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Univ of NWF Project

AM

November 30, 1983

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Chief, Asia Bureau
Office of Project Development
U.S. Agency for International Development
Washington, D.C.

Mr. Donor M. Lion
Director, Mission to Pakistan
U.S. Agency for International Development
Islamabad

Gentlemen:

On behalf of Skidmore, Owings & Merrill and our consultants, I am pleased to submit the master plan report for the Northwest Frontier Province Agricultural University in Peshawar, Pakistan. This report culminates a seven month study process involving U.S. AID, the NWFP Agricultural University faculty and staff, the University of Illinois Design Team, and Skidmore, Owings & Merrill staff. This successful collaborative effort has produced a framework to guide the detailed design and construction of the expanded University campus.

We believe the University will make a significant contribution to the advance of the argricultural sector in the Northwest Frontier Province, and that it will be a credit both to the United States Government and the Government of Pakistan.

We are proud to have been a participant in this initial phase of the project and look forward to the resumption of work on the design phase.

Very truly yours,

SKIDMORE, OWINGS & MERRILL

Robert P. Holmes

Robert P. Holmes
General Partner

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cc: SOM File

391-0488

MASTER PLAN

NORTHWEST FRONTIER PROVINCE AGRICULTURAL UNIVERSITY

Prepared for the

Northwest Frontier Province Agricultural University

U.S. Agency for International Development

Prepared by

Skidmore, Owings & Merrill
Architects, Engineers and Planners
Boston, Denver, Chicago

In association with

Weidlinger Associates
Structural Engineers

Dober and Associates, Inc.
Educational Planning Consultants

William L. Porter, Inc.
Architecture and Planning Consultants

November 1983

PESHAWAR
PAKISTAN

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NWFP – Agricultural University

Dr. G.M. Khattak, former Vice Chancellor
Mohammad Hussain Khan, Vice Chancellor
Mr. Siraj Afridi, Director of Works

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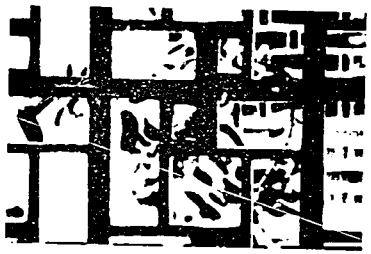

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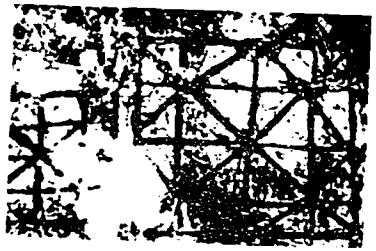
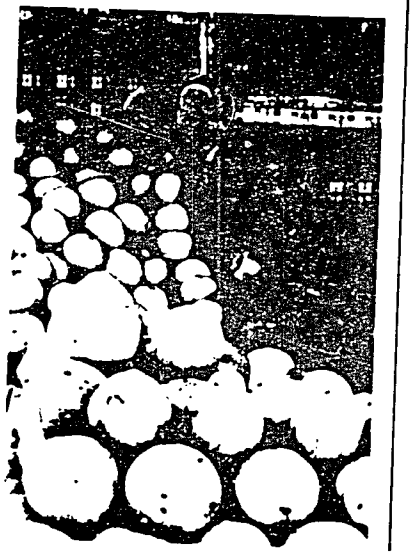


NATIONAL AND REGIONAL SETTING

As a center for agricultural education and research in a predominantly agricultural nation, the Northwest Frontier Province Agricultural University will play an increasingly important role in national and provincial development over the coming decades. Agricultural self-sufficiency is of fundamental importance to the continued stability and well-being of Pakistan. Improved technological and human resources are key to achieving that self-sufficiency. Expansion and upgrading of the Agricultural University's campus facilities in Peshawar will provide a necessary physical framework in which to achieve the multiple goals of the University. These physical improvements to the existing campus are one element of a multi-faceted improvement strategy which includes faculty training and upgrading, a new curriculum, improved training methods, and introduction of new, modern equipment.

LOCAL CONTEXT

The City of Peshawar is the capital and largest city in the Northwest Frontier Province. Its proximity to the Khyber Pass and its location on the Grand Trunk Road connecting such cities as Kabul, Rawalpindi, and Lahore have underscored its strategic importance since the days of Alexander the Great. Today, Peshawar serves as a political, economic, and cultural center for the 10.9 million residents of the Northwest Frontier Province. The Province is predominantly rural and agricultural in character: 85% of the NWFP population resides in rural areas; of these, approximately half are engaged in farming activities.



Prior to the establishment of the Agricultural University, academic training in agriculture in the NWFP was provided by the Faculty of Agriculture of the University of Peshawar. Since 1981, the former Faculty of Agriculture has been upgraded to University status. The new Agricultural University will assume responsibility for guiding certain research and outreach functions for the entire Province in addition to filling its traditional teaching role. These changes are indicative of the importance of the agricultural sector in the Province's economy, and of the importance of the University as a means of improving the productivity of that sector.

◀ *Agriculture in the NWFP supports, directly or indirectly, about 80% of the population and contributes about 40% of the gross provincial product.*

Forty percent of the total area presently tilled in the NWFP is irrigated.

The campus of Peshawar University is situated on the western side of the City, north of the Grand Trunk Road. Islamia College, initially developed during the second decade of this century, was the first institution of higher learning in the North west Frontier. It remains today as an important educational facility as well as one of the pre eminent architectural landmarks of Peshawar. Over the years, the University complex has grown to include schools of Law, Engineering, Medicine and Commerce, as well as a number of specialized training schools and research institu tions. Unfortunately, the architectural quality of later buildings has not matched the charm and character of the original Islamia College build ings. The Agricultural University campus repre sents an opportunity to return to the level of high quality design exemplified by Islamia College.

The terrain of agricultural lands in the NWFP is extremely varied, ranging from level plains in the Vale of Peshawar, to terraced hillside fields in Hazara and Swat.

Wheat is by far the most important food crop in the NWFP, with a cultivated area of 1.7 million acres (of a total 4.0 million acres tilled throughout the province). Other important crops include maize, gram, rice, barley, and millet. Tobacco and sugar-cane are important cash crops.

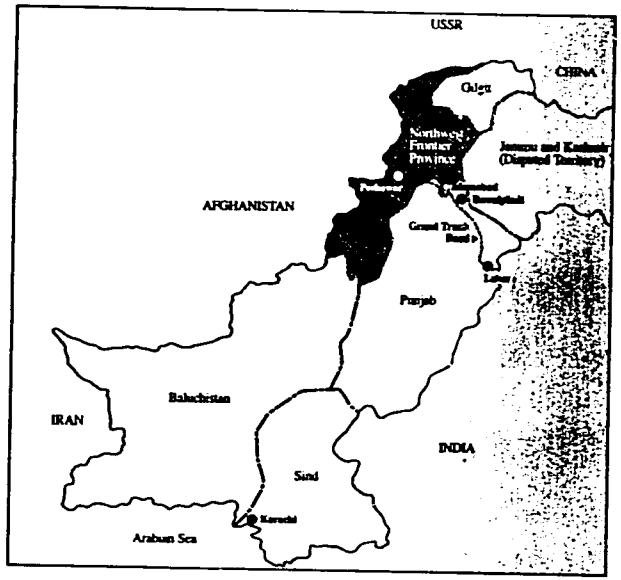
Islamic Republic of Pakistan

National Boundary

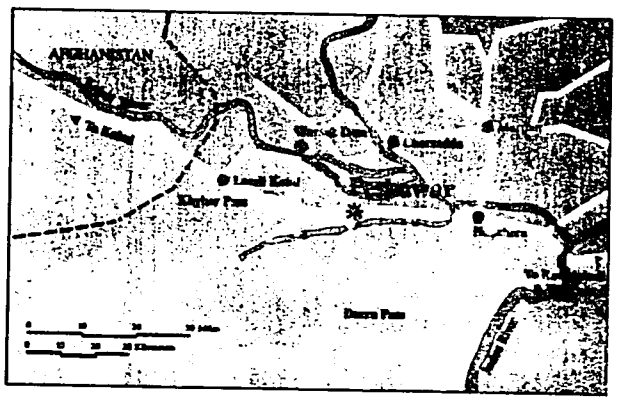
Provincial Boundary

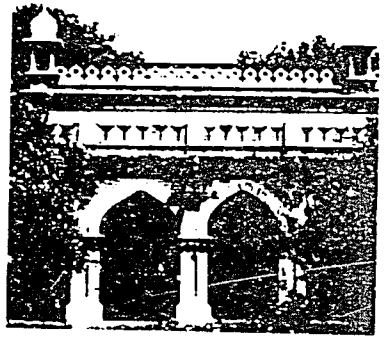
● Major City

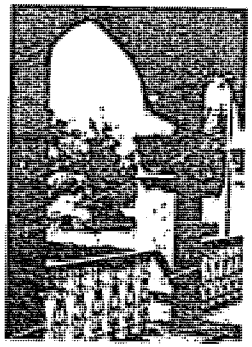
✱ Capital



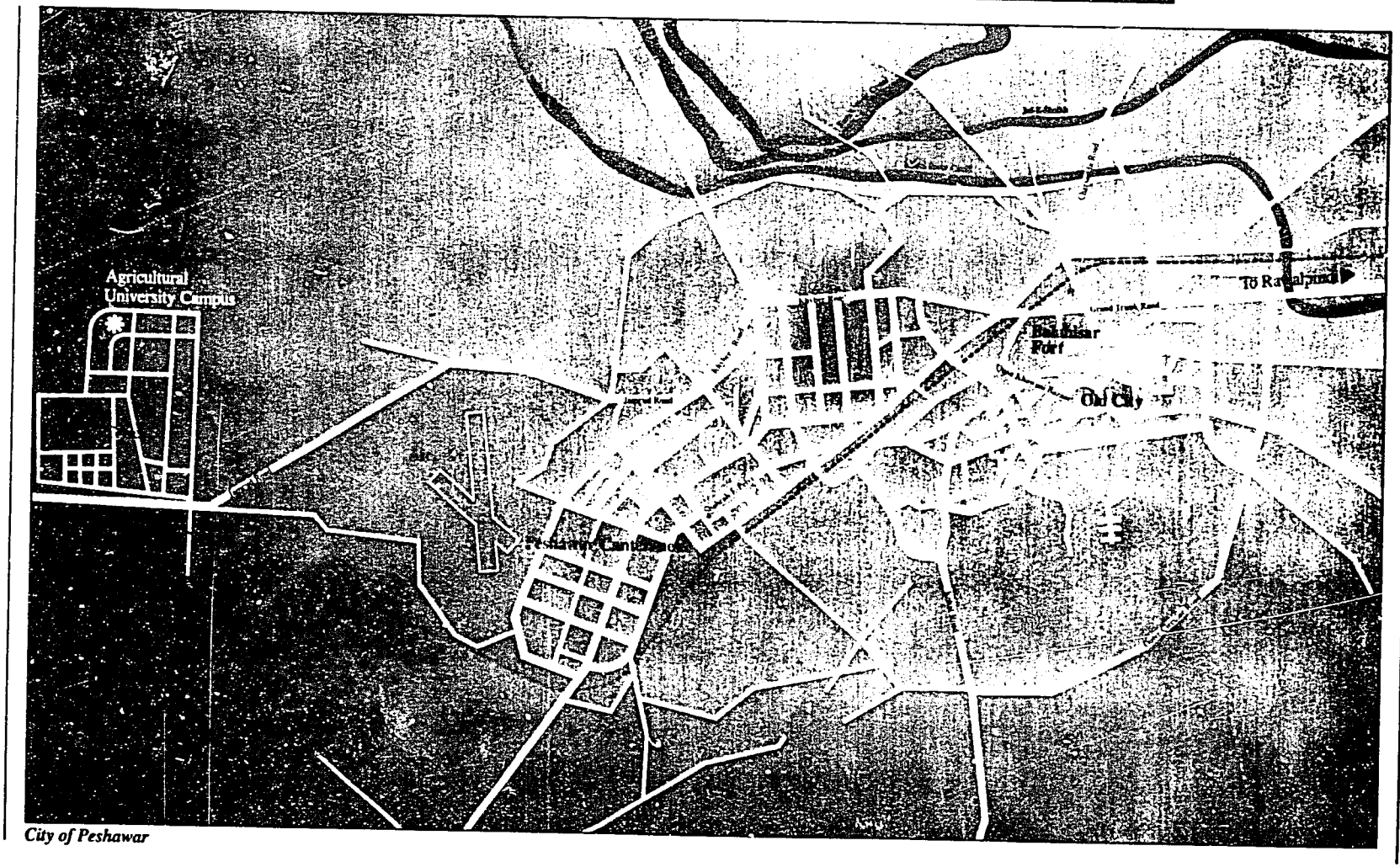
Peshawar Region





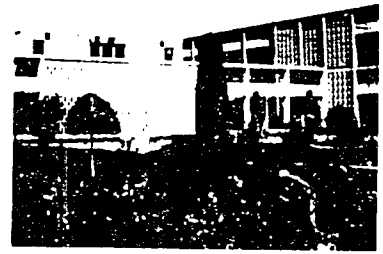


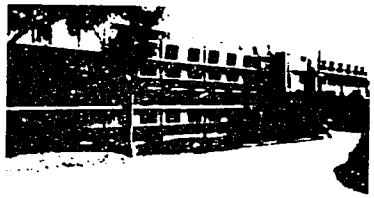
The architecture and landscaping of the Islamia College campus define a high standard of quality for academic facility design.



City of Peshawar

The existing major academic building will be retained, rehabilitated and integrated into the new agricultural university campus.





Two existing student hostels will be renovated and incorporated into the campus development program.

THE SITE

The site of the Agricultural University campus lies at the extreme northwest corner of the greater University of Peshawar campus. The 430-acre site is divided in two by a dry riverbed, or nullah. The eastern portion, approximately 70 acres in extent, contains the existing academic, teaching and student hostel buildings. The western portion, 320 acres in extent, contains the farm center and the majority of the experimental fields. The nullah, which is flooded occasionally during the monsoon season for short periods of time, contains some 40 acres of land.

The entire site is predominantly open, with trees limited to the edges of fields and building sites. Adjacent uses include a mosque and staff housing owned by the Pakistan Forest Institute, and the recently constructed Islamic Studies Center, both to the south of the campus, and a strip of commercial development along the northeastern edge of the campus. Although most of the adjoining land is presently undeveloped, rapid urban growth is projected for the future, spurred in part by the likelihood of new, high-quality campus development.

Access to the campus is provided via existing roadways serving the larger University Campus, along the eastern boundary of the Agricultural University grounds. Limited public bus transit service is also provided to this point.

At present, only an ungraded trail joins the eastern, developed portion of the campus to the experimental fields and farm buildings which lie to the west of the nullah. This trail is occasionally flooded and washed out. The proposed development plan will include improved pedestrian and vehicular access across the nullah, and throughout the campus.

Several major existing buildings on campus will be retained, while a number of others will be utilized on a temporary basis pending demolition and the construction of new structures. Principal existing structures to be renovated and retained include two student hostels, capable of housing up to 400 students, and the existing academic/administrative building, containing some 74,000 square feet (6,880 M^2) of classrooms, laboratories, offices and storage space. A new building, designed to house the Institute for Development Studies, has been contracted for and is to be completed for occupancy by late 1984. At the farm center, west of the nullah, several existing farm buildings will be retained and enlarged or otherwise renovated for more intensive use.

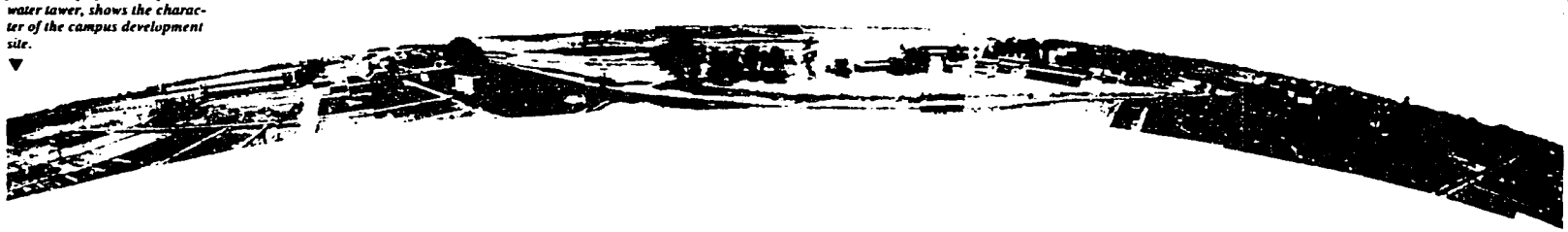
In addition to the above, the present campus includes a variety of smaller buildings of variable age and quality. To the greatest extent feasible, these structures will be retained for interim use, but none is to be retained in the ultimate master plan.

THE NWFP AGRICULTURAL UNIVERSITY

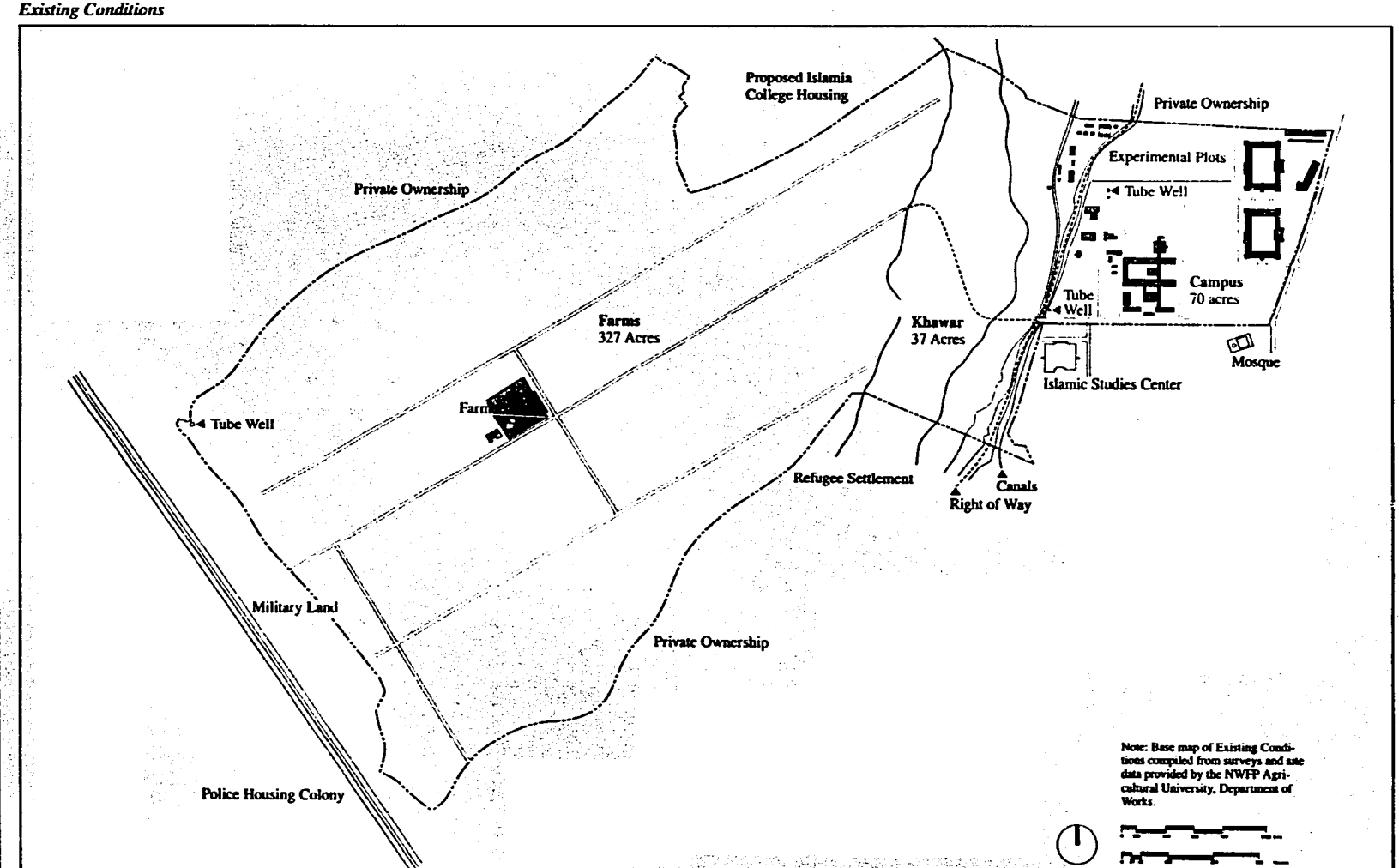
The Agricultural University presently has an enrollment of 680 students and a faculty of some 91 teachers and staff. Over the life of the ten-year project, enrollment will increase to approximately 1,200 students, while faculty and staff will grow to 210 to 250 persons. Additional growth can be expected beyond this ten-year period. Beyond the sheer increase in numbers, the institutional mission of the University will be modified significantly. A capability to undertake outreach activities and continuing education programs will be added to the traditional instructional function of the University. Faculty and student research will be given increased emphasis and, through the outreach program, new farming methods and practices will be transferred more quickly and efficiently to ultimate users and beneficiaries at all levels of the Province's agricultural sector. Teaching methods will be enhanced through the introduction of technological advances such as the Learning Resources Center, which will house an improved library, audio-visual equipment rooms, a micro-computer center, telecommunications equipment and staff capable of producing innovative "teaching packages" for use both on campus and off, through the outreach program.

