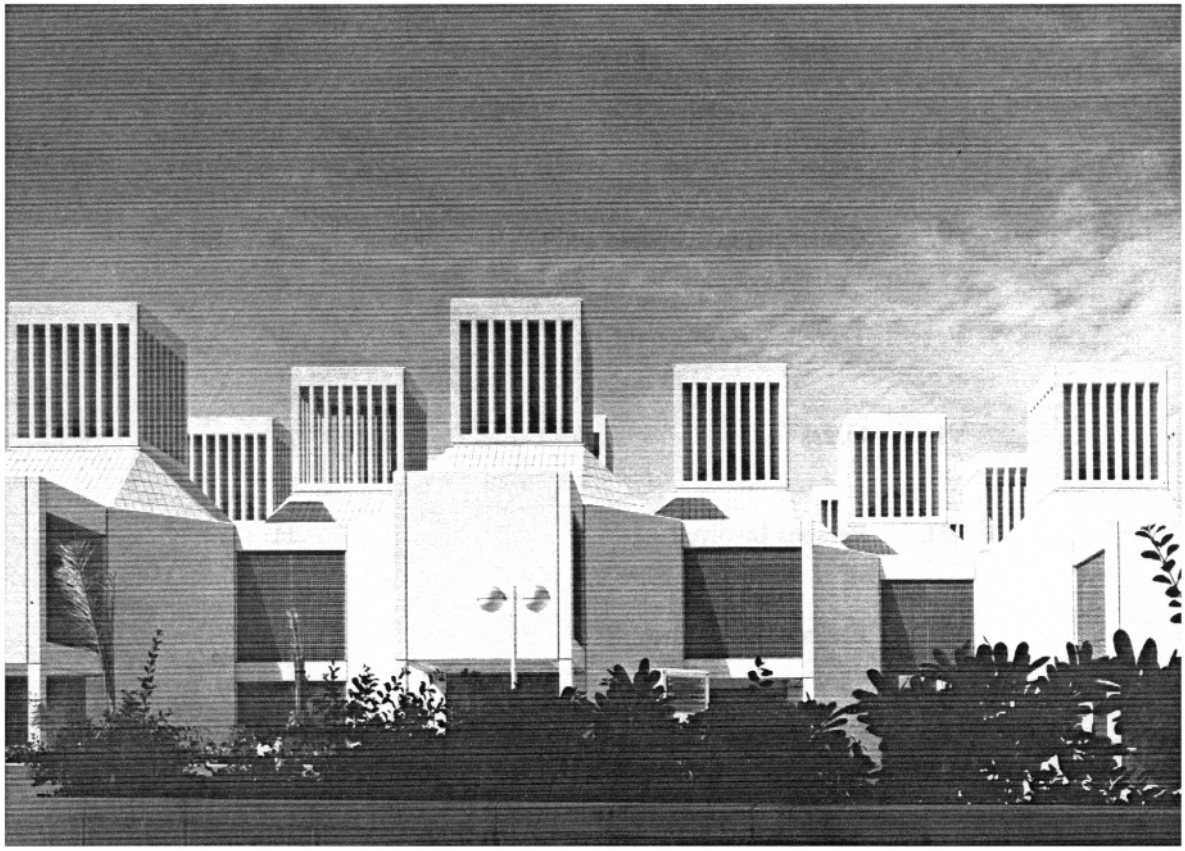
1992 Technical Review Summary
by *Romi Khosla*

380.QAT

University of Qatar

Doha, Qatar



Architect

Kamal El Kafrawi
Doha, Qatar

Client

H.H. Kalifa Bin Hamad Al-Thani The Emir of Qatar
Doha, Qatar

Completed

1983

Table of Contents

I. Introduction

The state of Qatar has a population of just under 400'000, most of whom now live in the capital city of Doha. A university has been established to serve the higher education needs of this population. During the last fifteen years, eight new universities have opened in the Gulf State countries and the initial idea of having common regional universities has been modified so that each of the states has chosen to open a prestigious university on its own. Qatar University was conceived in an unorthodox way. A single campus was proposed for both women and men even though their educational and recreational facilities were to be strictly segregated. The whole campus was designed and constructed by international teams using pre-cast cladding technology of German origin. There is no doubt that the campus is a remarkable institution both in terms of academic facilities and in terms of design. To find that over 9'000 graduates and diploma holders have already obtained higher education qualifications in a state that has urbanised in the last two and half decades is quite remarkable. The campus is significant for its social as well as technical achievements.

