Designing Architect's Brief for a Faculty of Engineering

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Abstract. A team of academics produced a Design Brief (DB) to assist architects design a scholarly physical environment for modern engineering education and research. The information gathered from external and internal sources was used to define important themes that the buildings should reflect and hence to arrive at a list of the required spaces. Critical internal and external reviews and budget constraints led to a series of successive refinements of the DB. A design competition was organised for all interested architects in the country to select the architect for the project and consolation prizes were awarded to second and third finalists. The planned development will provide 17900 m^2 and 25200 m^2 net usable space and estimated gross building area respectively.

Introduction

In 1996 the former Botswana Polytechnic was incorporated into the University of Botswana (UB) as the Faculty of Engineering and Technology (FET). The Polytechnic was located on the east and west campuses that are about 1.7 km away from the main UB campus where a new facility would be built. The Faculty will consist of a Mining Centre and 5 academic departments, namely, Architecture & Planning, Civil Engineering, Electrical Engineering, Mechanical Engineering and Industrial Design and Technology.

The specifications for earlier projects of the UB had largely been prepared by the office of its Physical/ Institutional Planning, often with the assistance of external consultants. However the planning of buildings for FET presented a clear opportunity to involve faculty professional expertise in planning, design, architecture, information technology and engineering. The University assigned a team of its staff the task of producing the Design Brief (DB) for the new facility. The DB is essentially a statement of the requirements of the University to guide the actual design process. Under the guidance of the Dean, the Design Team (DT) members included at least one member from each of the departments and others selected to provide a range of expertise. A committee consisting of all heads of the cognate departments and the Dean reviewed the work of the DT regularly.

The DT consulted both staff and students to discover their aspirations for the new buildings, and their experiences of other engineering facilities. Simultaneously, the team consulted architects locally, regionally and internationally. Also the DT visited some engineering and architecture faculties in the region to assess their buildings and learning environment. There was active correspondence with the University of Colorado, Washington State University, and De Montfort University, all of which had been identified as having constructed innovative facilities in recent years.

The DB was prepared in recognition that the degrees will seek accreditation by appropriate international professional agencies or organizations whose requirements are usually stringent in terms of space for laboratory, teaching, workshops, research, staffing offices etc. The use of space and facilities in the DB was rationalized. For example, one control and instrumentation laboratory was provided to serve both Electrical and Mechanical Engineering departments.

Technological development is changing rapidly and this will certainly affect the type and mode of engineering learning environment. However, the growing importance of online teaching and digital scholarship will assume new proportions due to the growing availability of Internet applications [1-4]. As online teaching requires sufficient internet connectivity, some of the classrooms and laboratories will be provided with computers, internet facility and projectors so that students can interact with the

lecturer. This will be desired as Distance Education and Open Learning progress to new heights at the University [5-7].

Scope of the Project

Site. The building site occupies an area of approximately 2.5 ha. Two notable constraints on the positioning of the buildings are 1) the presence of a City Council sewer line, which crosses the site centrally from north to south and 2) a central linear landscaped open space to be created across the site from east to west, in order to provide a clear line of view between the University Library and a proposed multi purpose hall.

Planning Period. The planning period considered for the facility is 15 years. During this time, substantial changes may be expected not only in the structure and functions of the University, but also in technology. There is a clear need for design solutions that promote flexible use and adaptation. Also, space was set aside for future expansion.

Departments. The buildings are to accommodate those disciplines that FET firmly expects to offer during the planning period. It is not possible, however, to predict departmental divisions to be adopted throughout the life of the building. As departments are not static in size or function, it must be possible to regroup and adapt the use of spaces within the buildings, as academic organisation and programmes change.

Planned Programmes and Enrolment Numbers. Detailed prediction of the relative or absolute full time equivalent (FTE) student numbers in each programme is likely to be wrong both in terms of numbers and in subject definition. Therefore a simple equal FTE numbers was assumed in several departments. This simplification does not expect all departments to have equal numbers of students. It serves as a starting point for calculating a reasonable target for total FTE students, and for indicating a likely number of programmes and classes. Some programmes may be considered as temporary surrogates for programmes that will be developed as modes of instructional delivery and subject demands change.

From the total estimated FTE, the number and size of lecture rooms required, and of the number of staff and research offices were obtained. Other space requirements were based on subject specialisms. Dedicated laboratories for the present portfolio of subjects were used as the basis for calculating the laboratory and workshop space. FTE for graduate students was assumed to be one and a half times FTE for undergraduate students. Table 1 shows the notional capacities of the full-time programmes. In addition effective numbers will be increased by short courses (continuing professional development, largely at graduate engineer level), part time access to existing full-time and special part-time study programmes, distance learning modes of study and doctoral students. **Cost.** The original project cost of about P70 m was approved about 10 years ago and increased to P110 about 4 years ago ($1 ≈ P6). Inflation and decreasing exchange rate of the currency implies that the facility to be procured today may not be equivalent to the initial concept.