The student body will also change over time. A program to introduce female students is an important part of the University development plan. Similarly, an increase in the number of students coming from locations outside the Northwest Frontier Province is to be encouraged, with special emphasis on the neighboring province of Baluchistan. The quality of student life is to be upgraded through renovation of the existing hostels and construction of new dormitories and dining facilities; provision of a student center; the improvement of extracurricular and recreational opportunities; and development of work/study programs. Incentives to learn will also be put forward: longer library hours to increase access to

This 360° photo montage, taken from the top of the campus water tower, shows the character of the campus development site.



Existing Conditions



learning resources; better access to advanced equipment, such as computers and telecommunications devices; expanded research opportunities; and a new basic curriculum.

Through this combined program of institutional, pedagogical and physical redesign, a concerted effort will be made to reorient the basic purpose and mission of the Agricultural University. In the past, the University and its predecessors produced candidates to fill the professional agricultural positions available in the provincial government, but did not make an appreciable impact on the total agro-industrial sector. The restructured University will be designed to play a much broader and more significant role in the development and growth of the province's agricultural economy.

Together with the training of new faculty (and the upgrading of existing faculty qualifications), as well as improved institutional linkages to off-campus agricultural production and research centers, the physical facilities of the expanded campus promise to be a major factor in achieving this reorientation. Above all, the physical facilities of the campus will symbolize and make visible the substantial commitment of public resources to achieving an improved educational program. This message will be communicated not only to faculty and students, but to all who come to the campus as visitors, outreach students or guests of the University. The new campus will both signify the important position occupied by the agricultural sector, and provide a tangible measure of the progress being made by the Northwest Frontier Province to foster its growth and development.

RECOMMENDED PHYSICAL DEVELOPMENT STRATEGY

Since new construction will be phased in order to spread the fiscal impact of the capital investment program, a development strategy will be required in order to maximize the usefulness of the interim stages and to minimize unnecessary disruption and inconvenience to campus users and residents.

Elements of the strategy include:

1 Early development of basic infrastructure elements (water and sewer service; electrical service; major roadways). Basic systems should be sized to meet ultimate demands and installed during early construction phases, except in situations where logical, self-contained extensions can be added as part of later phases. This implies a disproportionate investment in the early years for infrastructure, but will reduce the likelihood of undersizing and the need to disrupt areas of the campus where other building activities have been completed.

2 Concentrating each phase of building construction in as small a contiguous area as possible. This will serve to limit the area being disrupted by construction activity at any one time while allowing the finished project to provide maximum effect as a "finished" addition to the campus.

3 Providing sufficient newly constructed space so that planned student enrollment and faculty growth can be accommodated, and existing structures can be vacated in areas where demolition or substantial renovation is needed.

4 Allowing for the interim use or planned sharing of certain new and renovated space by administrative staff, central support functions, or the four Faculties until such time as the ultimate development is achieved, and all campus users are housed in their final quarters.

5 Allowing for the early completion of certain needed, as well as highly symbolic, elements which will give definition and character to the entire campus and which, in any event, cannot be properly housed in any of the existing structures. Such elements include the Learning Resources Center; the Continuing Education/Outreach Center; a central reception courtyard; and a student/faculty campus center.

6 Encouraging the early provision of landscaping throughout the campus, in both formal and informal plantings. The splendid plantings at the Islamia College campus attest to the value of landscaping for both aesthetic and microclimate purposes.

SUMMARY OF THE UNIVERSITY CAMPUS MASTER PLAN

Although the new and renovated physical facilities are a central component of the overall redesign strategy, budgetary constraints will require construction to be limited to the most necessary and cost-effective facilities. During the master planning effort, a number of technical analyses were undertaken by SOM in collaboration with the UIUC-SIU team in order to identify priority program elements and to develop a construction phasing plan which minimizes cash requirements in the early years of the total ten year development program. The relevant technical analyses included:

1 An inventory and assessment of the condition and reuse potential of existing structures on the NWFP-AU campus.

2 An identification—in cooperation with the faculty and staff of the NWFP-AU—of current and likely future physical space and equipment needs over the life of the ten-year project.

3 An assessment of functional interrelationships and "adjacency needs" of the various elements of the campus plan.

4 A review of recent relevant international experience in campus programming and development for universities of similar size and mission.

The *Development Program and Budget Profile* summarizes key programmatic conclusions that were reached at the completion of this technical analysis, and which are discussed in further detail in the following chapters of this report. In brief, to accommodate the planned increase in student enrollment, faculty and staff positions, and to provide physical facilities for a vastly improved teaching and learning environment, a total capital investment of nearly $34 million in 1983 dollars will be required over a ten-year development period. Approximately 60% of this amount, or slightly more than $20 million, will be spent for construction or renovation of academic space (classrooms, laboratories, offices), or other support space (library, auditorium, computer center, etc.), student living and dining facilities, and relat[illegible] [illegible]structure and site improvements.

The remaining 40% ($13.6 million) will be devoted to construction of a faculty/staff housing colony containing some 320 housing units, and located primarily along the western edge of the nullah which traverses the campus. Detailed cost figures are presented in Appendix I.

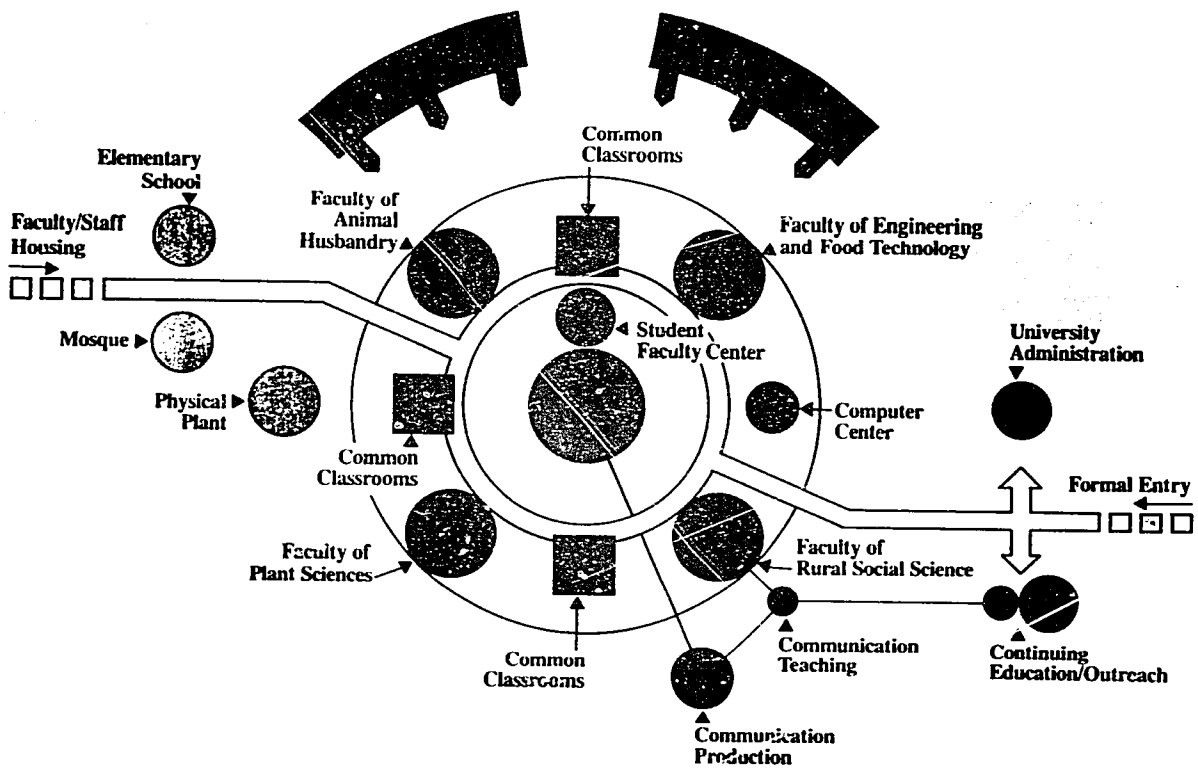
[illegible] BUDGET PROFILE

Program Element	Amount to be Provided: Through Renovation	By New Construction	Total	Construction Cost (1983 Dollars)
A. Academic Space				
(Classrooms, Laboratories, Faculty Offices, Farm Center)	4,900 Gross M^2 (Main University Building, IDS Building	14,325 Gross M^2	19,225 Gross M^2 (206,925 G.S.F.)	$ 4,828,750
B. Academic Support				
(Library, Communications Teaching/Production, Computer Center, Central Administration, Outreach Center)	500 Gross M^2	11,150 Gross M^2	11,650 Gross M^2 (125,175 G.S.F.)	$ 3,647,500
C. Other Support				
(Athletic/Recreation, Student/Faculty Center, Physical Plant, etc.)	2,500 Gross M^2	4,350 Gross M^2	6,850 Gross M^2 (73,725 G.S.F.)	$ 1,663,750
D. Housing				
• Student Housing & Dining	400 students (Renovated Hostels)	560 students (Incl. 60 Women)	20,350 Gross M^2 (218,700 G.S.F.)	$ 3,545,600
• Other Campus Housing	0	20 units Visiting Scientists' Housing (long-term); 50 units Outreach Housing (short-term)	3,700 Gross M^2 (39,750 G.S.F.)	$ 740,000
• Faculty/Staff Housing Colony	0	320 units	49,250 Gross M^2 (529,800 G.S.F.)	$ 9,495,625
E. Housing Support				
(Market, Mosque, Elementary School)	0	All	2,200 Gross M^2 (23,475 G.S.F.)	$ 518,730
F. Infrastructure & Site Work				
• Campus & Farm Center	0	All	—	$ 4,065,000
• Housing Colony	0	All	—	$ 2,345,000
Subtotal			113,225 Gross M^2	$30,849,975
Contingency (10%)			(1,217,550 G.S.F.)	3,085,250
Total				$33,935,225
Funds Utilized for Campus, Farm Center, and Related Infrastructure:				$20,340,000 (60%)
Funds Utilized for Faculty/Staff Housing Colony, Housing Support, and Related Infrastructure:				$13,595,225 (40%)

Notes:

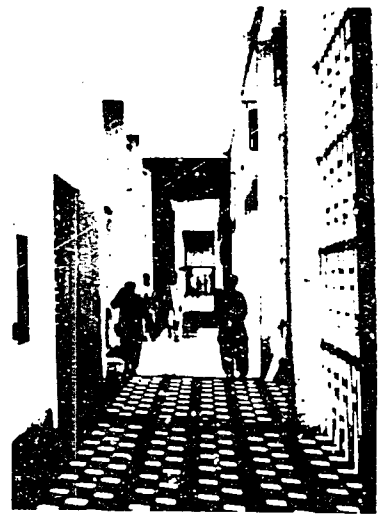
1. All costs in 1983 Dollars.
2. Costs exclude movable equipment, furnishings, off-site electrical power supply connections, and A/E design fees.

Academic Physical Organization



The *University Organization Diagram* indicates, in schematic form, some of the major elements of the University's institutional structure—central administration, Learning Resources Center, the four Faculties, student housing, and so forth—and abstractly portrays basic adjacency relationships which in turn suggest preferred locational options. These features are presented and discussed in more specific detail in Chapters B and C.

Finally, the *Illustrative Master Plan* provides a graphic overview of the campus at the conclusion of the 10-year development period. This master plan drawing illustrates how the total development program can be accommodated on the site while satisfying basic locational requirements of each component element. It also suggests an attitude towards landscape treatment of the campus grounds which will soften and enhance its ultimate character and appearance.



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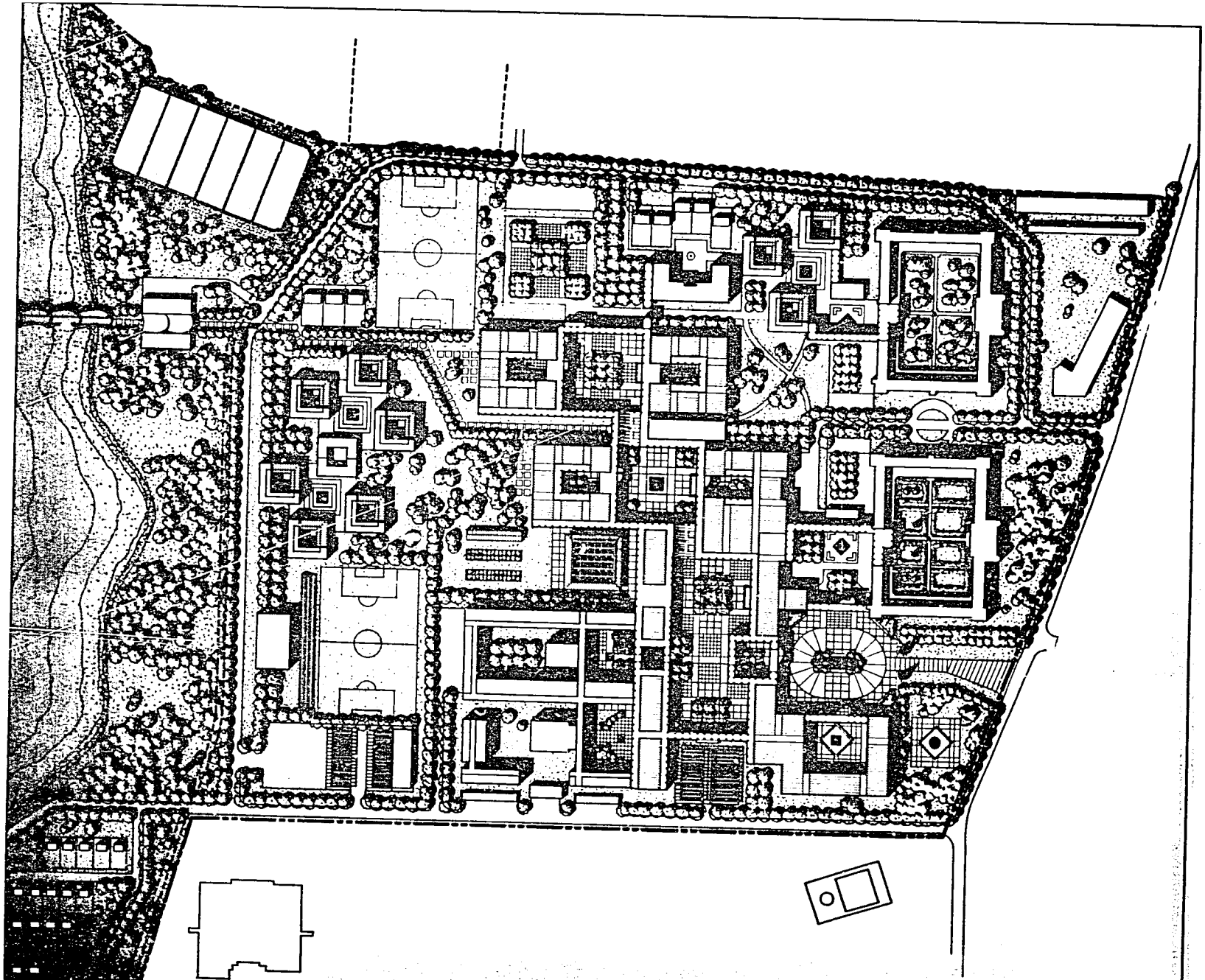


Illustrative Master Plan–**Academic Campus**

CONCEPT DEVELOPMENT

INTRODUCTION

The Master Plan concept has been shaped by a variety of forces:

- The size and location of the campus, as well as the existing structures to be retained;
- The natural features of the site—soils, topography, solar orientation, climatic variation;
- The infrastructure and services elements which will support future activities on the campus;
- The architectural tradition and practice of rural Pakistan and the Northwest Frontier Province; and most importantly,
- The educational and space program for the Agricultural University, as jointly developed by the UIUC-SIU/SOM Design Team in consultation with the faculty and staff of the University.

ADEQUACY OF THE SITE

The 430-acre campus provides adequate space for all needed buildings and for the experimental farm fields and other farming functions, as currently programmed. The location of certain buildings which are to be retained (see below) on the 70 acres east of the nullah argues for concentrating new academic and student housing at that location. This portion of the site is also more readily accessible to the balance of the University of Peshawar via the roadway system which services the larger University complex. Similarly, the desire to minimize unnecessary traffic and activity near the experimental fields argues for locating that function in the more remote reaches of the campus. This combination of factors lead to a search, during the early stages of the Master Plan effort, for alternatives which allowed nearly all new construction to be placed on the east side of the nullah. However, as the total building program became better defined, it was clear that this could only be accomplished by constructing a relatively dense complex of multi-story buildings.

This was deemed inadvisable for several reasons:

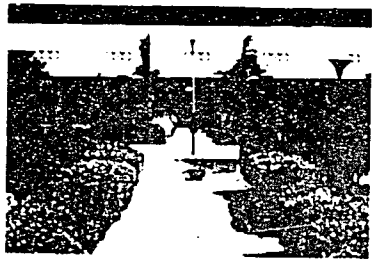
- A dense building pattern will not provide a comfortable setting for the predominantly rural student body;
- Taller buildings are more demanding in terms of structural and mechanical systems;
- Apartment-style housing accommodations would not be acceptable to the faculty and staff.

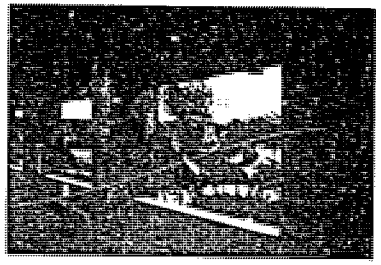
In order to develop a campus with buildings no more than two, or occasionally three, stories (25 to 35 feet in height; 7 to 11 meters), it was decided to concentrate all academic and related support buildings on the east side of the nullah, and to place the major portion of the faculty/staff housing colony on the west side. The resulting pattern, from east to west, consists of a high-activity academic campus zone; a moderately active, low density housing colony; and finally, a rural-appearing farm center surrounded by experimental fields.

DESCRIPTION OF EXISTING BUILDINGS AND PROPOSED RENOVATION

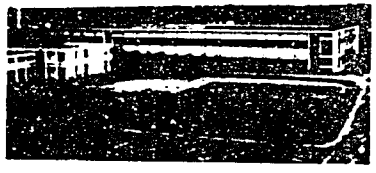
Main Academic and Administration Buildings

The principal existing building on the campus houses the central administration, faculty offices, classrooms, library, and most existing laboratories and storage facilities. The 74,000 square foot (6,900 square meters) reinforced concrete structure consists of several wings joined by a system of covered walkways. It was completed in the 1960's, and appears to be structurally sound, if somewhat stolid in appearance. The building will require some renovation, but will then be able to provide a substantial period of useful life. Through careful planning, the structure can be visually and functionally integrated with future construction without detracting significantly, in an architectural sense, from the overall aesthetic character and quality of the campus.



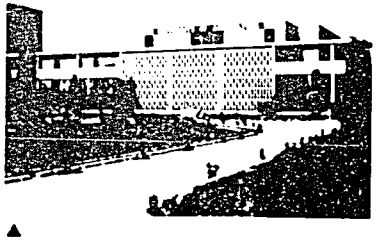


◀ *The internal courtyards of the existing hostels are their most attractive feature.*



To the south and west of this building is the site of a 9,000 square foot (830 square meters) structure which has been designed to house the Institute of Development Studies (IDS). Although construction of this project has suffered delays, it has now resumed and is expected to be available by late 1984 for occupancy by members of the Agricultural University faculty. The existence of this structure has been assumed in the Master Plan. No funds in the current Master Plan budget have been allocated for its construction, however, since its financing was established previously.

In the Master Plan, both of these structures are designated for reuse as classroom and office space. The buildings will house such uses and functions as the Rural Social Sciences Faculty, a portion of the Central Administration staff, and a portion of the Physical Plant Facilities. Several of the larger lecture halls and auditorium spaces will be retained and used to serve the needs of all four Faculties. However, most if not all of the existing teaching and research laboratories will be relocated over time into new buildings as these new facilities are completed. Existing laboratories will then be converted to office or classroom use, which may require insertion of new partitions, but which generally will have low demands for mechanical/electrical/plumbing services, and will not exceed the apparent structural capacity of the buildings.



▲ *The main academic/administrative building presently houses all laboratories, classrooms and faculty offices, as well as the library and a cafeteria.*

Prior to preparation of detailed renovation plans, a thorough inspection of the buildings will be conducted. Structural, mechanical, electrical, plumbing, life safety, energy conservation and functional conditions will be documented and appropriate renovation or retrofit actions identified in each instance.

Immediately to the north of the main complex of academic and administration buildings is a two-story structure which houses several laboratories and related offices. This structure is of later and visibly poorer construction, and its location is an impediment to the logical growth of new campus buildings. It is of no value to the long-term plan for the University, and should be demolished as soon as suitable replacement space can be completed.