II. Context

a. Historical Background

The state of Qatar achieved independence from British protection in 1971. In 1973, Qatar University was instigated with two colleges, one for men and the other for women. It then expanded and diversified its activities and the number of its faculties and, in 1977, was given university status.

In 1973, the Egyptian architect Kamal El Kafrawi was commissioned by UNESCO to make preliminary studies for the design of facilities for the first two Colleges of Education. At this stage, the proposals were confined to the establishment of only two colleges for teacher training. The architect moved to Doha in March 1974 to commence the detailed planning of the brief as well as the buildings. At this time, the Colleges of Education for which the project was initially proposed gave a report to the office of the Emir to suggest that a much larger facility be built to accommodate 4'650 students. Today there are over 6'000 students.

The Emir accepted the proposal and a fresh master plan was prepared. By August 1975, the design and layout of a fully fledged campus was finalised and approved for realisation by the Emir, who granted QAR 741 million for Phase I.

By early 1976, the detailed plans had been completed for Phase I which would form the core of the campus. This consisted of two colleges of education as initially proposed in 1973, along with colleges of science and civil aviation. Central facilities such as the libraries and administration were also to be built, along with services and road infrastructure.

In May 1976, the site of the university was displaced 4 km to an equally sandy site situated 10 km from Doha. The new master plan was prepared, presented and accepted in October 1976.

The establishment of universities in the Gulf States in the last twenty years is quite a remarkable event. The accumulation of the petro-dollar in the 1970's has transformed these societies from rural based traditional Bedouin clans to an urban based car owner society. With this change has come the effort towards universal education and social transformation, an effort that in other parts of the third world has taken many decades. The Gulf States have condensed this transformation into a much shorter period. A most significant change in this process has been the education of women. There is no doubt that the sudden opportunity of western styled higher education for women has indeed begun to transform these societies. In Qatar University, two-thirds of the university students are women. For a woman from the Arabian Peninsula to change clothes and play basketball between lectures, in her own country, is to attain what was unthinkable less than two decades ago.

b. Local Architecture Character

One needs to refer to local building traditions with caution when one deals with the Gulf region. The relevant buildings where such local character could be traced are usually the *suq*, the mosques and the forts or palaces. The Qatar National Palace was built in 1912 and reflects the architectural traditions of the Indian coast of Malabar, from where the builders had probably originated. Al Kout, Qatar's oldest fort, was built in 1880. One wind tower house survives and is now the Ethnography Museum which was built in 1935. This wind tower of the *badgir* type is quite common in the Gulf region and has became a symbol of the architectural heritage of the oil producing states.

c. Climatic Conditions

Qatar has a desert climate where the winters are warm (18°C) and summers are hot; temperatures can attain 46°C. Rainfall is minimal with precipitation of 75 mm per year. Humidity ranges between 40% and 75%. The prevailing wind is north-westerly. Sand storms are frequent in summer.

d. Immediate Surroundings of the Site

The site allocated for the university is enormous and measures 1'451 ha, which includes a large tract of wasteland towards the sea. There is a *wadi*, or dry river bed, that cuts through the site at the southern side of the built complex.

A wide, dual carriageway links the university to the centre of Doha and developments have begun to emerge along this link road. The campus complex is ringed by a circular road within which the campus is located and outside which the recreation spaces are located. The vehicular access and the extensive parking facility for the campus of 6'000 students is important because everybody arrives and leaves by automobile.

e. Site Topography

The site consists of flat rock surfaces partially covered by shifting sands. The most important land feature is the *wadi* which flows through the site. The built complex, which is compact, edges onto the *wadi* which is treated as a landscape element. The northern bank of the dry river bed rises up 8 m to meet the walls of the library.

