating and Air Conditioning (Costs include other elements)	£ 3,927,907	£ 477.62			22 %
5G Ventilating Systems					
5H Electrical Installations	Included in element 5F				

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5I Fuel Installations				
5J Lift and Conveyor Installations	£ 78,593	£ 9.56		
5K Fire and Lightning Protection				
5L Communications and Security Installations				
5M Special Installations				
5N Builder's Work in Connection				
5O Management of the Commissioning of Services				
5 Services	£ 4,006,500	£ 487.17		23 %
Building Sub-total	£ 12,469,361	£ 1,516.22		70 %
6A Site Works (Costs include other elements)	£ 3,102,656	£ 377.27		17 %
6B Drainage	Included in element 6A			
6C External Services	£ 177,000	£ 21.52		1 %
6D Minor Building Works	£ 11,595	£ 1.41		
6E Demolition and Work Outside the Site	£ 121,295	£ 14.75		1 %
6 External Works	£ 3,412,546	£ 414.95		19 %
7 Preliminaries	£ 1,323,536	£ 160.94		7 %
8 Contingencies	£ 563,603	£ 68.53		3 %
Total (less Design Fees)	£ 17,769,046	£ 2,160.63		100 %
9 Design Fees	£ 234,598	£ 28.53		1 %
Total Contract sum	£ 18,003,644	£ 2,189.16		101 %

Specification

Element		Specification
1	Substructure	Undefined piling. Concrete pad foundations and bed.
2A	Frame	RC frame.
2B	Upper Floors	RC upper floors.
2C	Roof	Steel flat roof with Kalzip aluminium cladding.
2D	Stairs	RC stairs.
2E	External Walls	Brick, cladding.
2F	External Windows and Doors	Curtain walling, windows and doors. Brise Soleil.
2G	Internal Walls and Partitions	Undefined.
2H	Internal Doors	Undefined and folding doors.

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3A	Wall Finishes	Undefined.
3B	Floor Finishes	Soft, ceramic tile, sprung timber and raised access flooring.
3C	Ceiling Finishes	Suspended ceilings.
4	Fittings and Furnishings	Fittings.
5A	Sanitary Appliances	Sanitaryware.
5C	Disposal Installations	Soil and waste pipes.
5F	Space Heating and Air Conditioning	Gas HW central heating.
5G	Ventilating Systems	Mechanical ventilation.
5H	Electrical Installations	Electric light and power.
5J	Lift and Conveyor Installations	Lift.
5L	Communications and Security Installations	Fire alarm.
5N	Builder's Work in Connection	Builder's work in connection with services.
6A	Site Works	Site preparation. Making good grassed areas. Block paving, retaining walls.
6B	Drainage	Drainage.
6C	External Services	Services connections. Site lighting.
6D	Minor Building Works	Work to lambing barn.
6E	Demolition and Work Outside the Site	Demolitions.
7	Preliminaries	8.33% of remainder of Contract Sum (excluding Contingencies).
8	Contingencies	3.55% of remainder of Contract Sum (excluding Preliminaries).
9	Design Fees	1.32% of Contract Sum.

BCIS Online - Elemental analysis number 24303**B - 5 (3) - 10,366**

Building Function :	721. - Universities
Type of Work :	New build
Gross Floor Area :	10,366 m ²
Job Title :	Jubilee Campus Extension, University of Nottingham
Location :	Nottingham, Nottinghamshire
District :	Nottingham
Grid Reference :	SK5641
Dates :	Receipt : Nov-2006 Base : Nov-2006 Acceptance : Dec-2006 Possession : 8-Jan-2007
Project Details :	University campus extension comprising 3 blocks in 3 and 5 storey construction together with external works including macadam and stone paving, landscaping, services, drainage and site lighting.
Site Conditions :	Level brownfield site with good ground conditions. Excavation above water table. Unrestricted working space and access.
Market Conditions :	Good for contractors. Value engineered to contract sum. Excludes £521,957 design fees. Project tender price index: 267 on 1985 BCIS Index Base
Client :	Nottingham University

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Tender Documentation : Bill of Quantities			
Selection of Contractor : Design and build - competitive			
No of Tenders :	Issued : 3	Received : 3	
Contract : JCT design and build contract 2005 edition			
Contract Period (mths) : Stipulated : 18 Offered : 18 Agreed : 18			
Cost Fluctuations : Firm			
Basis of Analysis : Altered - see market conditions text			
Tender List :			
	£ 25,858,750	-	
	£ 26,804,220	3.7%	
	£ 27,348,481	5.8%	
Contract Breakdown			
Measured Work	£ 19,783,891		
Provisional Sums	£ 50,000		
Prime Cost Sums	£ 0		
Preliminaries	£ 2,461,817		
Contingencies	£ 213,250		
Contract Sum	£ 22,508,958		
Accommodation and Design Features : 3 university blocks. Piling. RC foundations, floors; RC and PCC stairs. RC and steel frame. Zinc, Rainscreen and curtain walling. Zinc clad steel pitched roof, RC flat with plastic; Sunpipes, windcatcher. Double glazed aluminium windows. Block, metal stud, glazed metal and cubicle partitions. Flush doors. Plasterboard, tiles to walls; vinyl, carpet, stone, access flooring; suspended ceilings. Fittings. Sanitaryware. Geothermal/heat pump LTHW heating, air conditioning, ventilation, electrics. Lift. Alarms, chilled water, fall arrest, BMS, data cabling.			
Basement	- m ²	Area of External Walls	- m ²
Ground Floor	- m ²	Wall to Floor Ratio	- %
Upper Floors	- m ²	Average Storey Heights	
		Basement	- m
Gross Floor Area	10,366 m ²	Ground	- m
		Upper	- m
Usable Area	- m ²	Internal Cube	- m ³
Circulation Area	- m ²	Spaces Not Enclosed	- m ²
Ancillary Area	- m ²		
Internal Divisions	- m ²		
Gross Floor Area	10,366 m ²	Number of Units	3