Student Hostels

Near the eastern boundary of the campus lie two student hostels constructed in the 1960's. Each masonry structure hostel was designed to accommodate approximately 200 students. In recent years, however, significantly greater numbers of students have been housed in each structure. Although of relatively recent construction, the hostels show clear signs of heavy wear and abuse. Moreover, the basic layout and organization of space in the hostels is ponderous and overbearing; it does not promote the kind of student living experience which is sought for the campus. Even the large internal courtyards—which in many ways form the most attractive feature of the hostels—appear confining and somewhat oppressive.

In the absence of fiscal constraints, it would be desirable to raze the existing hostels in favor of newly constructed and socially more acceptable dormitories. In the present case, the realities of limited fiscal resources require a plan of interim, though relatively long-term, reuse of the existing structures.

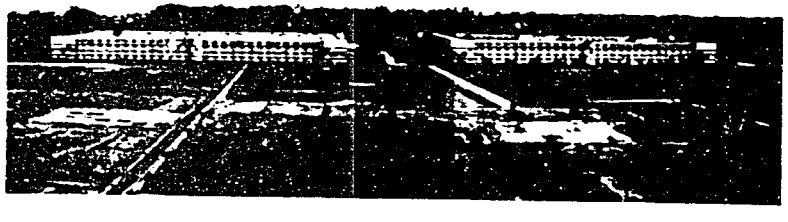
At a minimum, and pending a more detailed inspection of the physical condition of the hostels, all electrical and plumbing systems need complete replacement. Kitchen facilities will also be replaced with new, free-standing facilities. The existing kitchens and spacious dining halls can be converted to student activity rooms. During detailed design, each structure will be inspected in greater depth to determine whether renovation work will require more substantial structural repairs. Based on the structural survey, options for selective removal of portions of the existing hostels will be explored during the design phase in an attempt to lessen the apparent massiveness of the two structures and to diminish the sense of isolation from the balance of the campus.

In time—perhaps well beyond the ten-year project period currently envisioned—the hostels will have deteriorated to the point where more substantial renovation is warranted. When this occurs, demolition and replacement with new housing or other appropriate uses will be in order.

Other Structures

Other buildings currently existing on the campus are indicated on the Existing Conditions plan. While several of these structures can be retained for interim use, their location, condition and visual appearance will eventually render them candidates for demolition and clearance. They have little lasting merit, and their retention will detract unnecessarily from the logical and orderly growth of the campus.

View from the top of the water tower looking eastward towards the student hostels. ▼



OTHER SITE FEATURES

Topographic Features

The Agricultural University site is an open and, except for the nullah which divides the property, predominantly level terrain. Much of the topographic variation which once existed has been eliminated as a result of leveling of the land for agricultural use. The elevation of the site is approximately 1,200 feet (365 meters) above sea level.

The nullah is an irregularly shaped channel from 10 to 20 feet (3 to 6 meters) deep and varying in width from 500 to 1,250 feet (150 to 380 meters), the narrower and deeper portions lying at the north end of the site. The nullah drains an extensive watershed of 85 to 90 square miles (225 square kilometers) in area, lying to the south and west of the campus. It is reputed to be flooded one or two times yearly to a depth of four or five feet, for a period of several days. Flooding which occurred during the summer 1983 rains is said to have exceeded "typical" flooding conditions, although precise hydrologic data are difficult to obtain. Because of the lack of historic data, major highway and rail bridges upstream from the campus have been designed with what is intended to be a considerable margin of safety.

Although the disruption of vehicular access during times of flooding will be an inconvenience, the expense of constructing a vehicular bridge crossing at this time was deemed too great for inclusion in the Master Plan. The Plan, therefore, contemplates construction of an at-grade vehicular ford.

Location of the housing colony on the west bank does argue for construction of a smaller-scale bridge which can accommodate pedestrians, cyclists and occasional emergency vehicles. This pedestrian bridge will be a major convenience at all times, inasmuch as it will obviate the need to descend into and climb out of the nullah; it will be a necessity during times of flooding when all movement across the nullah would otherwise be severed.

The nullah presents a rough and desolate prospect of gravel, rubble and mud or dust, depending on the time of year. Long-term options addressed in the Master Plan envision reconstruction of the nullah banks, narrowing of the channel, and reclamation of a portion of the land area for productive use. In the short term, the introduction of trees and shrubs along the top of the nullah banks will provide visual relief while protecting and stablizing the earth from the effects of major flooding.

Geological Features

The campus appears to be underlain by numerous strata of sand and gravel which form an extensive natural groundwater aquifer.

A series of on-site wells provides water to the campus. Although new wells may eventually be required in order to irrigate the experimental agricultural fields, the groundwater resource appears adequate to meet all future demands.

Access and Water Rights

Four irrigation channels traverse the site, entering the property from the south, just east of the nullah, and exiting to the north. These channels provide water to agricultural fields beyond the campus and thus must be retained in operation. They will be relocated and lined.

A public right-of-way across the site also exists in a corridor roughly adjacent to the present course of the irrigation channels. The precise rights of use which the public enjoys along this right-of-way are not clear at present. It will be desirable to modify the pathway so as to conform to the proposed campus perimeter roadway; in so doing, it may be possible to discourage through travel, but such travel apparently cannot be prohibited.

Climate

Temperatures in the Peshawar region range from cool in the winter to very hot in summer. Daily means for January range from 4.1°C minimum to 17.3° C maximum. Comparable figures for June are 25.7° C and 40.2° C. Wettest periods occur in March and July/August, with the March rains typically the heavier.

The relative humidity at noon ranges from 39% to 50% for all months of the year except for April, May and June which are drier, exhibiting a range of 21% to 34%. Night winds are calm ranging from zero to three knots for the entire year. The summer daytime period shows stronger winds ranging from three to seven knots for the months of March through September. The latitude is 34° N resulting in high summer solar angles. At noon, it is cloudly only 32% of the time with little variation between summer and winter.

On clear days, the Khyber Hills provide a pleasant vista to the west. The outline of the Khyber Pass, some thirty miles distant, can be seen.

◀ *The nullah divides the site and presents a rough and desolate prospect of gravel, rubble and dust most of the year.*

Existing irrigation channels passing through the site to adjacent properties will be relocated along the new north/south perimeter roadway.

INFRASTRUCTURE AND SERVICES

Existing systems include on-site tube wells which provide water for domestic, fire protection, and agricultural (irrigation) purposes; leaching pits for disposal of sanitary wastes; a system of surface and subsurface drains for removal of "gray water"; an 11 kv overhead electrical supply to the main campus from the Peshawar Grid Station, and a similar supply line to the Farm Center from the Jamrud Grid Station. Gas is provided to the site for water heating and cooking. No storm drainage structures are present. Roadways are paved, but not curbed.

Although an adequate quantity of groundwater is available on site for use of the campus and the housing colony, the proposed development will require improvement to the water storage and distribution system, including new pumps and an enlarged storage/distribution capacity. Alternatives to be explored include retention of the existing central water tower on an interim basis, construction of a new storage tower, or development of a system of in-ground storage tanks. The first costs, maintenance requirements, and aesthetic implications of each option will be explored during detailed design.

An existing north/south right-of-way parallels the nullah, on the east bank. It is used by pedestrians, vehicles and livestock, and must be maintained in operation.

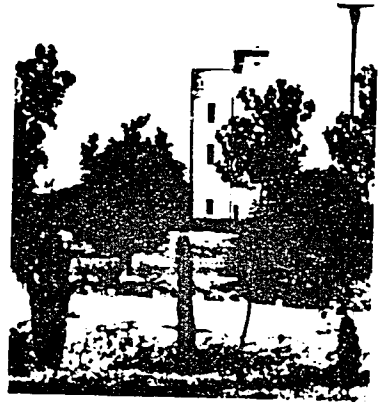
Centralized sewage treatment is recommended for inclusion in the Master Plan. This will eliminate the need for periodic replacement of leaching pits, which currently have a useful life of six to eight years. A centralized treatment system, if properly maintained, will also reduce the risk of groundwater contamination which results from overloading of the leaching pit capacity.

Two methods of centralized sewage treatment will be assessed during the detailed design phase. One method involves the use of stablization ponds equipped with aerators; the other is the provision of a package treatment plant. The two options present differing cost, effectiveness, and reliability performance records, and will be evaluated accordingly. In either case, care will be taken to design a system to avoid ponding of the effluent in the nullah.

Electrical service in the Peshawar area is subject to frequent, often daily, outages. Surges and brown-outs are also common. Although the proposed campus requires, for the most part, a relatively low level of technology, certain key buildings and activities will require consistent delivery of electrical power, notably computer, telecommunications, and certain research laboratory facilities. Current regulators and back-up power generation equipment will therefore be included in the Master Plan.

New roadways and roadway lighting will be provided as indicated on the Master Plan. Design of these roadways will be kept as simple as possible, consistent with the expected vehicular usage levels. A vehicular crossing of the nullah will be designed as an at-grade structure. A pedestrian bridge across the nullah will maintain pedestrian and bicycle access even when the nullah is flooded, and will provide a convenient means of crossing the nullah at all times of the year.

On a clear day the Khyber Hills are visible to the west. The flat terrain of the farm fields lying to the west of the nullah can be seen in the foreground.



The campus' abundant groundwater resources are tapped by on-site wells and distributed from a central water storage tower.

Longer-term elements of the master plan contemplate protection of the nullah banks through the use of gabions or other suitable retention devices. A scheme for reclaiming some of the land area now consumed by the nullah is also proposed. The plan involves construction of a new bank structure and back filling with suitable fill material. Further engineering analysis of peak flows (i.e., fifty-year or greater storm conditions) in the nullah will be required as part of the final design of all structures in or adjacent to the nullah.

ARCHITECTURAL CHARACTER AND PRACTICE

Three principal sources of architectural tradition and practice can be reviewed for application to the Agricultural University Campus:

- The simple but efficient architecture of the rural village;
- The dense and lively architecture of the "old city", best typified by the Peshawar bazaar;
- The elegant and striking style of the Islamia and Edwardes College buildings, each reflecting strong British influences.

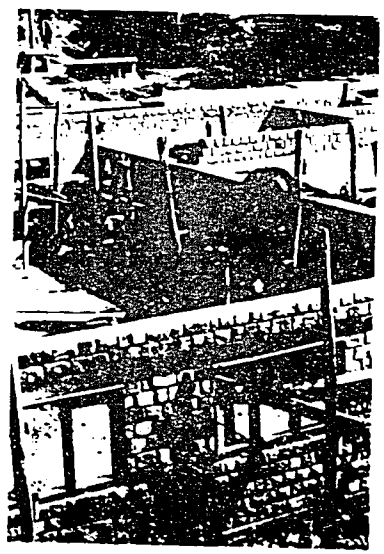
None of these architectural sources is wholly appropriate to the needs of the Agricultural University Campus. Present day building structure and materials, mechanical systems, solar design considerations, the culture and preferences of both students and faculty members, and a host of other factors will require a selective recombination of some of the best attributes of each tradition. These include:

- The predominantly horizontal scale of one to three story development in a rural village or town;
- The use of exterior arcades to shade a building, and to provide shaded walkways between buildings;
- The use of brick, concrete and other locally available building materials and trades;
- Development of temporary (i.e., canvas) or semi-permanent (i.e., trellises) shading devices to mitigate the effects of direct sunlight on otherwise unprotected indoor and outdoor spaces;
- The use of courtyards as an outdoor "room", and as an organizing device for adjoining buildings;
- The use of landscape material, paving and water features to create interesting and attractive outdoor spaces, and to achieve climate control objectives;
- Proper solar orientation to augment daylighting of building interiors, and to take advantage of solar heating during winter months; and
- The use of natural ventilation in buildings which do not require climate control.

▲ *The simple architecture of the rural village.*

EDUCATIONAL AND SPACE PROGRAM

The charts on the following pages provide a detailed breakdown of the program of development as it has been developed by the UIUC-SIU/SOM Design Team, in consultation with the faculty and staff of the Agricultural University. The program detail is sufficient to develop an overall master plan level of analysis, and to structure the key elements of the Master Plan—the size and location of the four faculties, student housing, faculty and staff housing, support facilities and the like. It is expected, however, that some refinements in the space program may be made as



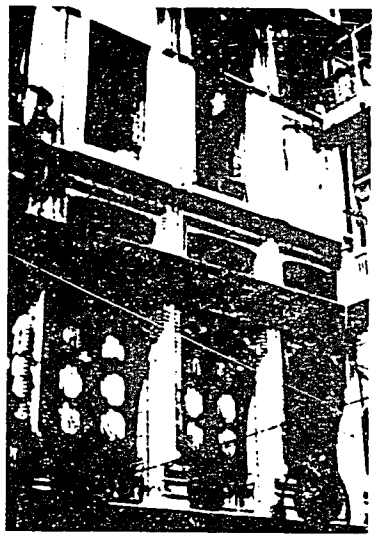
development of the campus proceeds over the ten year period, and actual experience is gained with the new programs, services and people involved with the new University.

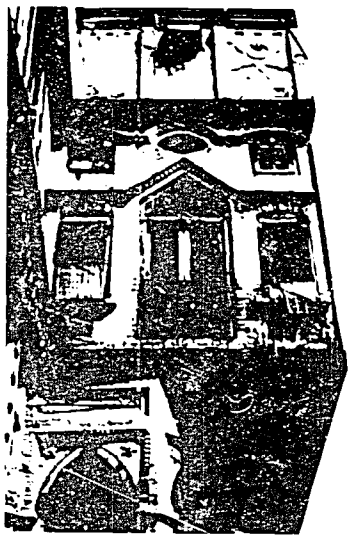
Population

Enrollment in the University will increase from 680 to 1,200 students over the ten-year development period, an average of some fifty additional students per year. Estimates of students and faculty members by Faculty, developed by the UIUC-SIU Team, are as follows:

Faculty or Function	Number of Students	[illegible]
Plant Sciences	480	[illegible]
Engineering Applications & Food Technology	240	[illegible]
Animal Husbandry	180	[illegible]
Rural Social Sciences	300	[illegible]
Outreach Center	—	8
Learning Resources Center	—	[illegible]
Other Key Staff	—	[illegible]
Total	1,200	[illegible]

The excitement of the "Old City".

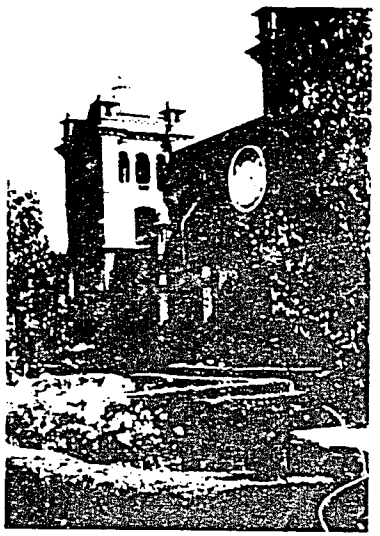


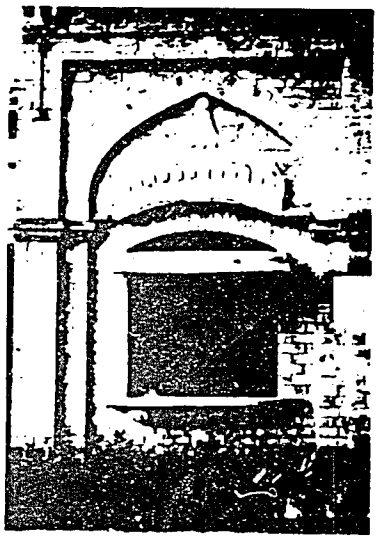


Special program requirements (such as, most notably, the various componets of the Learning Resources Center and the Farm Center) have been defined with considerable precision by the UIUC-SIU Team. Other more generalized support program numbers were derived by SOM from an analysis of comparable educational facilities.

The program recognizes that the broadened mission of the Agricultural University will require new and innovative physical facilities. The buildings and equipment of the new campus will facilitate both the learning and the teaching experience, and help foster a progressive image of the Province's foremost instructional and research institution.

The striking style of Edwardes and Islamia Colleges.





Program Element	Net Square Meters	Gross Square Meters	Comments
A. Academic Space			
• Classrooms	1,300	1,950	Classroom usage to be scheduled by central administration and made available to each faculty as needed. Average of 1.1 net square meters (11.66 net sf) per student.
• Teaching Labs	2,500	3,750	15 Teaching Labs; 480 stations @ 5.2 net square meters (56 net sf) per station.
• Research Labs	2,490	3,725	Based on average allocation of 13 net square meters (138 net sf) of research space per researcher.
• Faculty/Staff Offices	2,925	4,400	Accommodates 166 faculty members from the four Faculties, plus 80 research assistants and 42 secretarial/support staff.
• Farm Center	4,325	5,400	Includes both new and renovated facilities; houses livestock, feed storage, equipment, storage and administrative space.
Subtotal	13,540	19,225	
B. Academic Support			
• Library	3,725	5,575	Detailed program prepared by Mr. John Behrens.
• Communications Production	1,050	1,600	Detailed program prepared by Mr. John Behrens.
• Communications Teaching	225	350	Detailed program prepared by Mr. John Behrens.
• Computer Center	275	425	30 Microcomputer stations and related space.
• Auditorium	450	675	Conversion of existing examination room; 500-600 seat capacity.
• Continuing Education/ Outreach Center	1,000	1,500	Outreach housing not included in this total.
• Central Administration	1,025	1,525	
Subtotal	7,750	11,650	

Program Element	Net Square Meters	Gross Square Meters	Comments
C. Other Support			
• Athletic/Recreation	1,275	1,900	One-third of space in former dining halls to be located in renovated hostels; balance in new indoor facility.
• Dispensary (2)	200	325	One each for men and women.
• Student/Faculty Center	1,275	1,925	Includes faculty/guest dining; student organizations.
• Physical Plant	1,100	1,650	
• Covered Parking	850	1,050	For senior faculty and staff and VIP's.
Subtotal	4,700	6,850	
D. Housing			
• Student Housing	12,725	19,100	Assumes 960 students housed on campus; 400 in renovated hostels; 500 males in new housing, double occupancy. Separate quarters for women and single female faculty (60 rooms).
• Student Dining	850	1,250	Six dining halls, associated with student dormitories
• Visiting Scientists' Housing	1,125	1,675	20 units for long-term visiting faculty.
• Outreach Housing	1,350	2,025	50 sleeping rooms, double occupancy, plus common facilities.
• Faculty/Staff Housing			
"A" level	6,225	8,400	30 units.
"B" level	17,200	23,225	100 units.
"C" level	7,225	9,750	70 units.
"D" level	2,750	3,725	40 units.
"E" level	1,650	2,225	40 units.
"F" level	1,425	1,925	40 units.
Subtotal	55,525	73,300	
E. Housing Support			
• Commercial Center	425	625	Supports residential community.
• Mosque	350	525	In addition to renovated Forest Institute Mosque: Capacity: 200 persons.
• Elementary School	700	1,050	Capacity: 150 students.
Subtotal	1,475	2,200	
Grand Total	79,990	113,225 (1,217,550 Gross SF)	

ELEMENTS
OF THE
MASTER PLAN

The Master Plan for the Agricultural University will serve as the basic framework for detailed design and implementation of all campus facilities. As noted in Chapter A, the plan incorporates the philosophical aspirations and the academic, research, and outreach objectives of the UIUC-SIU Design Team. The plan provides all requisite academic and support facilities for a proposed student enrollment of 1,200, including housing for 80% of students and senior faculty and staff. The plan not only caters for all space requirements, but seeks to locate and organize them in a manner which facilitates their most effective use. A further objective of the Master Plan is the preservation of agricultural land, a finite resource in a campus of 430 acres with no effective potential for expansion.

MAJOR LAND USE ZONES

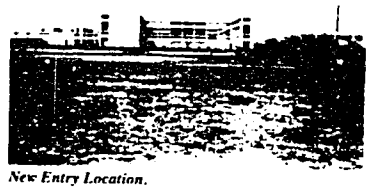
The site is bisected by the dry river bed, or nullah. The eastern zone comprises some 70 acres; the western 320; and the nullah itself consumes approximately 40 acres. The majority of academic space, academic and other support facilities, and male student housing are located in the eastern zone where they will be most visible and easily accessible to the public. Faculty and staff housing are sited immediately west of the nullah, as are female student housing and community facilities which support this housing colony. This location provides a measure of privacy and security for these residential uses.

Remote and to the west of the housing compound is a complex known as the farm center which comprises certain facilities of both Plant Sciences and Animal Husbandry, plus facilities to accommodate farm equipment and livestock. This complex is situated near the location of the present farm center at the center of the experimental agriculture fields.

VEHICULAR ACCESS AND CIRCULATION

The campus is accessed across its eastern boundary from the north-south frontage road which is connected (via the University of Peshawar roadway system) with the Khyber Grand Trunk Road. Three points of access are identified in the plan along this frontage road, one at the south-east corner of the site at the present entry to the campus, a second located approximately 300 feet (90 meters) to the north, and a third at a point between the two existing student hostels. The three entries will serve different kinds of traffic and allow traffic to and from different parts of the campus to distribute itself efficiently.