III. Description

a. Formulation of the Programme

There is a long heritage of education in the Islamic world. Its re-organisation into a western style classroom and laboratory based education is entirely new. Bahrain and Kuwait were the first states in the Gulf to initiate this move towards a system that is primarily secular and concerned with a range of subjects taught in European and American institutions. Qatar first started schools at primary and secondary levels in the 1950s, when the teachers were often Egyptians. The programme for the university was formulated on the basis of the successful experiments at changes in the education system at primary and secondary levels.

Normally when programmes for such universities are formulated, the population in the catchment area of the university is the primary factor in assessing demand. In the case of Qatar University, the target student population was the point of departure for the programme.

Female Student Wing (Zone 2)
An area of over 35 ha was set aside for women's hostels and set apart from the remainder of the campus to the west of the circular road. This required independent vehicular access and sports facilities.

Male Student Village (Zone 3)
An area of over 80 ha was required for the recreational and residential requirements of the male students. The plan envisaged a range of residential apartments and villas which cater for the requirements of foreign students, bachelor students and married students.

Faculty Staff Township (Zone 4)
90 ha was required for this function. This was to consist of villas for married staff members only as well as VIP and guest accommodations.

Support Staff Compound (Zone 5)
6 ha was set aside for this function. The accommodation was proposed in hostels.

National Conservation Zone (Zone 6)
The low lying area in the vicinity of the dry riverbed - *wadi* - was to be designed as a desert park which could be used for research in arid agricultural practices.

Marine and Leisure Facility (Zone 7)
There was a requirement to build a berth for the university's marine research boat. Together with the berthing facilities, a marine and recreational space needed to be provided for the use of the university staff and students.

The functional requirements in these seven zones were not adhered to rigidly. The initial phases were defined as 1A and 1B in which the academic zone was built. The recreational facilities for both men and women were also completed. None of the housing has been constructed as yet.

d. Building Data

The entire academic zone has been planned with octagons within a grid of 8.4 x 8.4 m. The exceptions to the grid are:

- the central administration building
- the computer centre
- the student activity centres
- some service buildings and sports facilities.

This grid results in a surface pattern which consist of 8.4 m wide octagons and 3.4 m wide squares. The roof volumes and profiles have been achieved by projecting the octagonal forms and transposing them into a pyramidal form capped with cube-shaped rooflights and wind catchers.

The built form that projects from this surface pattern is generally two storey except for the library, which has three storeys in the central section. The library is located in such a way that it forms the head of this grid.

The major areas for Phase 1A are as follows:

Functions	m^2 Area
Faculty of Science: 45 laboratories and 44 research laboratories	16'785
Faculty of Engineering: 30 laboratories and 20 research laboratories	12'497
Faculty of Humanities (male): 10 departments and lecture room	7'632
Faculty of Humanities (female): 10 departments and lecture room	10'141
Educational Technology Centre: TV, radio, studios, graphics	7'589
Library/Exhibition Building capacity for 300'000 books	8'141
Administration building	4'510

Central Services Unit: 4 centrifugal chillers		5'043
Mens' Refectory		980
Womens' Refectory		820
Engineering Workshop		1'734
	Total Area	75'872 m^2

Phase 1B consists of two student activity centres, a men's library, sports facilities and the computer centre. This second phase was completed between 1986-89 and added 25'000 m^2 to the campus area.

Currently under completion are the mosque and Islamic Centre, of 4'341 m^2, and the Sadar Laboratory of 285 m^2.

The total built area of the campus at present is almost 100'000 m^2.