Table 1. Programmes and Notional Numbers

Programme	Duration [yr]	Enrolment Per yr	No of Students in Faculty at one Time	Full time Equivalent by dept.
B.Eng.(Civil)	4*	50	200	
M.Sc.(Civil)	2	10	20	230 Civil
B.Eng.(EEE)	4*	50	200	
M.Sc.(EEE)	2	10	20	230 Elec.
B.Eng.(Mech)	4*	50	200	
M.Sc.(Mech)	2	10	20	230 Mech.
B.Design	4*	60	240	
M.Des.	2	10	20	270 IDT
B.Sc. (Planning)	4	20	80	
M.Sc.(Planning)	2	10	20	
B.Architecture	5	20	100	
M.Architecture	2	10	20	240 Arch+Pl
Mining Dip.	2	25	50	
Inter-University B. Mining	1*	15	15	65 Mining
Faculty Total Capacity			1205	1265

* excludes 1 year of study in the Faculty of Science

Themes of the Design Brief

The DB emphasises the following themes:

Energy Efficiency and Resource Conservation. Requirements for low-energy and optimal use of rainfall catchment over the building surfaced area were included in the DB. This principle would not only exist in the design, but also be demonstrable to students. For example, part of the building and services would be available for monitoring and testing during normal occupancy.

Information Technology. Increasing use of computers as teaching tools can materially affect space requirements. The Brief was written to guide the designer to provide for information technology as supplying the primary teaching tools for all FET subjects. Sufficient terminals were incorporated to allow each student to use a computer up to 5h per 24 hour period. Also some classrooms may be convertible to full computer-based configuration as methods of instructional delivery during the life of the buildings.

Flexibility. Flexibility of use has been emphasised at appropriate points in the Brief. The teaching space will be modular for effective space utilization.

Integration. The engineering facility will be embedded with the existing and future development of the University where it will be located. The buildings will promote aesthetic appearance of the University.

Maintainability. The materials should be selected to ensure durability and low maintenance. The building envelope may be of brick walls that will not require painting finishes or regular attention.

Space Allocation

The majority of class sizes would continue to be less than 100 students. Only the common courses in the second year are likely to require lectures to about 225 students. Accordingly, one auditorium for an audience of 250 persons, with the normal projection and public address facilities is required. The requirements for rooms were estimated being aware that the larger rooms are more versatile.

In many engineering departments the Staff Student Ratio (SSR) varied between 1:8, and 1:18. In this case, a ratio of 1:10 was assumed to calculate the number of academic offices per department. Sufficient instructors' and technicians' offices have been provided. The number of technicians was assumed at a ratio of 2:3 with academic staff but some technicians will be accommodated in shared

offices. Table 2 gives a breakdown of usable space within which rooms may be easily reconfigured for new use.

Table 2. Classification of Usable Space

Type	Description	Area [m^2]
1	Information Technology-based spaces	1,300
2	Lecture and Tutorial Rooms	1,300
3	Studios and light Laboratories	5,200
4	Heavy Laboratories and Workshops	6,700
5	Offices, Meeting Rooms and Ancillary	3,400
	Total =Net Usable Space [NUS]	17,900
	Gross Building Area [=1.4*NUS]	25,200

As research activities are critical to developing and maintaining regional and world-wide recognition for excellence, staff will participate actively in research, consultancies and innovative activities. In this regard, collaboration will be forged with other institutions either in the region or elsewhere. Also linkages will be fostered with industry, companies and government. A faculty-based, fully-fledged Technology Assessment/Development Unit will be required for liaison with other bodies and also to take care of industrial attachments.

External Review and Architects Competition

The FET design brief is the most detailed building specification that the UB has ever prepared for its architects. Two external engineering professors reviewed the academic requirements reflected in the brief, while a campus design architect reviewed the architectural parameters. Their reports recommended the DB to the University.

A design competition was promoted to provide the University with a wide choice of architectural design solutions to the requirements of the brief. The competition was in two stages. The first stage was open to all professional architects with permanent offices in Botswana. The second stage was restricted to those architects who were estimated to possess the capability to complete the design project. The competitors admitted to the second stage presented an outline design for buildings and open spaces within the requirements of the DB. The presentation was in form of drawings, sketches, photographs, a model, and a report. They further demonstrated how their designs would meet the requirements of the client, within the stated budget constraint.

A jury assessed the entries on the basis of how well the design will meet the requirements made explicit in the DB. The matrix of the scoring criteria is presented in Table 3. The winner of the second stage of the competition was commissioned as the Architect for the project. The elevation of the winning design as produced by the external assessor is depicted in Figure 1. The second and third competitors were awarded monetary prizes.