Existing Entry Location.



New Entry Location.

▲

The existing vehicular entry to the campus will be retained as part of the perimeter roadway access system. A new and more formal entry will be created approximately 300 feet to the north.

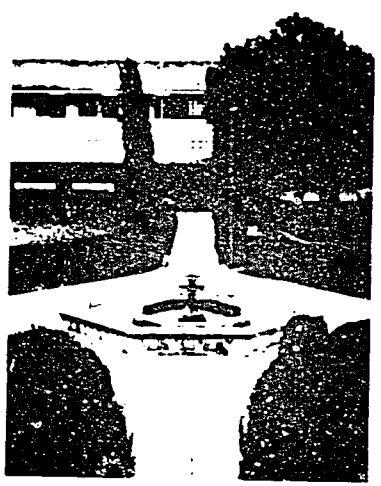
The southern-most entry road will serve vehicular traffic via a ford to destinations west of the nullah—the housing colony and the farm center—as well as service traffic to the Department of Works and other campus locations. Long-term campus parking areas will also be accessed from this edge of the campus. (Adjacent uses such as the Islamic Studies Centre will utilize this roadway as well.)

The northern-most entry and roadway will provide access to the student hostels, and accommodate service traffic to the Learning Resources Center, the Student/Faculty Center, and student dining facilities. A campus perimeter roadway will connect the two entry roadways and provide convenient access to all areas of the eastern campus.

The third and more formal visitors' entry will serve as an entry courtyard at the southeast corner of the campus. This entry will include limited short-term visitor parking.

THE ACADEMIC CAMPUS

The large ceremonial entry court, around which are arrayed the administration buildings, the outreach center, and other facilities with public orientation, is linked to a series of other smaller courtyards along a pedestrian path, or spine, extending through the center of the academic complex. Each of these courtyards or exterior spaces varies in size and character and derives its identity in part from the uses which surround it



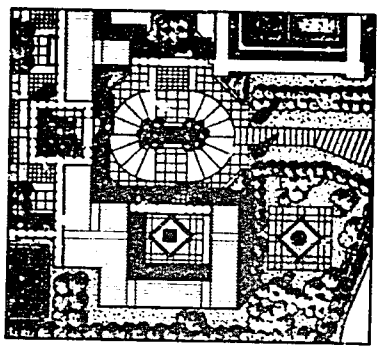
The Entry Court

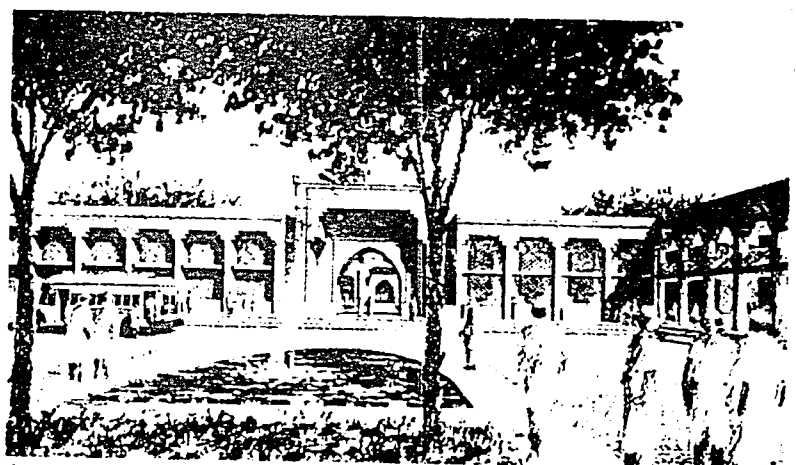
The Outreach/Continuing Education Center, the component of the University which will be most open to the public-at-large, is situated at the principal formal entry to the campus. The Outreach Center contains office space for the Director of Outreach, and other administrative personnel, meeting rooms and a reception area. In addition, fifty hotel style rooms will be provided to accommodate overnight or other short-term guests who may be participating in outreach functions.

The Outreach Center will draw heavily on the faculty and other human and physical resources of the University. In particular, the media facilities of the communications production/teaching units, the library resources, and the classrooms and auditorium of the University will be extensively utilized for outreach activities.

Space for the Agricultural University's central administration offices and related functions is also provided at the University's "front door", facing the main entry courtyard. This location makes it accessible to visitors and convenient to parking as well as to the academic buildings of the campus. The central administration buildings will house the Vice-Chancellor, the Deputy Vice-Chancellor, the Directors of Teaching and Research, other central administrative staff, public reception space and storage space for records and files.

Short-term and long-term parking will be available within convenient walking distance of the entry courtyard.





▲ *The Entry Court.*

Learning Resources Center

The Learning Resources Center (LRC), consisting of a 150,000 volume library, communications production and teaching units, and the computer center, will form a symbolic bridge between the public-oriented functions clustered at the campus entry and the more strictly academic and student-related buildings of the central campus spine.

A program for the innovative LRC was developed by John H. Behrens of the UIUC-SIU Design Team. Excerpts from his report, set forth below, highlight some of the considerations which influence the program and location of this complex:

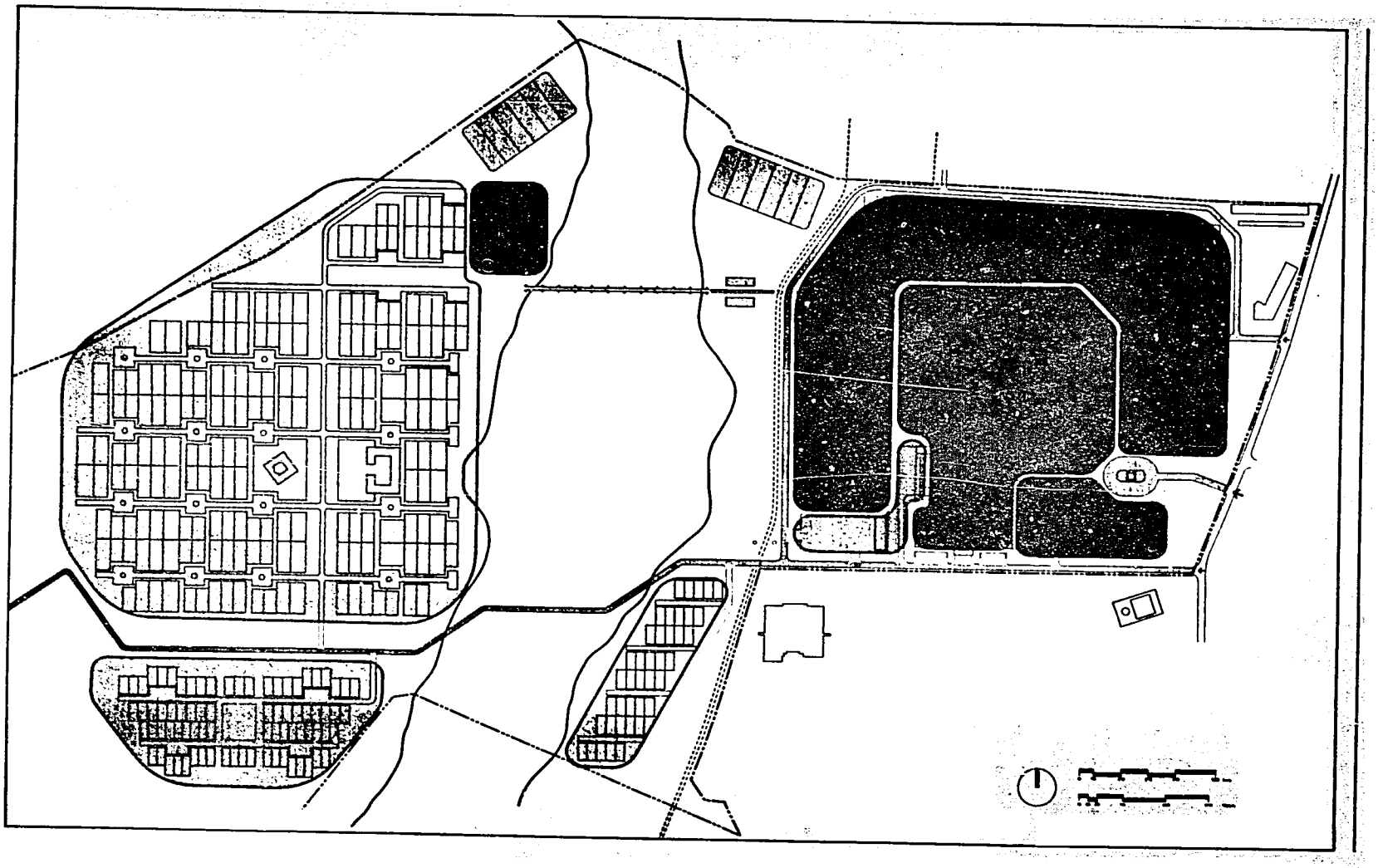
"Many of the elements of a modern agriculture library incorporate autotutorial learning programs, data bases for information, microforms, and audio-visual media elements in addition to the conventional volumes of books, periodicals and journals that are normally considered the basis of a library. Because these added elements are dependent upon production and development by communications staff, it is logical to provide associated physical accommodations for staff convenience.

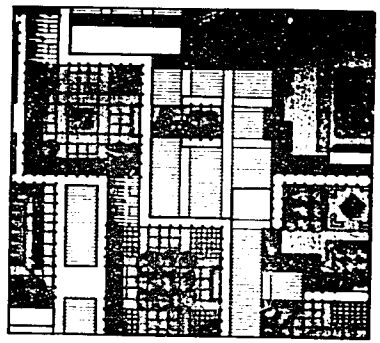
"This is especially important in a developing situation where trained technical staff will be added slowly and are a scarce commodity at the present time.

22

Land Use Zones

- Academic Facilities
- Student Housing and Recreation
- Faculty/Staff Housing Colony
- Administration
- Support and Access





"It is not necessary that the two functions, Production and the Library, be housed in one physical unit. The Library should be of open access to the students and faculty and centrally located to the campus activities. The Production Unit needs to be more restricted in access, but still in close proximity to the Library.

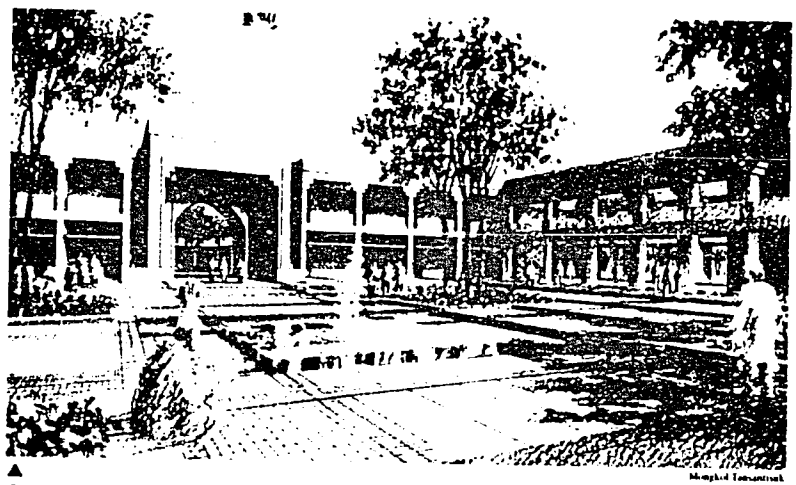
"A third related unit is provision of facilities for Communications Teaching for projected courses for students in communications, and some areas of in-service or continuing education. Because these courses will in all probability be taught by personnel of the Production Center and because of their need for specialized facilities such as darkrooms and recording facilities, some consideration should be given to locating them fairly adjacent to the Production/Library complex."

Environmental issues which will affect design of the LRC have also been identified by the Behrens' report, and include:

- dust control,
- temperature control,
- use of sound deadening/absorbing materials,
- sufficiency and consistency of electrical service capacity.

The Four Faculties

Three of the four proposed academic Faculties—Plant Sciences, Animal Husbandry, and Engineering Applications and Food Technology—will be housed in new buildings averaging 2800 gross square meters (30,000 GSF) in size, to be constructed around two courtyards immediately to the west and north of the LRC. Each Faculty building will contain classrooms, faculty offices, and laboratories as well as space for the Dean of the Faculty and his staff. The fourth faculty—Rural Social Sciences—will be housed in the renovated academic building.



▲ *Learning Resources Center.*

By providing each Faculty with a separate building, a clear sense of identity can be created. It is recognized, however, that individual Faculties vary in size, and are likely to grow or contract over time at different rates. Consequently, it is unlikely that the Faculty building will be used exclusively by only one Faculty. Rather, some faculty members' offices, classrooms, and possibly laboratory space belonging to one Faculty may be housed in an adjacent Faculty building.

Classrooms, Lecture Halls and Auditoria

Classrooms, in particular, will be shared by all Faculties and will not "belong" to any individual Faculty. Existing lecture halls (Rooms 20 and 21 of the main academic building) will be retained and renovated for future use. These lecture halls can accommodate up to 100 students. The large existing examination room can also be upgraded to serve as an indoor auditorium, having a capacity of 500 to 600 persons with fixed seating. Smaller classrooms and seminar rooms will be distributed throughout the campus academic buildings. Finally, one of the exterior courtyards (lying between the Plant Sciences and Rural Social Sciences Faculty buildings) will be designed as an outdoor amphitheater with the capacity to seat over 1,000 persons.

This open air space will be able to accommodate large gatherings, such as graduation ceremonies, and other major convocations or special events. Since gatherings of this size are infrequent, the use of an outdoor space will avoid major expenditure for an enclosed building having a low rate of utilization.

Teaching and Research Laboratories

Fifteen teaching labs will be provided (not counting computer lab space in the LRC). Teaching lab capacity will range from 24 to 40 students, with the average being 32 students/lab. This will provide a total of 480 stations (15 labs x 32 stations = 480), or the equivalent of 40% of the total student body.

Of the fifteen labs, nine will be in Plant Sciences, four in Engineering Applications and Food Technology, and two in Animal Husbandry. Within each lab, approximately 5.2 gross square meters (56 net sf) will be allowed per work station.

Research labs will occupy a total area roughly equal in extent to that required by teaching labs. Research labs, however, will be designed to more closely satisfy the unique research needs of a particular problem area, or faculty member, and thus may vary considerably in size, equipment needs, occupancy levels, and technological sophistication.

Faculty Offices

Faculty office space will be housed, to the extent possible, in the Faculty building to which an individual faculty member is assigned. Office space for graduate students, research assistants and secretarial/support staff will also be provided.

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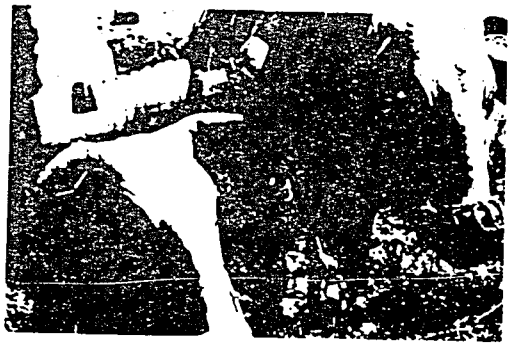

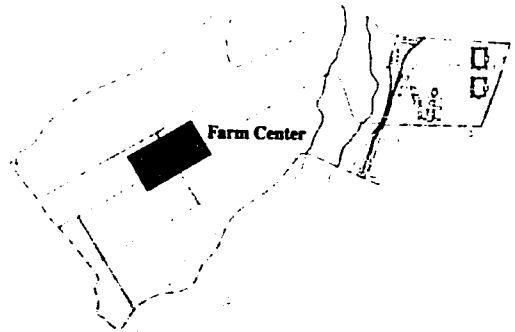

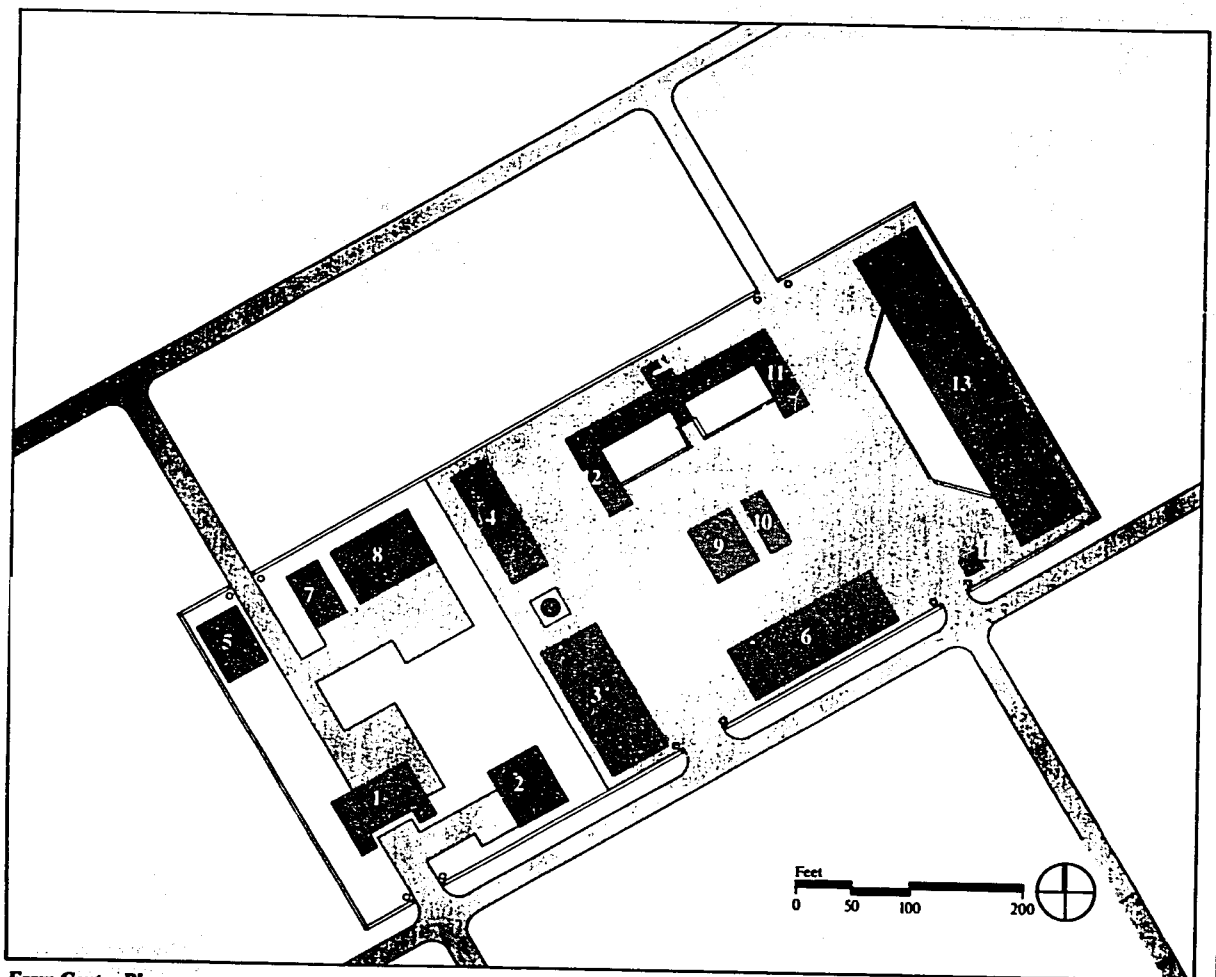

Farm Center Plan

Farm Center/Experimental Fields

The Farm Center on the west side of the nullah will be expanded to better house certain key facilities of relevance to the Plant Sciences, Animal Husbandry and Engineering Applications and Food Technology Faculties. These facilities include barns for small dairy, sheep and goat herds and a poultry flock; seed and pesticide storage; farm machinery shops and storage; and other related facilities.

1 Farm Center Headquarters
2 Farm Manager's House
3 Shop/Machinery Storage
4 General Storage
5 Pesticide Storage
6 Poultry Barn
7 Threshing Shed
8 Seed House
9 Livestock Food Storage/Handling
10 Slaughter House/Meat Storage
11 Goats
12 Sheep
13 Dairy Barn
14 Pump House
15 Security Gate House

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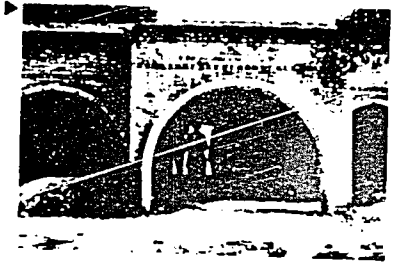
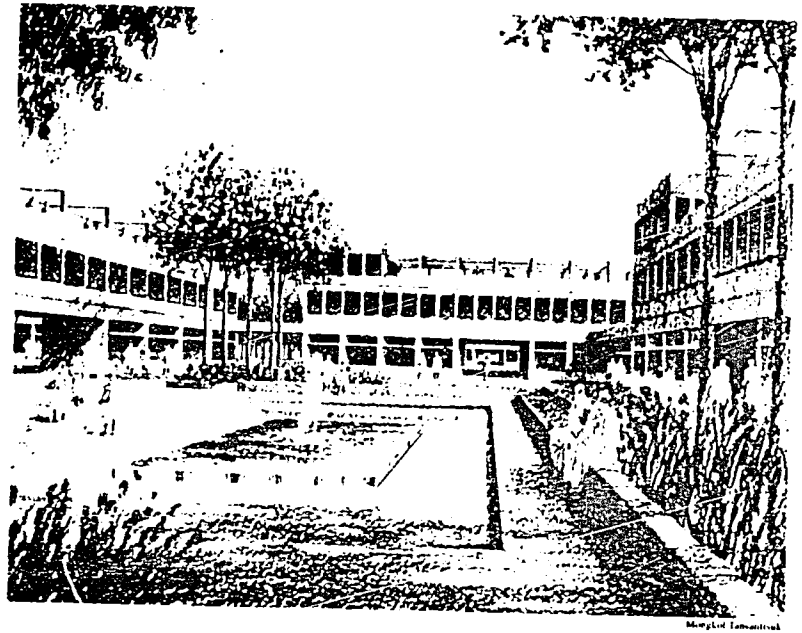
Faculty/Staff housing under construction on the nearby University of Peshawar campus.