It is perhaps difficult to give a vivid written description of the volumetrics of a complex which has been planned on a demi-regular octagonal pattern. Apart from the octagons, a series of free-standing buildings have also been built in phase 1B. These structures are not disciplined by the octagonal grid. A series of over 600 octagons are linked together to define the plan of the faculties and library which form the bulk of complex.

e. *Evolution of Design Concept*

Physical Constraints

The site is typical of the desert: deficient in surface soil and water. Vegetation is very sparse. The *wadis* model the site and create contours along the valleys. This modelled effect is sufficient to give interest to how the complex is sited. There is a 6 m escarp on the eastern boundary of the site which has been used to enhance the location of the major buildings of the complex. The contours of the site are also reflected in the levels of the various buildings which are placed along the contours. The vast area outside the campus ring-road has been left as natural desert and the area within the ring-road has been landscaped in a manner that complements the buildings. The plants used were selected after suitable agronomical studies were made.

The other major constraint was the extreme climate. The decision was made to protect the interior areas of the university with a heavy building fabric. Construction of pre-cast concrete panels, insulation and in-situ concrete walls provide this shield from the heat. The most prominent feature of the buildings are the cubical roof forms of the octagons that have been placed at the upper level as climate regulators and which evoke traditional wind towers. Wind tunnel tests were carried out to design these features and movable panels were installed to permit control of air movement. It was not possible to verify the effectiveness of these features as they were firmly closed in April when the central air-conditioning system was in operation for the teaching areas. Circulation areas are not air-conditioned and can use the wind towers to stimulate air movement, if required.

Spatial organisation and user requirement

The use of an interlocking octagonal grid of units of identical size for all teaching, laboratory and library functions could clearly present problems. For instance, the span of the structure has to remain uniform regardless of the function. Variation in corridor width is difficult, such that major and minor circulation routes have the same size and form. In some cases, such as the laboratories of the faculty of science, two adjacent octagons have been combined and the resultant space has a clear span of 20 m. In the larger lecture rooms in each faculty, two to four octagons have been grouped to give extremely successful and functional spaces. User requirement has been adequately fulfilled. This is not a crowded campus and the ratio of covered area to the number of students seems more than ample.

For the design of the campus, the architect used German norms of 24 m^2 per student for the teaching areas. The equivalent norms in France are 10 m^2 per student and in Cairo 5 m^2 per student. The Qatar equivalent at the present student strength is 12 m^2 per student. Today, approximately 45% of the built area is used for circulation.

The campus is zoned in a straightforward manner. The layout is symmetrical with a central spine. The library is at the head while the science and engineering faculties form the body. The humanities faculty, with separate facilities for men and for women, forms the arms. The feet contain the service areas which are located at the western end.

The science faculty for women currently operates from temporary cabin structures which are located in the open courtyards of the women's area. It proved impossible to integrate this particular faculty within the main science area without a breach of segregation.

A plan has been prepared by the architects which segregates the circulation corridors for men and women. They are separate yet linked into the central complex. However, due to religious objections that were not anticipated from certain quarters, it was thought prudent to separate the women's section from the men's section by building a wall at the southern end of the science faculty. The central library is used by women while men have a separate, smaller library.

Formal aspects

The formal aspects of the massing are extremely impressive. Despite the complexity and repetitive nature of the octagon form and its projection on the roof, the building provides immense variety of internal spaces of the kind associated with *suqs*. The decorative features that are consistent throughout the complex are the timber and GRC lattice screens - *mashrabiyyas* - the rooflights of the library towers and on the roof, as well as the ventilating slits of the cube forms over the circulation areas. The pre-cast cladding panels have been extremely well made and finished and give an unusually smooth and pure look to the façades.

Landscaping

The architect has taken great care to landscape the courtyards and the *wadi* area with desert type plants. These plants are now more mature and shall soon provide the campus with shade in the courtyards and parks. The concept drawings prepared by the architect place emphasis on plants which offer protection from the wind, which offer shade and which are ornamental.

f. Structure, Materials and Technology

Structure System

Concrete has been used to cast in-situ loadbearing walls upon which the weight of the floors and roof is placed. Where the octagonal form opens on one side, columns take the structural loads. Loadbearing walls have been clad with white, pre-cast concrete panels. The decision to pre-cast the cladding was taken very early in the design process. The heavy mass of the panels delays heat radiation. The use of pre-cast panels was necessary to save labour, to obtain an exposed surface that would be durable in the region, and to control the quality and hence the durability of the structure. The design of the concrete mix required to achieve the colour and smooth texture that would not catch the sand involved considerable experimentation and research.