Analysis

Element	Total Cost	Cost per m ²	Element Unit Quantity	Element Unit Rate	Percentage
1 Substructure	£ 931,589	£ 89.87			4 %
2A Frame	£ 1,078,999	£ 104.09			5 %
2B Upper floors	£ 1,233,210	£ 118.97			5 %
2C Roof	£ 1,975,841	£ 190.61			9 %
2D Stairs	£ 368,336	£ 35.53			2 %

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2E External walls	£ 3,384,692	£ 326.52		15 %
2F Windows and external doors	£ 1,493,792	£ 144.10		7 %
2G Internal walls and partitions	£ 464,607	£ 44.82		2 %
2H Internal doors	£ 328,916	£ 31.73		1 %
2 Superstructure	£ 10,328,393	£ 996.37		46 %
3A Wall finishes	£ 302,695	£ 29.20		1 %
3B Floor finishes	£ 557,100	£ 53.74		2 %
3C Ceiling finishes	£ 186,301	£ 17.97		1 %
3 Internal finishes	£ 1,046,096	£ 100.92		5 %
4 Fittings	£ 277,150	£ 26.74		1 %
5A Sanitary appliances (Costs include other elements)	£ 49,368	£ 4.76		
5B Services equipment				
5C Disposal installations	Included in element 5A			
5D Water installations				
5E Heat source				
5F Space heating and air treatment	£ 3,734,648	£ 360.28		17 %
5G Ventilating systems				
5H Electrical installations	£ 1,527,057	£ 147.31		7 %
5I Gas installations				
5J Lift and conveyor installations	£ 165,250	£ 15.94		1 %
5K Protective installations				
5L Communications installations				
5M Special installations				
5N Builder's work in connection	£ 198,580	£ 19.16		1 %
5O Builder's profit and attendance				
5 Services	£ 5,674,903	£ 547.45		25 %
Building sub-total	£ 18,258,131	£ 1,761.35		81 %
6A Site works	£ 970,394	£ 93.61		4 %
6B Drainage	£ 359,859	£ 34.72		2 %
6C External services	£ 245,507	£ 23.68		1 %
6D Minor building works				
6 External works	£ 1,575,760	£ 152.01		7 %
7 Preliminaries	£ 2,461,817	£ 237.49		11 %
Total (less Contingencies)	£ 22,295,708	£ 2,150.85		99 %

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8 Contingencies	£ 213,250	£ 20.57		1 %
Contract sum	£ 22,508,958	£ 2,171.42		100 %

Specification

Element		Specification
1	Substructure	Piling. Concrete strip foundations and beds.
2A	Frame	Steel and concrete column and beam frame. Mixed construction frame.
2B	Upper floors	Concrete upper floors.
2C	Roof	Steel pitched roof with zinc cladding; RC flat with single layer insulated polymeric cladding. Sunpipe and windcatcher. Fall arrest system.
2D	Stairs	RC spiral, RC and PCC stairs.
2E	External walls	Zinc cladding on Metsec, curtain walling, terracotta Rainscreen.
2F	Windows and external doors	Double glazed aluminium windows. Glass sliding doors.
2G	Internal walls and partitions	Block, glazed metal, metal stud, plasterboard and WC cubicle partitions.
2H	Internal doors	Flush doors.
3A	Wall finishes	Plasterboard and tiles to walls.
3B	Floor finishes	Vinyl, carpet, stone and access flooring.
3C	Ceiling finishes	Mineral fibre and plasterboard suspended ceilings.
4	Fittings	Fittings.
5A	Sanitary appliances	Sanitaryware.
5C	Disposal installations	Soil and waste pipes.
5F	Space heating and air treatment	LTHW geothermal heating with heat pump. Air conditioning.
5G	Ventilating systems	Central mechanical ventilation.
5H	Electrical installations	Electric light and power. Emergency lighting.
5J	Lift and conveyor installations	Lifts.
5K	Protective installations	Lightning protection.
5L	Communications installations	Fire, panic and intruder alarms, data cabling, chilled water, induction loop.
5M	Special installations	BMS.
5N	Builder's work in connection	Builder's work in connection with services.
6A	Site works	Site preparation. Macadam and stone paving; landscaping.
6B	Drainage	Drainage.
6C	External services	External services; site lighting.
7	Preliminaries	12.41% of the remainder of the Contract Sum (excluding Contingencies).
8	Contingencies	1.08% of the remainder of the Contract Sum (excluding Preliminaries).