Student housing: external courtyard.



Mongkol Tansanitesk

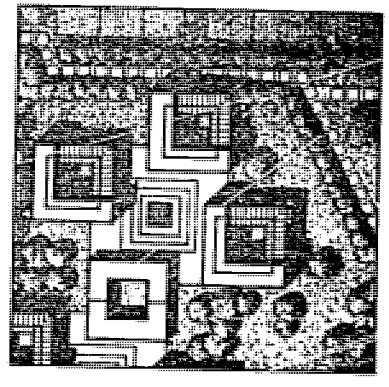
STUDENT HOUSING AND DINING

A combination of new and renovated student housing and dining facilities are encompassed by the Master Plan. Major improvements in the quality of the student housing and dining environment has been identified by the faculty and staff of the University as a prerequisite for improving the educational experience and success of the University as a whole.

Nine hundred male and sixty female students are to be housed on campus, or 80% of the 1,200 person student body. Four hundred males will reside in the renovated student hostels; five hundred will be assigned to nine new student residences located immediately east and west of the academic spine. The location of student housing on either side of the major academic spaces is intended to highlight the central importance of the academic experience, and to encourage students to meet and interact with each other and with the faculty in the very heart of the University

Student/Faculty Center

To reinforce this attitude, the Student/Faculty Center has been located between the Learning Resources Center and the Engineering Applications and Food Technology Faculty building, at a



point central to all student residences, and at one end of the pathway leading to the faculty/staff housing colony and women students' residence.

The Center will include meeting rooms, office space for student organizations, and dining facilities for non-resident students, faculty, and their guests.

The twenty unit Visiting Scientists' Housing Complex will be located near the Student/Faculty Center. This complex is designed to provide long-term housing for visiting faculty members, other high-level dignitaries, and their spouses. Its central location will help foster the close interactions between visiting faculty and NWFP-AU faculty and students which are key objectives of the university development program.

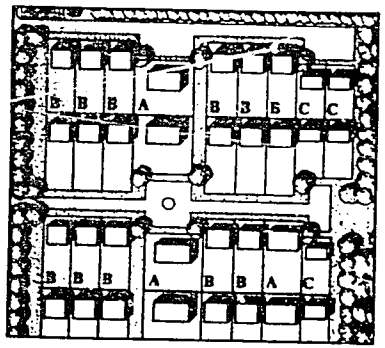
Athletic/Recreation Facilities

Both indoor and outdoor recreation space is provided in the Master Plan. The dining halls in the existing student hostels will become available for reuse once new, free-standing dining facilities are completed. These indoor spaces can be renovated to serve as attractive recreation/activity space. More strenuous athletic activity will be housed in a new gymnasium near the perimeter roadway, on the west side of the campus. One soccer field will be laid out next to the gymnasium, and a second playing field to the north and west of the Animal Husbandry Faculty building. Smaller basketball and volleyball courts can also be accommodated near student residences.

FACULTY AND STAFF HOUSING COLONY

The Master Plan includes the provision of 320 dwelling units for use by faculty and staff of the University. The lack of adequate and affordable housing in the Peshawar area has operated as a deterrent to the recruiting of faculty and staff. Resolution of this chronic housing problem is therefore of prime importance to the goal of expanding and retaining qualified faculty and staff at the University.

A variety of techniques to deal with this problem are presently under study, ranging from direct construction of new housing on the campus, to the provision of housing allowances which would permit qualified recipients to purchase or rent housing off-campus. It is likely that a mixture of approaches will ultimately be utilized, since no single technique will be capable of addressing adequately the many kinds of housing problems which may confront individual faculty or staff members and their families.



Therefore, the 320 units of housing which are encompassed by the current Master Plan program may prove to be too many or too few as the ten-year development program unfolds. The housing colony is laid out in such a way as to allow the total number as well as the mix of units to be adjusted over time to reflect emerging perceptions of actual needs.

For purposes of illustration and planning analysis, several basic housing program assumptions have been established. The maximum building area, or floor area, to be provided for each housing type is taken from the ECNEC Standards issued by the Executive Committee of the National Economic Council for use in all government employee housing projects, according to civil service levels A to F. The maximum floor area for each category is as follows:

Category	Permitted Area: Square Meters	Permitted Area: Square Feet	Units Provided in the Master Plan
A	278.81	3,000	30
B	232.34	2,500	100
C	139.41	1,500	70
D	92.94	1,000	40
E	56.32	606	40
F	48.33	520	40
Total	—	—	320

After consultation with the existing faculty and staff, it was determined that all houses would be constructed as single family dwellings, on lots surrounded by fencing or walls. Houses may be two-stories in height and share party walls so long as each unit and lot is self-contained. Lot sizes are to be determined as a multiple of building "footprint". In final design, actual housing units may occupy less than the maximum square footages indicated by the table, above, in order to respond to land and budgetary constraints.

The housing colony should be located so as to be easily accessible but not immediately adjacent to the academic campus. The west bank of the nullah, therefore, emerged as the most desirable housing location. In addition to the vehicular crossing at the proposed ford, a pedestrian bridge across the nullah will be provided for use by residents of the housing colony.

Also located on the west bank of the nullah is the Women's student residence (capacity: 60 students) which, because of traditional cultural considerations, can be best accommodated in the family environment presented by the housing colony.

Finally, the housing colony is to be provided with a small support complex consisting of a mosque (capacity: 200 persons), an elementary school and related playfields (capacity: 150 students), a commercial area (also open to use by University students) and a dispensary for use by female students and female family members. (A second dispensary, for use by male faculty and University students, is situated on campus in the Student/Faculty Center.)

LANDSCAPE AND OPEN SPACE

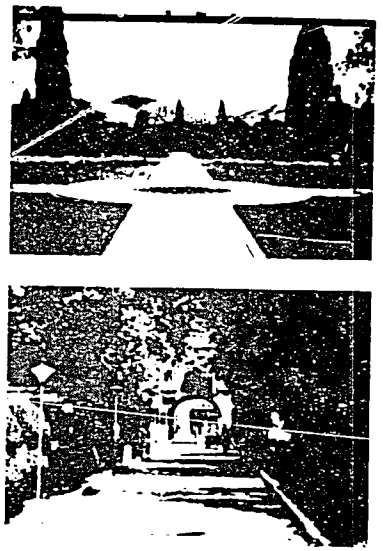
Landscaping, special paving and water features will be used extensively throughout the campus to serve aesthetic and micro-climate control objectives, as well as to provide a means of visual orientation. Trees, shrubs and flowers will be selected and located:

- to define pathways, edges and places for formal and informal gatherings;

View of the Islamia College mosque. A new mosque and an elementary school at the center of the Agricultural University Faculty/Staff housing colony will provide a focal point for community activities.

- to restrict or direct pedestrian and vehicular travel, where appropriate;
- to shade walkways, courtyards and buildings;
- to reduce glare by diffusing natural sunlight;
- to provide seasonal color through blossoms or foliage;
- to protect against erosion by wind or water; and
- to demonstrate horticultural and/or agricultural practices which themselves contribute to the interest and educational mission of an Agricultural University campus.

Examples of traditional Islamic landscape design.



Paving will form an integral part of outdoor landscape treatment, and both living and inert landscape materials will be designed in such a way as to enhance the architectural character of buildings and spaces on the campus. Bricks or other unit pavers will be preferred for use in most roadways, pathways and courtyard conditions. Water features will be used for both aesthetic and micro-climatic ends, particularly in the series of courtyards which punctuate the academic spine.

An on-campus plant and shrub nursery will be established as soon as a suitable site can be made available, and seedlings planted so that plant material of sufficient maturity will be available for transplanting as the initial and subsequent phases of construction near completion. The nursery will be managed by the horticultural faculty of the University, and could possibly be run as a work/study program with the involvement of student labor.

Plant species likely to be utilized in the landscape plan are listed in Appendix II. Additional species may be added as detailed landscape design proceeds.

SUPPORT SYSTEMS

Supporting infrastructure systems have been designed to serve a 1,200 person campus, plus an additional 25% growth factor—the equivalent of a 1,500 person campus. Moreover, expansion beyond this number can be readily accommodated by additions to the basic systems. Major systems and their attributes are described in the following sections.

Water Supply Demand

A modern water system is of paramount importance to the proper development of the University. Not only must the basic operational demands of a 1,200 student campus be met, but life safety and an improved quality of life should be provided for. To meet these needs, an adequate supply must be available and a distribution system must be designed which will meet future growth requirements without expensive duplication. Storage facilities for efficient operation of the system and for emergency situations must be provided.

Domestic water requirements has been estimated on the basis of per capita daily demand for the program population. Design values for resident and non-resident students, faculty and staff, including all school and public usages were selected from a study published by the American Society of Civil Engineers as Technical Memorandum No. 27. Water demands for the various housing types have been estimated as an expected quantity per household. An allowance of 10% has been added to the average daily demand for Phase III of 305,000 gallons per day to account for losses in the system, resulting in a total average daily requirement of 335,000 gallons. Water usage on maximum days has been estimated at 130% of the average daily demand. The peak hourly demands have been estimated at 250% of the average daily demand.

Water demand for fire fighting purposes has been estimated at 500 gallons per minute with a duration of one hour. Flowing pressure of 40 psi at the hydrants will be provided.

Water demand for irrigation of landscaped areas of the east campus has been estimated at 0.10 inches per day. (Water Encyclopedia by D.K. Todd). Water demand for irrigation of the housing unit plots has also been accounted for.

Water Sources

The water supply for the University will be obtained from on-site tube wells. Information provided by the Public Health Engineering Department indicates that the on-site well drilled in 1981 produces good quality water at a rate of 392 gallons per minute. This exceeds the projected average daily water demand for Phase III requirements (230 gallons per minute) by better than 50%. The chemical analysis of the water drawn from this well indicates it is of potable quality and meets recognized health standards. The water is moderately hard and may require local softening for boiler or laundry use but does not warrant any treatment other than providing residual chlorine in the distribution system.

A second well located near the center of the existing campus presently supplies the existing potable water demand and is thought to be of similar characteristics to the above well. It is planned to retain this well, which should be upgraded, if required, to deliver a quantity of 250 gallons per minute in order to ensure reliability of the water supply.

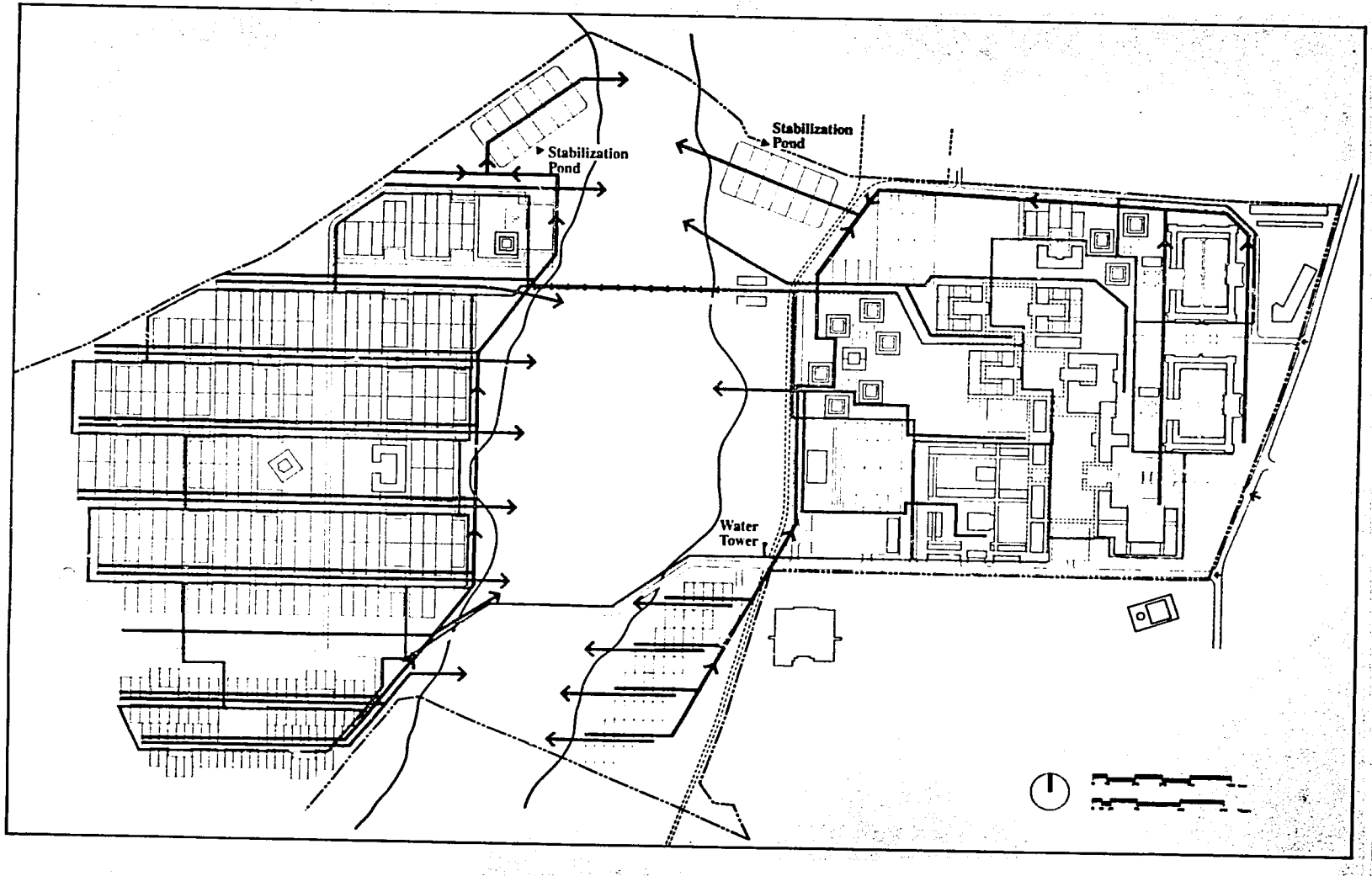
Water for the Farm Center is obtained from a well situated within the Center. Water for irrigation of the experimental fields will be obtained from the irrigation canal west of the farm property, and from a well at the extreme western edge of the University property. No information has been obtained regarding the productivity of this well.

Water Distribution, Sewage and Storm Drainage Plan

Water Distribution

Sanitary Sewage

Storm Drainage



Irrigation needs of the areas to be cultivated must be assessed to determine if this existing well is adequate, if it must be improved, or if additional sources are required.

Water Storage

A water storage reservoir of 100,000 gallon capacity will be required for the distribution system. This reservoir will contain a dedicated fire reserve of one hour and, in addition, six hours of the average domestic demand shall be stored to equalize pumping requirements during periods of maximum demand.

Two forms of reservoir storage are under consideration. In one type of storage facility, the reservoir would be elevated and designed to "float" on the distribution system. The elevated tank would be 100 feet (30 meters) above the ground to the bottom of the tank. This system would allow adequate pressure to be maintained in the system through gravity, but would involve a relatively high first cost and, by its size and height, raise serious aesthetic concerns.

A second form of storage facility would be partially below-grade reservoirs located near the well. These reservoirs may be of concrete construction with rubberized or epoxy lining to prevent seepage losses and covered with a lightweight roof. An alternate form of reservoir could be earth supported fabric tanks. These low level storage options require a pump house containing domestic and fire pumps to deliver water to the distribution system at the desired pressure. Three 175 gpm domestic pumps would be provided to deliver water at rates from 175 gpm to 525 gpm which would meet the peak water demands of the system as well as the fire demand. An engine-driven, 500 gpm fire pump will also be provided as back-up. A small 50 gpm jockey pump is required to maintain pressure on the system during periods of low demand. An additional 175 gpm pump should be shelved as a spare.

Water Distribution

A single system of distribution mains is recommended as the most economical method of supplying water for domestic, fire protection, and landscape irrigation purposes. The water distribution system will consist primarily of 8" diameter water mains interconnected in a looped or grid-iron pattern. At all junctions, sectionalizing valves are provided so that any section can be isolated with minimum disruption of service. This arrangement of pipes provides a minimum of two sources of supply to any point in the system and also reduces head loss through the mains. Two connections across the nullah are recommended. The southern crossing should be along the at-grade vehicular ford and suitably protected against scour. The northern crossing should be via the pedestrian bridge. All households will be individually metered.

Fire hydrants are to be provided along the distribution system at roughly 400 to 500 feet (120 to 150 meter) spacing. It is recommended that a light pick-up truck equipped with hose, playpipes, axes, and first aid equipment be provided for each side of the nullah, and manned by University Department of Works personnel.

Irrigation of courtyards and the immediate landscaped areas surrounding buildings will be from hose bibbs. Broad areas to be irrigated may be provided with a system of large-diameter sprinklers. It is contemplated that the cultivated areas west of the nullah will be irrigated by flood and furrow means.

Sanitary Sewage

It is essential in promoting good health and sanitation practices and improving the quality of life at the University that a modern system of sewage collection and treatment be installed. The collection system should be extended to every building. Where required, acidic or toxic effluents from laboratory and research facilities are to be pretreated before discharge to the collection system. Sewers should be of buried vitrified clay or heavy duty polyvinyl chloride pipes. Gasketted joints to reduce infiltration and exfiltration should be provided. The sewage treatment facilities should provide a high level of treatment with BOD_5 removals of 90% and suspended solids removal of 95%. Effluent discharged from the treatment facilities will be controlled so as to avoid any ponding within the nullah.

Sewage Collection

The sanitary sewage collection system will consist of sewers ranging in size from 8" to 12" in diameter. Sewers should be sloped to provide minimum velocities of three feet per second and maximum velocities of ten feet per second and shall be sized to carry 2.5 times the average daily flow. Manholes are to be provided at all changes in direction and slope, at all major junctions, and at intervals not exceeding 400 feet (120 meters). The layout of the collection system will take advantage of the natural topography to allow gravity flow to treatment facilities, which will be located on each side of the nullah near the northern boundary of the site. Detailed topographic information must be provided before a final determination of the collection system routing and type and location of the treatment facilities is made, however.

Sewage Treatment

The amount of sewage flow to be treated may be estimated at 90% of the average domestic water consumption. Thus it is estimated that flows of 220,000 gallons per day will be generated by the end of Phase III development. These flows are about equally divided between the campus area east of the nullah and the housing colony west of the nullah.

Two methods of treatment are being considered. One method would be the use of stabilization ponds equipped with floating aerators for insect and odor control. Each side of the nullah would require approximately two acres of pond suitably cellularized. Effluent from the ponds could receive further treatment on intermediate sand filtration beds and possible chlorination before discharge into the nullah.

Another method of treatment being considered is the provision of package sewage treatment plants. A package plant, which would be factory fabricated and field erected, utilizing the activated sludge process, is the most likely version of this option. Other forms of treatment plants such as Rotating Biological Contactors, physical-chemical treatment, and sedimentation followed by an oval oxidation ditch where the effluent is circulated by rotating beaters (also known as the "Carrosel" process) should be evaluated after a detailed topographic survey has been secured.