Materials

- Structural Members: Reinforced concrete. Cladding: Double wall construction which uses pre-cast concrete cladding panels and insitu structural walls.

- Finishes: Exposed finishes on the exterior façades. Aluminium windows of solar tinted glass. Pre-cast terrazzo floors with concrete paving slabs.

- Construction Technology: The most important technology used for the construction of the complex was the use of pre-cast elements fabricated in-situ. The client requested a short construction period to avoid the use of labour camps and he agreed to establish the first pre-cast concrete factory in Qatar for prefabrication of the units. The prefabrication plant produced one million blocks, one million paving slabs and tiles, and 25'000 reinforced concrete elements of exceptional quality for phase 1A of the construction. The same prefabrication plant was used for phase 1B. The prototype octagonal unit was erected in the prefabrication plant premises where it remains to this date. The prototype was used to refine construction details. Panels were transported to the site in trailers, erected with cranes and bolted to the loadbearing structure.

- Building Services, Site Utilities: As the buildings form a compact unit, the services engineers (Ove Arup & Partners), proposed an underground service trench that would circulate under the complex. The trench is large enough to walk through and allows maintenance without disturbance. It carries chilled water, the 11 KV ring main, and telephone and computer cables as well as the fire hose. These services are all controlled from a central unit. The capacity of the air-conditioning system totals 4'800 tonnes. Larger areas such as laboratories and lecture theatres have ducted air and small areas such as classrooms, study rooms and staff rooms have fan coil units. Each system is provided with dust filtration for both recirculated and fresh air. To avoid unnecessary use of water, the central plant is air cooled. There is special provision to pump sea water into the department of marine sciences for research and teaching purposes. Electrical and water supplies are provided by the municipality of Doha to a local, centralised sub-station and reservoir. Potable water is circulated from the central reservoir. Water is pumped from the central reservoir to storage tanks within each building. Effluent is channelled to the Doha sewage treatment works.

g. *Origin*

Technology

- Prefabrication Plant: Installation by Dyckerhoff and Widmann. Munich, Germany.
  Pre-cast Production: Operation by Interbeton, Holland.

- Construction: Fujita Corporation, Tokyo, Japan for Phase 1A and Midmac, Doha, Qatar for Phase 1B.

- Mechanical and Electrical installations: local Qatari firms.

Materials

All building materials were imported except gravel and sand. The stained glass windows and GRC screens were made in the United Kingdom. Timber screens - which total an area of 14'000 m^2 - were made in South Korea.

Labour Force

The labour force available in the Gulf States is heterogeneous. The Japanese company Fujita used mainly Japanese labour while the Dutch had a mixed team. For Phase 1A, finishes were contracted to a South Korean company. For Phase 1B, finishes were contracted to Midmac, a local company who used a mixed labour force which included 40% from Thailand and 20% from India.

Professionals

- Architect — Originally from Egypt now settled in Paris.
- Contractors — German, Japanese, Dutch, South Korean, Lebanese (ex Qatar) and Qatari.

- Consultants — British.
- Others — The calligraphy panels of the rooflights were designed by Ahmed Mustaffa, an Egyptian calligrapher.

IV. Construction Schedule and Costs

a. History of the Project

- January 1973 — The architect, Kamal El Kafrawi, was commissioned by UNESCO for the preliminary studies for a College of Education.
- March 1974 — Having accepted the proposal, the State of Qatar commissioned Dr. Kafrawi to move to Doha and execute the works.
- May 1974 — The College of Education report recommends the instigation of a university complex.
- August 1975 — Dr. Kafrawi prepares the first Master plan.
- October 1975 — The Emir of Qatar sanctions QAR 741 million for phase I.
- During 1976 — Detailed plans were prepared by the architects.
- May 1976 — The site for the campus location was changed.
- October 1976 — The master plan for the new site was prepared and approved.
- September 1976-77 — The pre-cast concrete factory was established.
- September 1977 — Initial contractors were shortlisted.
- December 1977 — Site earthworks were completed.
- January 1978 — UNESCO team visits Doha. Subsequently the education programme was altered.
- March 1978 — Revised brief and area requirements were incorporated in the third master plan. The new budget and programme were also submitted for approval.
- April 1978 — The contract for the operation of the pre-cast production plant was put out to tender.
- 1979 — The pre-cast production plant fabricated the first components for the complex.
- June 1979 — Fujita Corporation of Japan was awarded the main contract for the erection of the structure and panels.
- During 1980 — Further changes to the brief were introduced to incorporate surfaces for the University Development Bureau.
- August 1982 — The original completion date of the contract of October 1982 was extended to October 1983.