Table 3. Matrix of Scoring Criteria for Design Competition

Criterion	*Source Data*
Completeness of the design *(i.e. Provision of the Space Requirements in the Design Brief*	*Drawings and Report*
Organization of Space (i.e. *Quality of Circulation and Communal Spaces)*	*Model, drawings and report*
Informal and Outside Areas, and Parking (i.e. *Site Planning and External Spaces)*	*Drawings, model and report*
Safety and Security (*i.e. are the number of exits etc. adequate*)	*Drawings and report*
Attention to detail (*i.e. attention to Services, Constructability and Maintainability)*	*Drawings, model and report*
Energy and Resource Efficiency	*Report, drawings and model*
Campus and future relationships *(i.e. .Relationship to Existing Buildings and. Expandability of facility)*	*Model, drawings and report*
Image and aesthetics (i.e. *Aesthetic Appeal)*	*Model and drawings*
Material Selection	*Drawings and Report*
Cost Analysis (*i.e. Value for Money)*	*Report*

Conclusion

The University of Botswana has approved a project during the current planning period with the aim of creating new facilities for its Faculty of Engineering and Technology. A learner-focused scholarly environment will ensure that the engineering graduates are adequately prepared for the work place. The DB included provision for state-of-the-art computing resources and space for hands on experimental investigations As future research, teaching and learning directions cannot be completely predicted in engineering and ICT developments, the FET facility will be flexible with abundant space for expansion. This DB must be seen as an initial input from the Faculty. A continuous consultation involving FET with the designer, consultants and contractors will be required at various stages to ensure that the final building satisfies the aspirations of the faculty and students. The DB was highly recommended by the external reviewers and the process of producing the DB has enriched experience of the academic staff in the faculty. It is envisioned that the building of the facility will be completed and commissioned in 2010.

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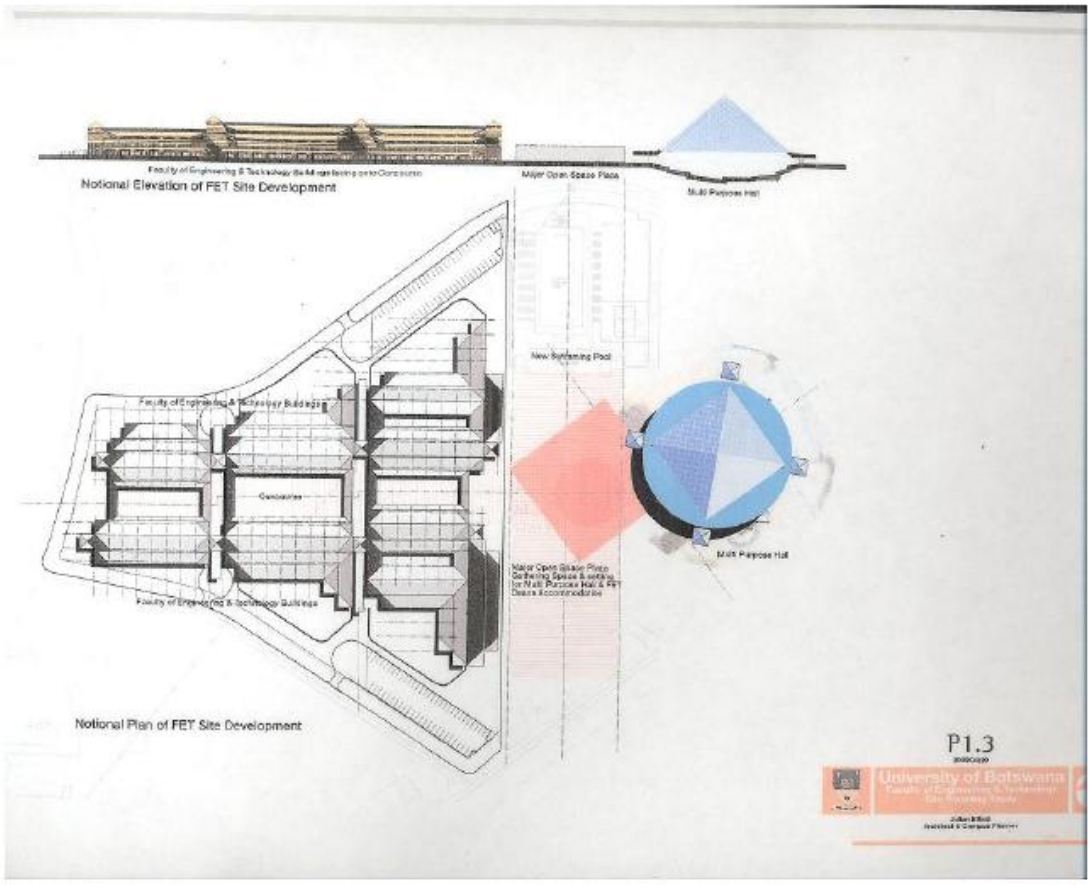

Fig. 1. Notional Elevation of Facility