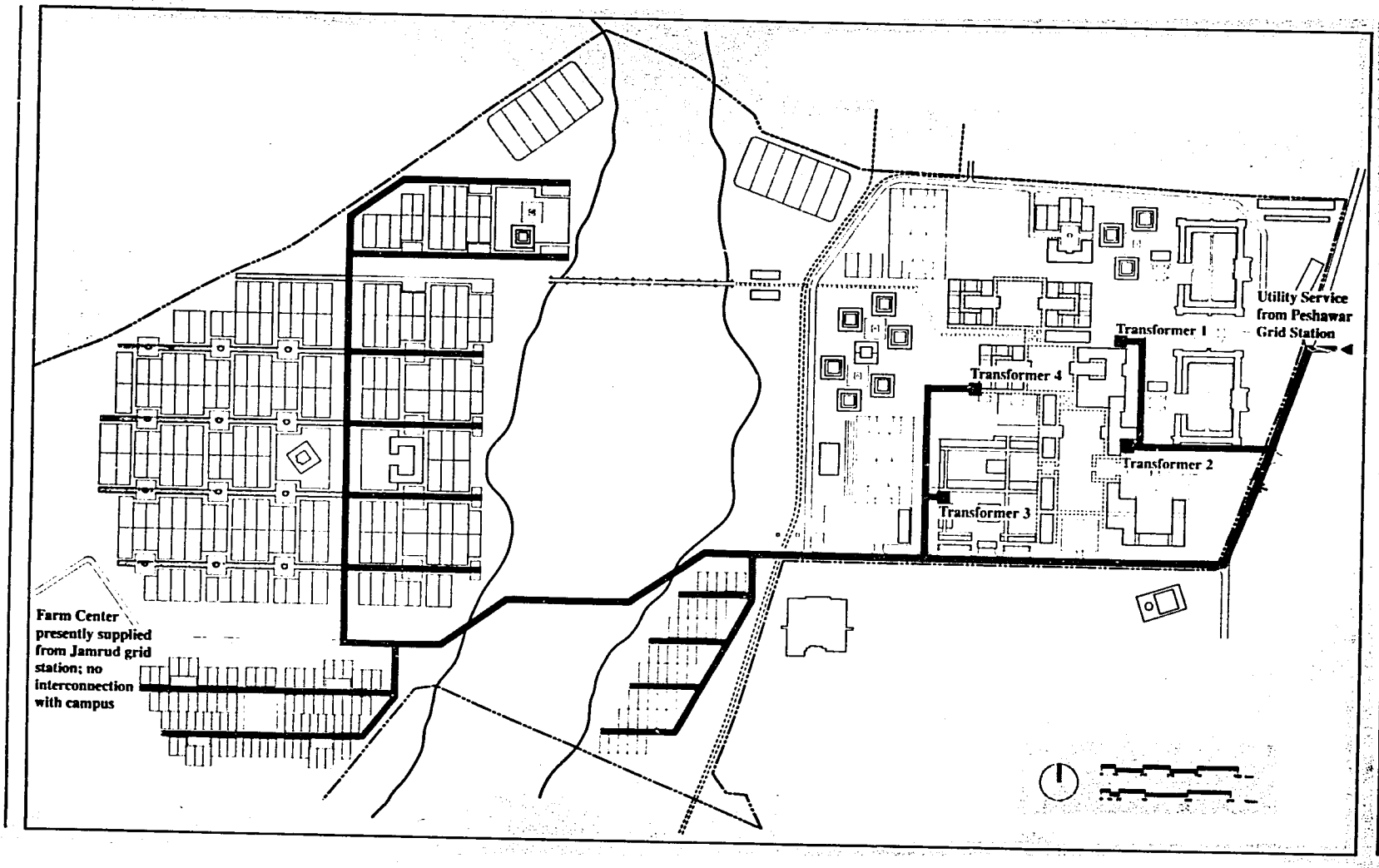
The quality of the effluent from any of the treatment alternatives will meet or exceed recognized standards for secondary treatment, and will be a significant improvement over the current situation.

Underground Electrical Power Distribution Plan

Phase I

Phase II

Phase III

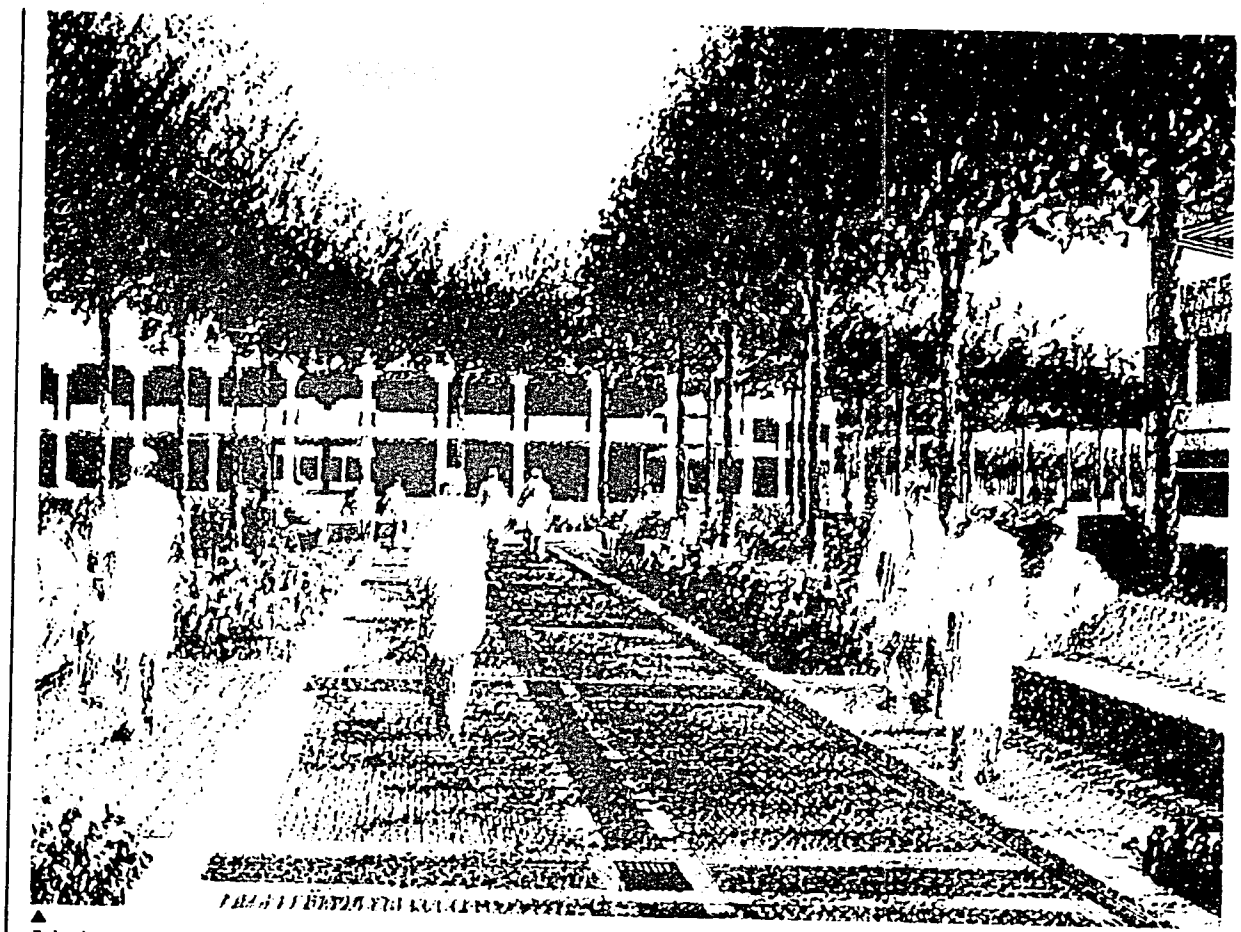


Storm Management

Although all structures within the nullah (i.e., the vehicular ford and the pedestrian bridge) will be designed to withstand the greatest flood of record, site drainage facilities on the campus will be designed to accommodate runoff from a five year storm. Overflow routes will be carefully examined to assess the extent of flooding when a five-year storm is exceeded. Specific drainage facilities may be upgraded to limit inundation in particularly sensitive areas. Typically, swales will be graded to provide flow velocities in the range of two to eight feet per second. These velocities are considered self-cleansing but not highly erosive. Small diameter culverts will be located to allow swales to flow under roadways, driveways, sidewalks, etc. In the housing area west of the nullah, swales will be located parallel to the east-west roadways on one side only, thus requiring fewer culverts for driveway crossings.

Based on topographic information produced thus far, it appears that the area of the existing hostels drains to the northeast. Every effort will be made to maintain this drainage pattern to minimize the volume of water flowing through the remainder of the campus, and to minimize regrading in the vicinity of the existing hostels. Further detailed site topographic data is necessary in order to produce a campus-wide storm drainage strategy, however.

In order to more fully utilize the available site in the vicinity of the nullah and to reduce the potential for disruption due to erosion, a program for stabilizing the banks of the nullah and possible reclamation of some of the riverbed is recommended. The preliminary concept (pending input from the soils consultant and more detailed topography) is to provide continuous bands of gabions on both sides of the nullah which will be integrated with the bridge abutments, swale outlets and ford crossing.



▲ *Pedestrian pathway leading to campus.*

Roadways

Site roadways will typically be designed in accordance with local practice. Pavement will be 24 feet (7.5 meters) wide with a one percent crown. The pavement structure will be composed of two inches of bituminous concrete over six to nine inches of aggregate base course and twelve to eighteen inches of select sub-base. Base and sub-base thicknesses will vary dependent upon anticipated traffic and sub-grade values. As an alternative to bituminous concrete, brick or other unit pavers may be used, particularly in areas of minimal vehicular traffic.

Vehicular access to the west side of the nullah will be by means of a roadway set flush with the bed of the nullah and located toward the southern edge of the site. Culverts will be provided at local depressions to allow some nullah flow to pass under this roadway. In the event of heavy rains, the pavement will be inundated and the roadway will be temporarily closed. Erosion control measures (gabions, riprap, etc.) will help to stabilize the roadway but occassional repair may be necessary. During periods of inundation, access to the west side of the nullah will be maintained by a pedestrian bridge located to the north, which could be designed to carry light vehicular traffic to provide continuous access for emergency vehicles.

Roadways west of the nullah will be designed as low speed, low volume streets consistent with the residential character of the area. Vehicular access will be provided to all housing units.

East of the nullah, vehicular traffic will be concentrated on the perimeter roadway which encircles the campus. The balance of the campus will be oriented toward the pedestrian. Vehicular roadways will be kept to a minimum so as not to impede pedestrian circulation. Some pedestrianways will be designed to carry occasional vehicular traffic to allow access for emergency vehicles and essential services. Any specific pre-existing rights-of-way through the site will be maintained as required.

All of the roadways and major pedestrian paths on the east side of the nullah will be provided with street lighting. On the west side, the pedestrian bridge and major roadways will be lighted; lesser roadways will not.

Parking

Short-term parking will be provided at the main entry court to the campus. Longer-term parking will be provided along the southern edge of the campus. Approximately fifty spaces, designated for senior staff and VIP's, will be covered. Additional open lot parking will be provided south of the soccer field.

Gas

Gas can be provided throughout the campus for water heating, space heating, and cooking purposes, provided adequate supplies are projected to be available. If sufficient gas is not available, these functions will have to be served through the use of electric power.

Shipping/Receiving

Centralized shipping/receiving functions will be handled at the Physical Plant loading dock, located at the western end of the existing main academic/administrative building. Secondary shipping/receiving points will be located at the Learning Resources Center, and at each of the Faculty buildings. Student dining halls will also require frequent service access.

Electrical Distribution

Existing electrical service to the portion of the campus on the east side of the nullah consists of a single three-phase, 440 volt, 11 KV, 50 Hertz conductor from the Peshawar Grid Station, located approximately three miles from the campus.

Three transformers are presently serving the campus. Their capacities are 100 KVA, 200 KVA and 100 KVA respectively. All three transformers are located on the east-west line passing between the two hostels.

The Farm Center is served by an 11 KV supply line, and a 100 KVA transformer located near the Center. This service is fed by the Jamrud Grid Station, located to the west of Peshawar.

An estimated future demand load of 2.57 Megawatts was derived by applying the U.S. National Electrical Code's watts-per-square-feet standard. Although high by comparison to present day usage levels in the Peshawar area, the projected Megawatt demand level provides a useful planning target at this stage of master plan analysis. Utility company officials (WAPDA) have indicated that the present existing campus power supply line is incapable of sustaining the future expected load of approximately 2.6 Megawatts. A new power line directly from the Peshawar Grid Station to the University campus will therefore have to be installed, at a cost yet to be determined.

Distribution feeders will extend the utility services to unit substations at four campus locations. Feeders will be three phase, except those serving the housing facilities, which may be of single phase configuration. Routing of site distribution feeders will be underground throughout the campus and housing colony complex.

Unit substations, incorporating transformation and distribution equipment, will be located in or adjacent to the buildings they are designed to serve. Building utilization voltage would be 230/400, 50 Hertz.

Masts or ground wires, or surge arrestors should be incorporated in the site distribution system to alleviate surge conditions.

Utility service voltage stability, outage frequency and duration, and program requirements will determine the extent of standby power system(s) required to adequately serve all critical loads such as equipment, science laboratories, communications facilities, freezers and fire and life safety systems. An uninterruptable power supply (UPS) should be considered for sensitive loads such as computer facilities and data processing. Small power generating units will be provided as required, and be sized to serve all the designated critical loads via automatic transfer switches, in case of power outage. Emergency and exit lights could be served from battery units. Possible application of photovoltaic technology will also be studied during the detailed design phase.

Telephone Communications

A telecommunications plan for the Agricultural University was developed by a U.S. consulting firm, Professional Planning Associates, Inc. A Private Automatic Branch Exchange (PBAX) System is proposed, consisting of either 12 trunks and 80 stations, or 20 trunks and 144 stations. The PABX equipment room is to be located on the second floor of the existing administration wing of the main building, in the former photo lab. The room must be secure and provided with climate and dust control equipment. All distribution wiring between buildings will be placed in underground conduits. A telephone closet will be located in each principal building on campus.

BUILDING DESIGN CONSIDERATIONS

A variety of building design and technology issues have been explored in preliminary fashion during the Master Plan phase. These initial studies will provide a starting point for detailed architectural and engineering design work as the project proceeds.

Seismic Considerations

According to the Seismic Zone Map of Pakistan, the country is divided into four seismic zones, based upon effective peak acceleration of the ground during an earthquake. The four seismic zones in Pakistan are categorized in accordance with probable damage which may occur due to the intensity of ground motion.

In order to determine the equivalent lateral force on the building during an earthquake, the building codes in the United States specify seismic zones (Zone 0 through Zone 4) in accordance with the seismic risk in that area, as set forth in the "Seismic Risk Map of the United States".

There is a correlation between the U.S. Seismic Risk Map and the Pakistan Seismic Zone Map based on horizontal acceleration. A comparison of the seismic zone map of Pakistan with the zoning map of the United States indicates that the following equivalent U.S. zones could be extrapolated:

Seismic Zone (Pakistan)	Equivalent Zone Based on UBC
Major (g/5 to g/10)	Zone 3
Moderate (g/10 to g/15)	Zone 2
Minor (g/15 to g/20)	Zone 1
Negligible (g/20 or less)	Zone 0

(Zone 4 in the U.S. is that area within Zone 3 that is determined by its proximity to certain major fault systems.)

According to the Seismic Zone Map of Pakistan, Peshawar lies in the "Minor Damage" zone. This will place it in Zone 1 of the Uniform Building Code.

However, due to the very approximate method of correlating these zones with the UBC, it is recommended that the structural design should be based on Zone 2 of the Uniform Building Code. All structural elements shall be designed and detailed in accordance with the seismic provisions of the Uniform Building Code. Lateral bracing and stability of the structure shall be achieved either by ductile reinforced concrete moment resisting frames or reinforced concrete shear walls.

Foundations

Foundations for all the structures are anticipated to be shallow isolated spread or combined footings, bearing on undisturbed natural soil. Each footing shall have varying thickness with a minimum of 8" near the edge of the footing, to the required depth at the face of the columns.

Structural Systems

Reinforced concrete framed construction shall be most appropriate for most of the two to three storied structures proposed for the campus. This system shall consist of cast-in-place reinforced concrete frames supporting solid concrete "one-way" or "two-way" slabs, depending on the ratios of slab spans.

The sizes of structural members shall be selected in such a manner as to use the least amount of reinforcing steel, as this is the most expensive structural material in Pakistan. This could be achieved by limiting span/depth ratios for the slabs between 18 to 24, and for the beams between 12 to 16. Generally, the most economical framing system shall be that which achieves the least amount of material, even if it is more labor intensive. This is contrary to the U.S. practice.

Lateral bracing of the buildings will be achieved either by moment resisting ductile frames or reinforced concrete shear walls.

Expansion joints in the structure should be provided at a distance between 150 feet to 200 feet (45 to 60 meters). Normally, double columns are provided at the locations of expansion joints.

All nonstructural partition walls shall be brick infill. Load-bearing walls and reinforced concrete slabs are feasible systems for single story buildings.

Large span spaces, such as auditoria or convocation halls, could be framed with cast-in-place concrete beams in a two-way grid pattern, supported on frames at the perimeter of the space. If necessary, the beams could be post-tensioned. However, post-tensioning will be quite expensive.

Materials Availability

To assist in controlling costs, efforts will be made to maximize the use of building materials made and readily available in the Peshawar area, or elsewhere in Pakistan. Cement, local aggregate, and locally-produced brick will be utilized extensively, and are expected to be available as needed. However, the building contractor will be required to stockpile sufficient materials to assure against delays due to non-availability.

Reinforcing steel, PVC piping, plumbing fixtures, wiring, aluminum doors and windows, and other specialty items are generally available in the marketplace. Some items, such as electric motors and generators, are available but are usually of foreign origin.

Environmental Systems

The most essential step in the development of environmental systems is to create an architectural design which is responsive to the environment. Prior to undertaking final architectural design, a thorough climatic analysis will be performed using hour-by-hour computer weather data, including temperature, relative humidity, wind speed and direction, precipitation, solar angle and intensity data, on a monthly and yearly basis. The climatic analysis will serve to identify and establish the aspects of the local climate which may be used advantageously, as well as the aspects that will require exclusion, to create an environmentally successful design. The programming and occupancy schedule of the various facilities wil be a major contribution to the environmental design strategy. The analysis will progress toward a series of environmental design guidelines to help achieve an architectural design harmonious with the local environment. The guidelines will be used in conjunction with the architectural engineering program and functional needs to evolve the best possible overall design solution for the University.

Indoor design criteria for the various facilities will be determined in terms of temperature, humidity, air motion, etc., and various methods of supplemental conditioning will be explored. Essentially, three types of spaces have been defined with regards to comfort control, and the design criteria obtainable for each will be determined. They are as follows:

Passively Conditioned — These are areas with more relaxed design criteria. Conditioning will be maintained through the beneficial interaction of the architecture and the environment. These areas would primarily be housing and classrooms.

Partially Conditioned — Areas requiring a higher maintenance of temperature and humidity control. These areas will be designed to operate on a passive basis for a portion of the year, and mechanically cooled during other portions. Energy efficient methods, such as direct and indirect evaporative cooling, will be explored for these areas, which may include large auditoriums and laboratories.

Fully Conditioned — Areas requiring strict maintenance of indoor conditions will be mechanically cooled locally. These areas would be electronic laboratories, computer facilities, and other specialized designated spaces.

Environmental Design Guidelines

The following design guidelines have been developed to aid in designing the architectural and mechanical environmental systems. The guidelines are preliminary, having been based on generalized climatic data for the Peshawar region. More specific environmental design strategies will be developed concurrent with detailed architectural design for the proposed campus and housing buildings.

Housing — Housing areas will be naturally cooled through the summer season. The following guidelines may be used to maximize the level of environmental comfort during the summer period:

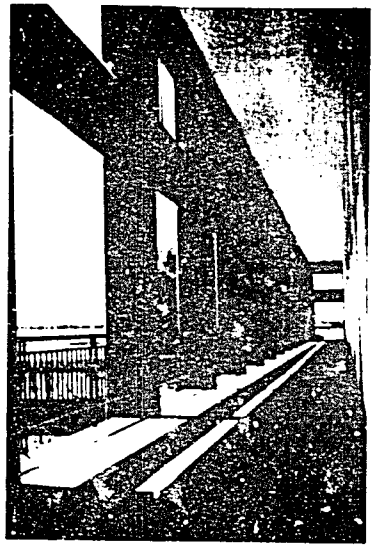
- Use building thermal mass to dampen the effect of the hot daytime temperatures and solar radiation;
- Provide complete summer solar shading of interior and habitable exterior spaces such as circulation areas and courtyards; and
- Include architectural elements such as operable windows and courtyards that would maximize the natural ventilation potential of the design utilizing a combination of thermal (stack effect) and dynamic wind forces.

The housing units, containing very little internal heat generation, will require heating during the moderate winter season. The amount of heating will be reduced by the following:

- Maximize south facing spaces and glazing areas;
- Minimize east, west and north facing spaces and glazing areas except those facing courtyards; and
- Allow natural ventilation elements described above to be controllable.

Academic Areas — Academic areas exhibit higher internal loads and are occupied primarily during the daytime hours. The following guidelines are suggested:

Devices to be utilized as environmental control features include covered walkways, or arcades, landscaped courtyards, and water features. Solar orientation and wind characteristics will also be carefully assessed.



- Maximize daylighting:
  - Allow daylight penetration to all areas through building massing with elements such as courtyards;
  - Provide high ceilings (3.6 to 4.5 meters or 12 to 15 feet) to improve daylight distribution;
  - Determine optimum glazing areas to attain a balance between cooling and lighting load and energy;
  - Utilize diffuse daylighting only.
- Use building thermal mass to dampen the effect of the hot daytime period and solar radiation;

- Incorporate insulation and shading for roof elements;
- Provide for complete summer solar shading of interior and habitable exterior spaces such as circulation areas and courtyards;
- Orient spaces to receive winter morning direct solar radiation (southeast facing);
- Incorporate natural ventilation.