- Early 1985 — Contract for Phase 1B was awarded to the Midmac Group of Engineering and Construction Companies.
- Late 1988-91 — Phase 1B was constructed.

b. Total Costs and Main Sources of Finance

It was not possible to determine the separate contract values for each contract of phase 1A. The pre-cast production plant cost QAR 70 million (USD 19.2 million). The overall cost of Phase 1A was QAR 800 million (USD 219 million) and the cost of Phase 1B was QAR 240 million (USD 65.75 million). Construction work was funded in its entirety by the State of Qatar.

USD = QAR 3.65, Qatar Riyals.

c. Comparative Cost

Comparative costs of recent campus construction in the Middle East are difficult to obtain and of limited use, as few detailed figures are available. The King Saud University in Riyadh cost USD 3'800 per m^2, Yarmouk University in Irbid in Jordan cost USD 722 per m^2, while the University of Kerman in Iran cost USD 520 per m^2 (source Mimar 42). Phase 1B of Qatar University cost USD 1'300 per m^2. Part of the reason why such comparisions are not useful is that the elements which compose the overall cost have not been standardised. If one were to make comparisions with local construction costs, these too would be of limited use, as the advanced technology and international consortiums engaged for the construction of the campus make the project unique.

d. Cost Analysis

It was not possible to obtain accurate figures for Phase 1A of construction. However, the cost of the various buildings in Phase 1B is as follows:

	Qatar Riyals
Male & Female Student Activity Centre	104'360'000
Women's Sports Centre	35'240'000
Computer Building	21'000'000
Men's Sports Centre	47'000'000
Nominated Sub-Contractors	25'000'000

e. Maintenance Cost

Maintenance of the electrical and mechanical services has been contracted to a company called GEMCO. The cost of a three year service period totals QAR 7.38 million (USD 2 million). Maintenance work employs a team of 69 people; this includes two engineers and four supervisors who are engaged full-time by GEMCO to carry out the maintenance.

V. Technical Assessment

a. Functional Assessment

The university is a large organisation with many sub-centres and work places. It was possible to meet the heads of the following centres and faculties:

- President of the University,
- Director of the Computer Centre,
- Dean of the Faculty of Science,

- Dean of the Faculty of Engineering,
- Director of Department of Education Technology,
- Dean of the Faculty to Humanities,
- Director of the Library,
- President of the Students Union with six other students from Mauritania, Jordan, Qatar, and Egypt.

It was clear from the interviews that the university functions well. Their personal reactions to the environment are dealt with below, but there was no doubt that they thought that the campus functioned well. The functional operation of a campus is complex, as disciplines and the large variety of users intermix and intermingle. The complex has no functional problems.

The disorientation that is felt when one moves through the honeycomb of spaces is disconcerting to the newcomer. However, none of the users complained or criticised this aspect. The organisational layout of the various faculties is clearly indicated in all the circulation spaces.

The circulation spaces are undoubtedly excessive. As they flow along the octagonal grid they inevitably pass through narrow, square spaces and wider, octagonal spaces. In some centres and faculties, the deans have taken over some of these spaces and expanded their functions into them; however, as the circulation spaces are not air-conditioned, such expansion can be disadvantageous.

The blank façade of much of the exterior of the academic complex and the library impedes the view from within. This can be problematic for the users.

b. *Climatic Performance and Other Factors*

The functional spaces are all air conditioned. The wind towers can be operated by remote control devices but in April, the wind towers were in the closed position. However, the wind towers ventilate only the upper levels, and the lower levels of the circulation areas are connected to staircase spaces that are open to the sky. There are no problems with acoustics. There are problems of orientation for newcomers and visitors.

c. *Choice of Materials*

Materials were selected after a great deal of thought and discussion with the experienced firm of Ove Arup and Partners.

The level of technology, method of construction and choice of construction materials was determined by the need to use labour saving methods. The government wished to limit imported labour to that which was absolutely necessary.

d. *Ageing and Maintenance Problems*

The most critical problem of ageing in the Gulf region is the corrosion of metals. It was observed that, in a number of places, in-situ concrete was beginning to spall and crack. The ceiling of the underground service trench has some serious corrosion problems due to spalling: in places, concrete is flaking into the trench. The pre-cast panels are in excellent condition. As the method of fixation relies on bolts, it is probable that this will need to be monitored. Buildings in the Gulf region which were constructed in the seventies are already beginning to suffer badly from corrosion and many in Dubai and Abu Dhabi have required extensive repairs. It is assumed that the University construction is of a much higher quality and will withstand severe weathering.

e. *Design features*

The mass and volumes defined by the surfaces of the octagon are indeed remarkable and profer strong images. Sometimes it is difficult to judge the scale of the building because familiar

architectural features do not appear on the external skin, which is often a smooth panel, two floors in height. The volume of the student activity centres is enormous and more reminiscent of sports halls than common rooms. They are crowded and quite intensely used. Integration with the site is successful.

VI. Users

a. *Beneficiaries*

University education is free. Many of the male students receive grants to assist with the expense of life in town. Books are also free. Thus, a wide range of socio-economic groups are able to use the university. The criterion for entry is to achieve at least 65% pass marks in the secondary school examinations.

The international nature of the university is reflected in the following figures for students for spring 1992:

GCC Countries		
Qatar	5'395	
Others	353	
Arab Countries	762	
Islamic Countries	28	
Other Countries	10	
Total	6'548	of which 1'828 are men and 4'720 are women (see appendix for details)

b. *Response to Project*

Serious complaints were difficult to identify in the interviews. Apart from some complaints about it being too cold or too warm in parts of the campus, there was a more widespread complaint about the lack of external windows in work places. This was particularly expressed by library users and some of the faculty staff. Without exception, every user on the staff seemed proud of the institution and architecture, as well as its facilities. Segregation of male and female students poses some problems, as the complex was designed to become an integrated campus.

VII. Persons Involved

Client	The Emir of Qatar, Chairman of Qatar University Abdulla Al Kubaisi, President of Qatar University.
Architect	Kamal El Kafrawi.
Main Consultants	Ove Arup and Partners.
Project Managers	Turner International, New York.
Furniture Consultant	Enulf Hans, UNESCO.

It should be emphasised that Ove Arup and Partners played a very significant role in the realisation of the project. While the concept and design drawings were prepared by the architect, Dr. Kafrawi, the detail drawings, road designs, services designs, traffic analyses, and public health requirements as well as specialist consultants were provided for and met by Ove Arup and

Partners. Phase 1A was designed in London and detailed at Ove Arup and Associates. Ove Arup and Partners established an office in Doha for the detail and implementation of the whole project and were responsible for the excellent quality achieved.

Romi Khosla
May 1992

Annex 1

Range of courses offered by the University of Qatar

The University offers bachelor's degrees and diplomas in Education. The following faculties have so far been established:

	Date of Establishment
- Education	1973
- Humanities and Social Sciences	1977
- Sharia and Islamic Studies	1977
- Science	1977
- Engineering	1980
- Administrative Science and Education	1985
- Technology	1991

In addition to these faculties, the following research centres were established in 1980:

- Scientific and Applied Research Centre
- Sirra and Sunna Research Centre
- Education Research Centre
- Documentation and Humanities Research Centre
- Arab Gulf States Development Studies Project.

In addition the following centres have been established:

- Computer Centre
- Education Technology Centre.