These guidelines apply to conditioned, as well as unconditioned spaces.

PROTOTYPICAL SPACE PLANNING ANALYSIS

Prototypical space planning studies have been undertaken for typical academic and student residence structures.

Prototypical Academic Buildings

New academic buildings will be designed with an internal courtyard that opens onto the system of larger courtyards which forms the central circulation spine of the new campus. The main entrance of each Faculty will be oriented on direct axis with the formal circulation court, thus providing a strong visual and symbolic connection with the rest of the campus. The two-story structure will be organized into functional zones that begin with shared spaces (such as classrooms) nearest the central campus courts and move away from the courts with more specific functions (such as specialty laboratories). The concept is to create gradations of use from general to specific moving away from the central academic circulation spine.

The diagram below illustrates how a typical academic faculty might be organized. This purely illustrative concept will be adjusted during architectural design in order to accommodate the specific programmatic requirements of each Faculty.

Academic Space Planning

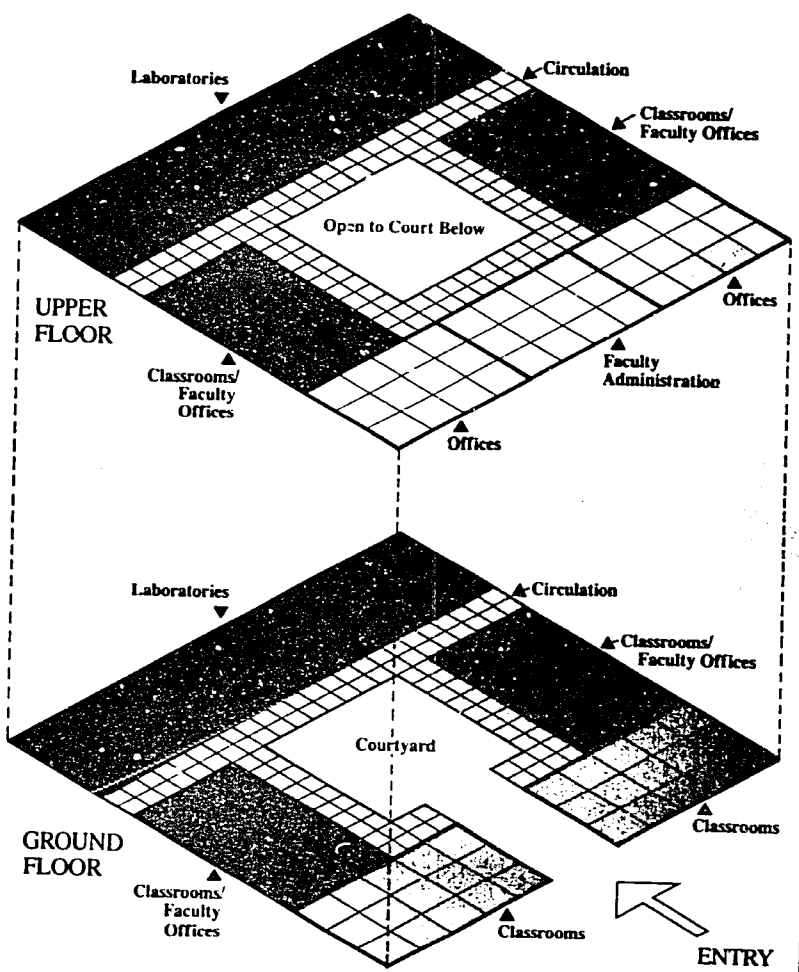
A space utilization system has been developed for planning new academic structures. The system includes prototypical component standards for offices, classrooms and laboratories. Each component has been studied in terms of its optimum function, efficiency and flexibility. Since the precise programmatic requirements of each Faculty and yet to be brought to the level of detail required for final architectural design, a flexible organizational system has been outlined which would allow any combination of component elements to create a functionally complete and efficient Faculty building.

The basic system is organized around a 3.6 meter square (11'-10") module that is superimposed on a 10.8 square meter (35'-6") structural grid. Each basic component is made up of 3.6 meter x 3.6 meter (12.96 square meters or 138 square feet) modules which are combined to achieve an optimum configuration for the specific component.

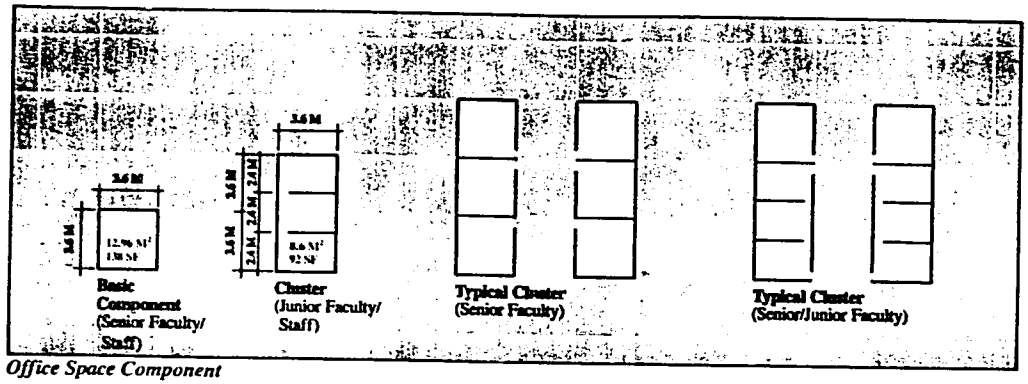
Offices — The basic office component for a senior faculty or staff person consists of one 3.6 meter square module (12.96 square meters or 138 square feet). For junior faculty and staff or support personnel, two modules are combined and then divided into three work stations. This would provide an average of 8.6 square meters or 92 square feet of work space for each junior or support staff person. The 3.6 meter square office module affords unlimited flexibility and can be organized as a cluster that would meet the needs of any particular faculty.

Research Laboratories — There are two basic types of laboratories—research labs and teaching labs. The basic research lab component is a 3.6 meter x 3.6 meter module. This provides 12.96 square meters (138 square feet) for each researcher. Since the optimum size of research lab space will ultimately be determined by the specific type of research being conducted, the number of individuals involved in a given research project, and special equipment requirements, this module can be combined and/or clustered to accommodate any specific research technique and its required scientific equipment.

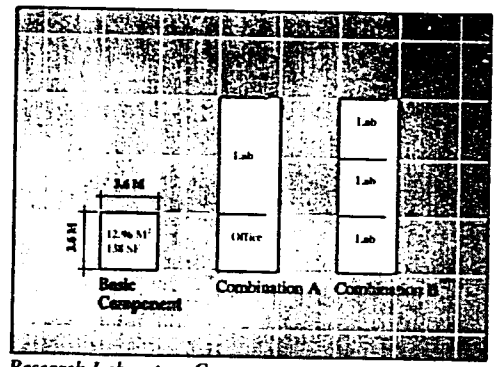
Teaching Laboratories — Teaching labs will vary in size from 24 to 40 work stations. The basic component is composed of three 3.6 meter square modules (3.6 meters x 10.8 meters). The 3.6 meter x 10.8 meter component will accommo-



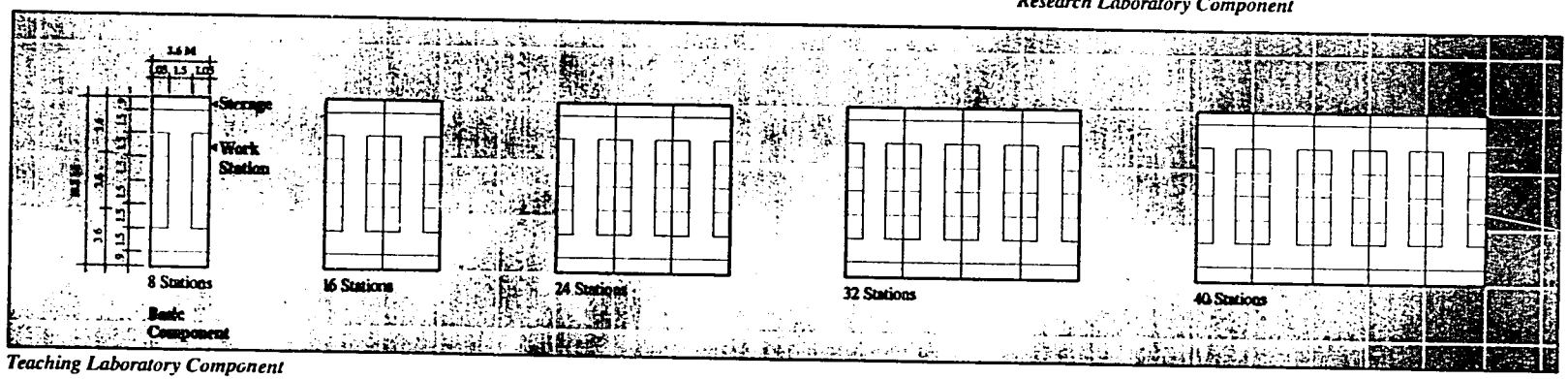
Organizational Zones of Typical Academic Faculty Building



Office Space Component



Research Laboratory Component

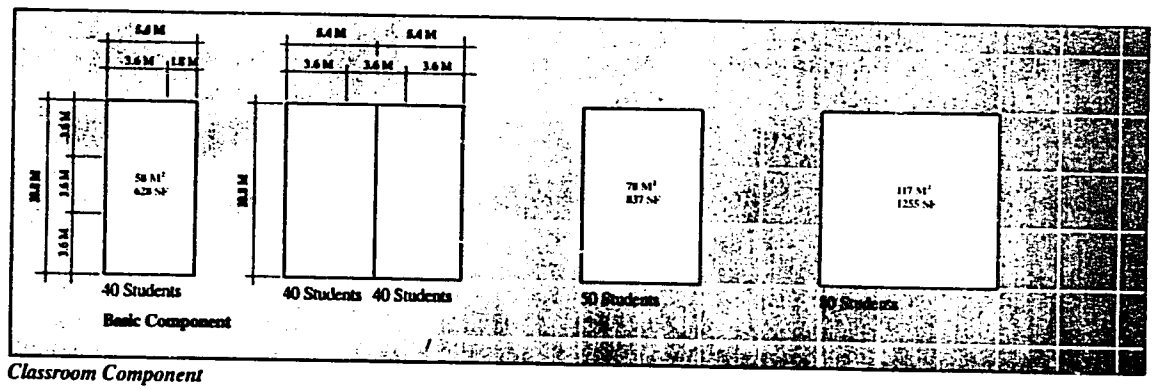


Teaching Laboratory Component

date eight lab stations and provide ample circulation and storage space. Any grouping of this component will produce excellent laboratory space which can accommodate 24 students (three basic components) to 40 students (five components side-by-side). By utilizing the basic 3.6 meter square design module, maximum flexibility is achieved and any lab configuration fits well within the structural grid of 10.8 meters square.

Classrooms — The classroom component is also based on a 3.6 meter square module. The basic classroom is 1½ modules wide by 3 modules deep (5.4 meters x 10.8 meters), and is designed for 40 students. Two classrooms side-by-side or 40 students each are neatly organized and fit well into the 10.8 square meter structural grid. A 2 x 3 module (7.2 meters x 10.8 meters) is ideal for 50 students and a 3 x 3 module (10.8 meters x 10.8 meters) provides ample space for 80 students.

The 3.6 meter square module, in conjunction with a 10.8 meter square structural grid, will provide optimum flexibility in the organization and final configuration and allocation of classroom space.



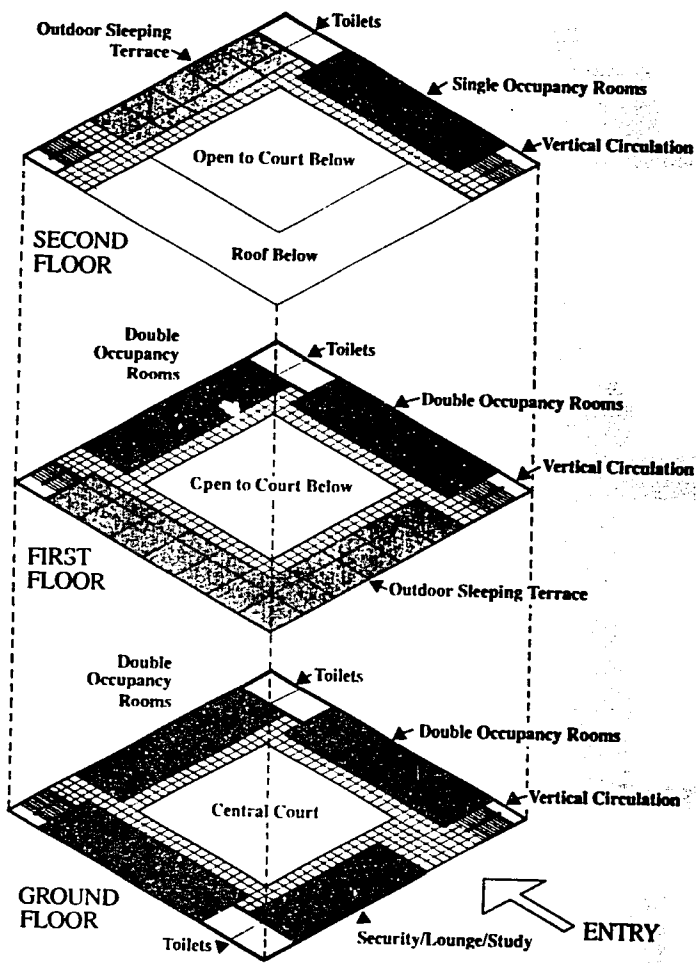
Classroom Component

Prototypical Student Residences

The Master Plan provides newly constructed living quarters for 560 students. Ten new student residences will be built that house an average of 56 students each. The student residences are organized in a clustered fashion and each cluster of three units will be provided with a detached dining facility. As the University expands, more residences of similar design will be constructed to accommodate the increasing number of students living on-campus.

Of the 56 rooms in each residence, 90% (50 rooms) will be for double occupancy and 10% (6 rooms) will be single rooms. The three-story structure will be organized around a central open court. The ground floor will have a secure entrance and will also contain a lounge and study area. Each floor will have covered terrace areas for outdoor sleeping during the summer months, and contain common toilet and shower areas.

Each student will be allotted approximately 10 square meters (107 square feet) of living space for double rooms and 12 square meters (125 square feet) for single rooms, and will be provided with a bed, a desk with bookcase and chair, and a wardrobe.



Prototypical Student Residence

PHASING OF DEVELOPMENT

The Project Phasing Schedule and Phasing Summary Charts on the following page depict the principal stages of activity in the development of the Agricultural University campus expansion.

MASTER PLAN PHASE

The first task—Master Plan and Site Survey—was initiated in April 1983 and will continue into the spring of 1984 when a detailed site survey is to be completed. This Master Plan report documents the physical implications of the development program and describes the sequence of actions which must take place over a ten-year development period to achieve full development of the project, as currently programmed.

The principal findings and recommendations of the Master Plan report will be reviewed and revised periodically. As indicated by the schedule chart, these reviews will occur in mid-1987, mid-1990 and late 1993. In each case, progress to date will be evaluated and documented, and unforeseen events which may affect the substance or timing of campus development will be identified. This periodic evaluation procedure will help assure that the Master Plan remains current so that, as necessary, later development phases can be redirected to better respond to emerging needs and conditions.

Project Phasing Schedule

PHASE I DEVELOPMENT

Phase I Development is scheduled to begin in early 1984. Final architectural and engineering design of the Phase I building program will be prepared over a six to eight month period. During the latter part of 1984 and early 1985, Bid Documents will be issued and a contractor selected. Actual construction will begin in the spring of 1985 and last for at least three years, to mid-1988. Phase I buildings will be available for occupancy for the 1988-1989 academic year. By this point, significant increases will have occurred in student enrollments (680 students in 1983 to 915 in 1988) and in the number of faculty and key staff (91 in 1983 to 150 in 1988).

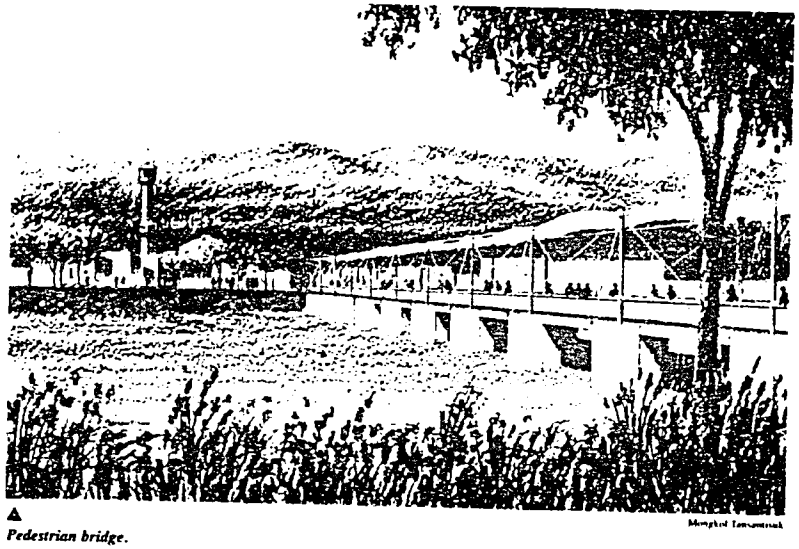
A primary objective of the Phase I development program is creation of a recognizable campus core and campus entry, introduction of new educational facilities such as the Learning Resources Center and major portions of the Outreach/Continuing Education Center, and accommodation of increased demand for on-campus student residential space.

Approximately 40% of all academic space, consisting of classrooms, offices and laboratories, will be constructed during this phase, including the entire Plant Sciences Faculty building, housing major portions of the largest of the proposed four faculties.

The core administrative and teaching components of the Outreach Center will be constructed at the principal entry to the campus. The complete Learning Resources Center (LRC) will also be constructed, at the center of the campus. The LRC includes the library and the communications production and teaching facilities. A computer research and training center will be associated with the LRC. The size, quality and technical sophistication of the facilities included in this complex will far exceed those currently available to the faculty and students of the Agricultural University.

The Student/Faculty Center will form the northern edge of Phase I construction. The center will provide a common meeting space for all students and faculty, filling a function which is met poorly on the existing campus. A medical dispensary for male students and faculty will also be part of this complex. The inclusion of the Student/Faculty Center in the first phase of construction is in explicit recognition of the need for an improved total campus environment, addressing extracurricular as well as academic needs of the student body and faculty.

Twenty long-term Visiting Scientists' Housing units for use of visiting faculty members and other temporary members of the University community will be developed near the Student/Faculty Center.



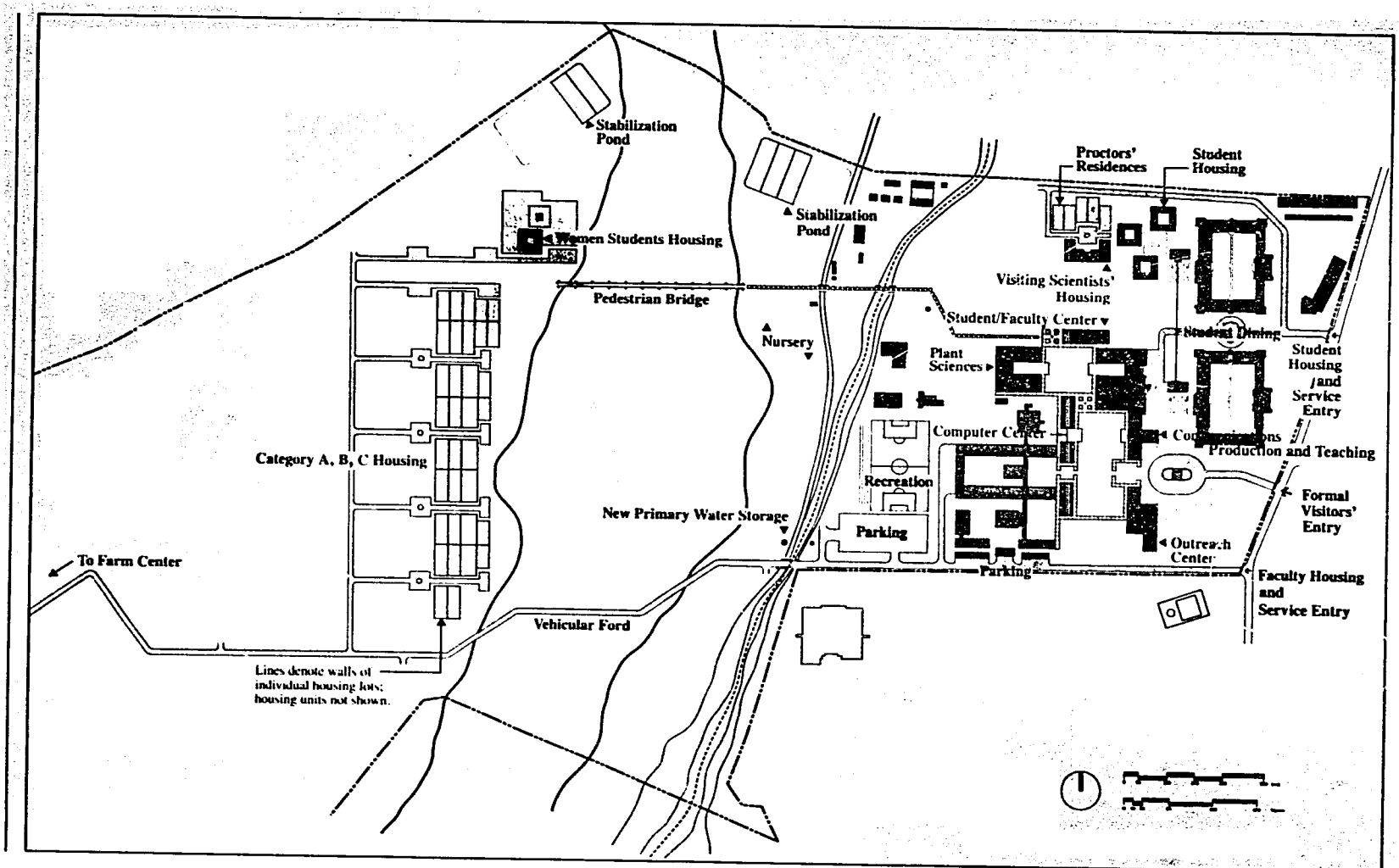
▲ *Pedestrian bridge.*

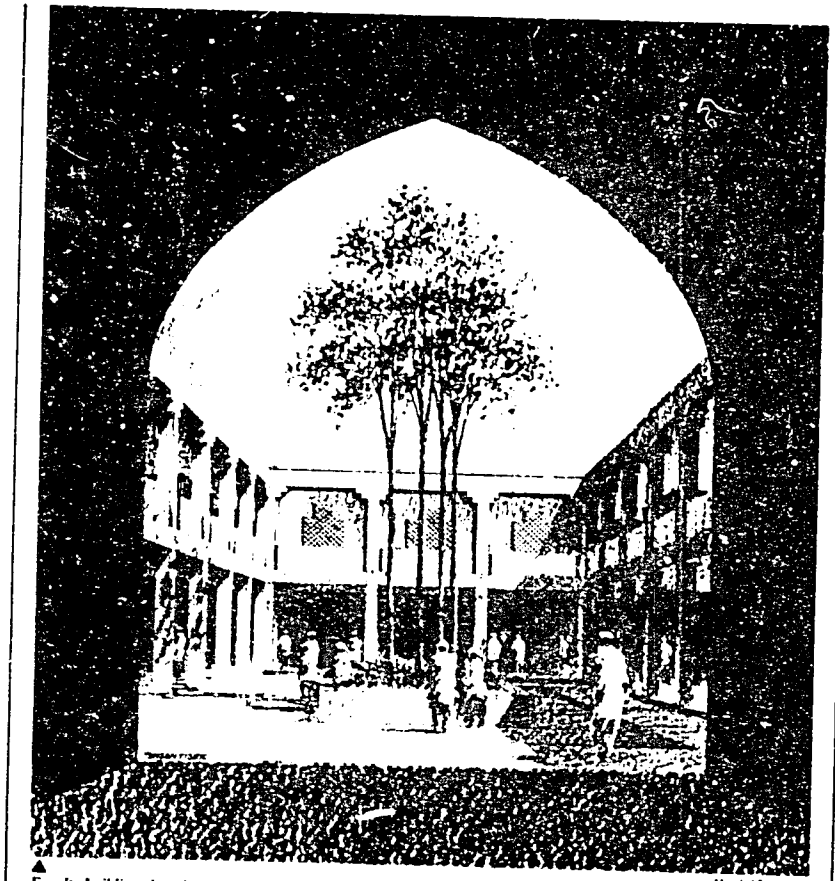
Mengkiel Tamsentnak

Program Element	Gross Square Feet	Gross Square Meters	% Total Program	Construction Cost ($1983)
A. Academic Space				
• Classrooms & Offices	27,330	2,530	40%	$ 762,000
• Research & Teaching Labs	32,200	3,000	40%	1,046,000
• Farm Center	29,075	2,700	50%	540,000
B. Academic Support				
• Learning Resources Center	80,925	7,525	100%	2,355,000
• Computer Center	4,500	425	100%	148,750
• Outreach Center	16,200	1,500	100%	450,000
C. Other Support				
• Student/Faculty Center	20,625	1,925	100%	577,500
o Dispensary (1)	1,825	175	54%	43,750
D. Housing				
• Student Housing (Men)	35,225	[illegible],275	18%	656,450
Student Housing (Women)	12,825	1,200	100%	238,000
• Student Dining	9,000	850	67%	250,000
• Visiting Scientists' Housing	18,000	1,675	100%	335,000
• A,B,C Housing	89,000	8,275	20%	1,655,000
E. Housing Support				
(None in Phase I)	—		—	—
F. Infrastructure & Site Work				
• 60% of Total Program	—	—	60%	1,655,000
Subtotal				$12,904,650
Contingency @ 10%				1,290,365
Total				$14,195,[illegible]
Less A, B, C Housing, Housing Support And Related Infrastructure				(2,932,[illegible])
Net Phase I Total				$11,262,765

Phase I Development

- New Building Development
- Existing Building Development
- New Site Improvements





▲ *Faculty building: interior court.*

Three student residential buildings housing 165 men and one building housing 60 women students will be added to the campus during Phase I. The men's units will be located near the new northern perimeter road, adjacent to the existing hostel. New free-standing dining facilities will be constructed to serve residents of the existing hostels as well as the newly contructed student residences.

The women's residence building will be placed on the west bank of the nullah. In keeping with Pakistani cultural traditions, the women's residence will be enclosed and secure. Separate dining facilities and recreation space will be provided within the compound. A dispensary for use by the women students and female members of families residing in the housing colony will be situated near the women students' compound. The introduction of women to the student body of the Agricultural University represents a major step towards inclusion of women in the ranks of trained agricultural personnel throughout the province and the nation.

Phase I will include the development of 20%, or 40 dwellings, of the higher level (i.e., A, B and C category) faculty and staff housing. Eight of these units will be situated on the east bank of the nullah, where they will house the student residence proctors. The balance of the A, B, C units [illegible] be completed in Phase I will be constructed [illegible] west bank, in the housing colony proper.

Major infrastructure and site work improvement undertaken during Phase I will include new sanitary sewage systems serving each side of the nullah, the repairing and/or construction of new roadways, new water, telephone and electricity lines, a soccer field, and significant new landscaping throughout the campus and the housing colony.

Intensive new landscaping and paving will occur in the heart of the campus in the courtyards defined by the Plant Sciences Building, the Learning Resources Center and near the entry to the campus. This landscape treatment will assist in creating a "finished" appearance to key elements of the campus, notwithstanding that major construction activity will continue on adjacent parcels over the following five or six years.

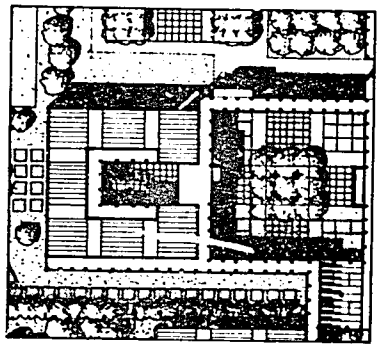
Finally, Phase I will include renovation and new construction of approximately one-half of the farm center at the heart of the agricultural fields on the west bank of the nullah.

The cost of Phase I construction will total $14,195,365 (1983 dollars).* Of this amount, $2,932,600 is estimated to be spent on faculty housing and related infrastructure improvements, leaving a net cost of $11,262,765 for the academic, student housing and related buildings.

New academic space (classrooms, offices and laboratories) totals some 5,530 gross square meters. Together with the approximately 6,900 square meters in the existing academic building and 830 square meters in the IDS building, which is also assumed to be occupied before the end of Phase I, a total building inventory of 13,260 gross square meters (142,000 G.S.F.) will be available to the University by 1988.

In addition, major academic support space, consisting of the Outreach Center, the Learning Resources Center and a Computer Center, will also be open. These facilities will total an additional 9,450 gross square meters (101,625 G.S.F.).

* All costs presented in the Master Plan text are stated in constant 1983 dollars.



PHASE II DEVELOPMENT

Phase II will begin prior to completion of Phase I construction activities. A project review and evaluation scheduled for the spring of 1987, will provide a basis for refining and adjusting programmatic objectives for the Phase II effort.

Phase II final design will be accomplished during 1986, while Bid Documents will be issued and a contractor selected in early 1987. Phase II construction will begin in spring of 1987, and extend to mid-1990.

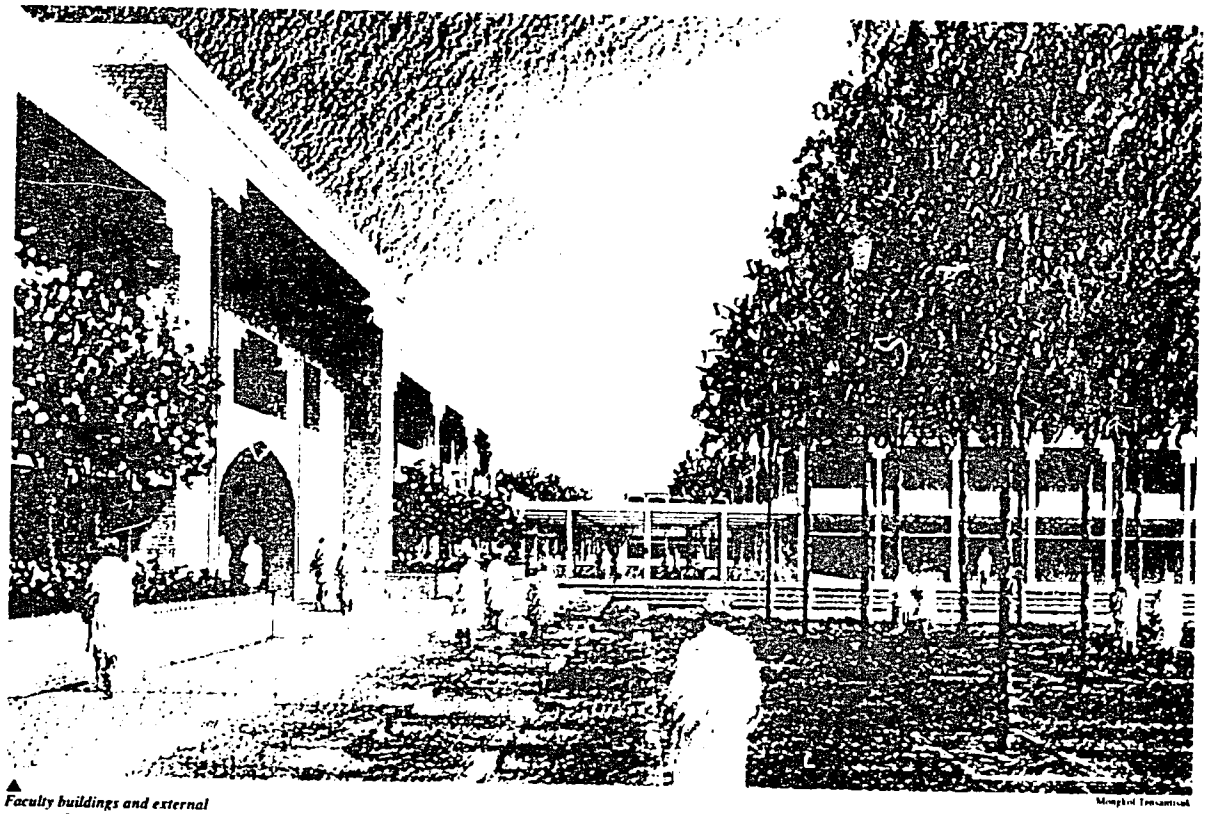
Major additions to the campus to be made during Phase II include another 40% of the programmed Academic space (classrooms, faculty offices, and research and teaching laboratories). Within this program component, the new Engineering Applications and Food Technology Faculty building will be completed during this Phase, while the Rural Social Sciences Faculty will be housed in renovated quarters within the existing main academic building.

Near the main entry to the campus, the Outreach Center's overnight housing accommodations for short-term visitors to the campus will be constructed. Central Administration space, housed partially in new construction and partially in renovated space in the existing administrative building, will also be developed, thereby completing major construction activity near the most prominent entry to the campus.

As new academic space becomes available, demolition of the sub-standard laboratory addition to the north of the existing main academic building can be undertaken. The resulting courtyard, framed by the new Plant Sciences building, the Computer Center and the northern wing of the existing academic building, will be used for development of an outdoor amphitheater, or campus gathering space. It is intended that this space will accommodate groups or events which would overflow any of the planned indoor spaces. Such events might include graduation ceremonies, major convocations or other large meetings. Approximately 1,000 persons or more could comfortably be accommodated in the outdoor gathering space. During final design of this space, options for providing permanent and temporary seating and shading devices will be explored.

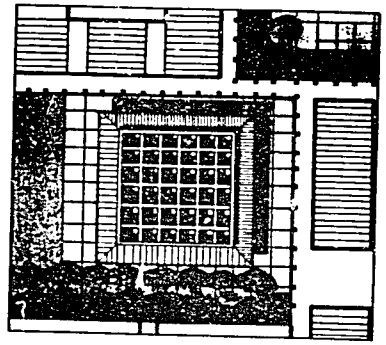
Phase II construction will also include renovation of the existing two-story auditorium in the existing academic building. With a capacity of 500 to 600 seats, this facility will comprise the largest indoor meeting place and lecture hall.

With respect to student housing, Phase II will see the construction of three residence buildings for 165 male students, plus related dining facilities. The southernmost of the two existing hostels will be renovated in order to improve the character and safety of these dwellings. Following renovation, 200 students will be housed in the structure.

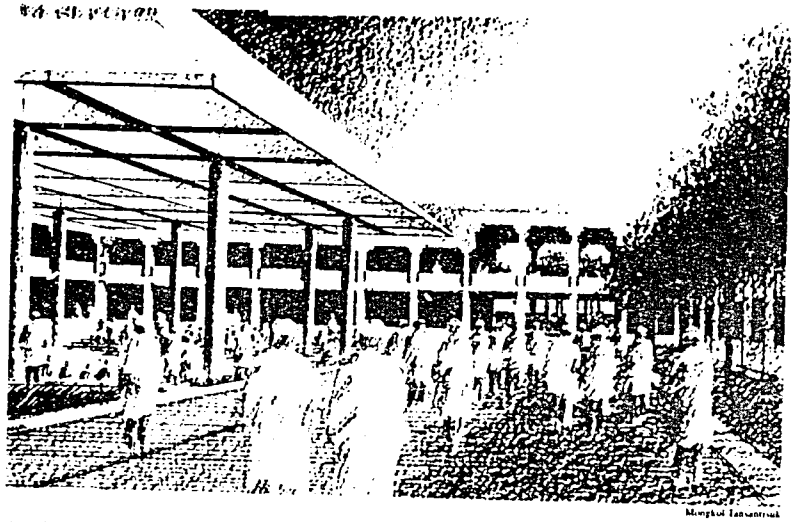


▲ *Faculty buildings and external courtyard.*

Memphis Tennessee



Outdoor amphitheatre and computer center.



An additional 20% of A, B and C category housing will be put in place, and 100% of the D, E and F housing. A small commercial area will be opened for the convenience of students and faculty, while a mosque and elementary school will be added for use by residents of the faculty/staff housing colony.

The farm center buildings in the western end of the campus will be finished, while on the east campus, covered parking areas and approximately one-half of the Physical Plant (i.e., Department of Works) space will be provided.

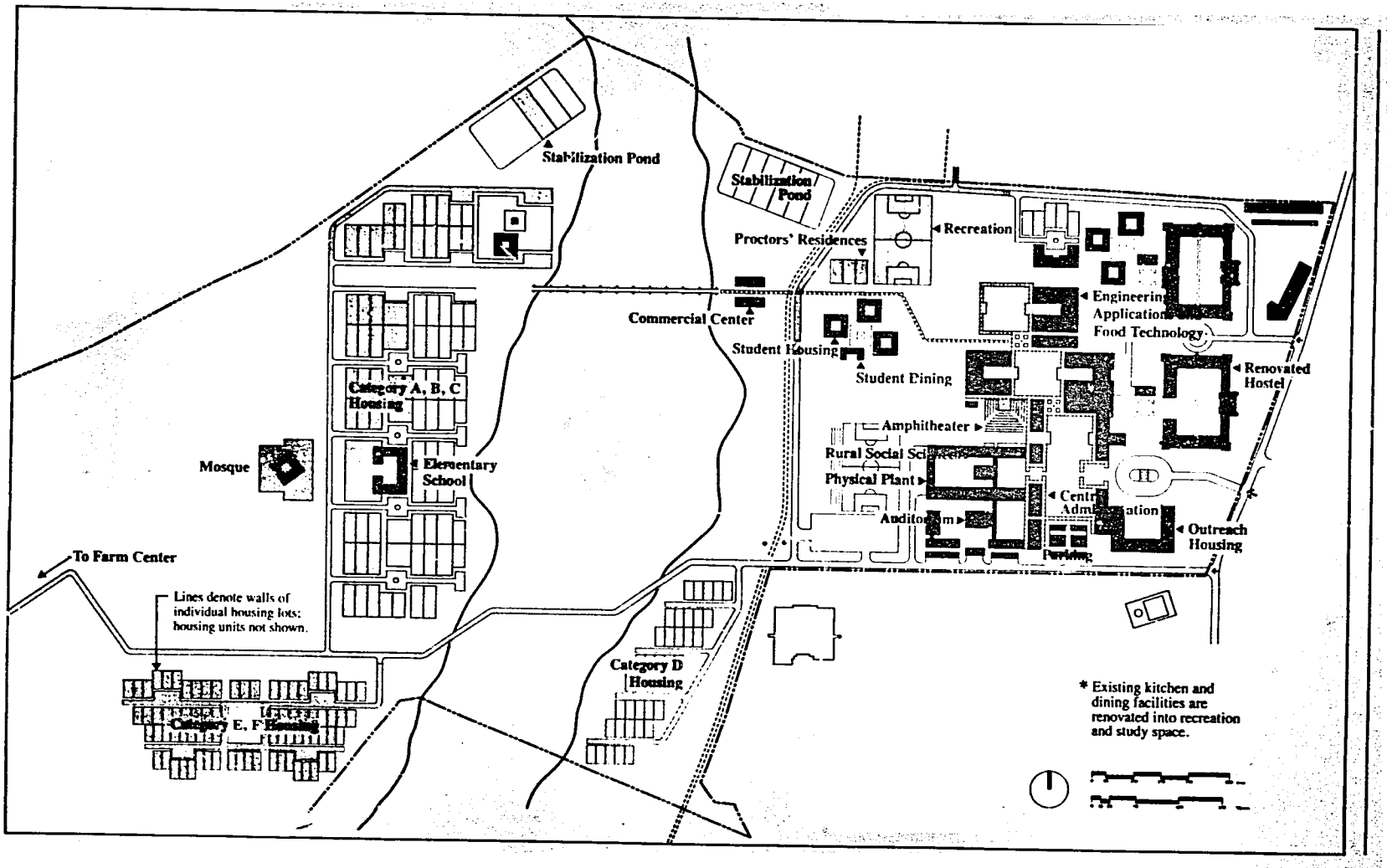
Major infrastructure and site improvement elements will include relocation and lining of the several irrigation canals which traverse the campus parallel to the east bank of the nullah, completion of the perimeter roadway system adjacent to the east campus, and further extension of the roadway, water, sanitary sewage and other utility services in the housing colony portions of the project. Construction of this segment of the perimeter roadway will necessitate demolition of the remaining out-buildings near the irrigation canals. Landscaping and paving of areas adjacent to completed construction sites will also be accomplished.

Phase II construction costs total $11,148,860 Of this amount, $4,919,525 is estimated to be spent on faculty/staff housing, housing support facilities, and related infrastructure, leaving a net cost of $6,229,335 for new and renovated academic, student housing and related improvements.

Program Element	Gross Square Feet	Gross Square Meters	% Total Program	Construction Cost (@1980)
A. Academic Space				
• Classrooms & Offices	27,330	2,530	40%	$ [illegible]
• Research & Teaching Labs	32,200	3,000	40%	[illegible]
• Farm Center	29,075	2,700	50%	[illegible]
B. Academic Support				
• Auditorium	7,200	675	100%	[illegible]
• Central Administration	16,350	1,525	100%	[illegible]
C. Other Support				
• Athletic/Recreation	6,800	625	33%	[illegible]
• Dispensary (1)	1,550	150	46%	[illegible]
• Physical Plant	9,000	825	50%	[illegible]
• Covered Parking	11,250	1,050	[illegible]	[illegible]
D. Housing				
• Student Housing	78,000	7,250	41%	[illegible]
• Student Dining	4,500	430	33%	[illegible]
• Outreach Housing	21,750	2,025	100%	[illegible]
• A,B,C Housing	89,000	8,275	20%	[illegible]
• D,E,F Housing	84,800	7,875	100%	[illegible]
E. Housing Support				
• Commercial Center	6,675	625	100%	[illegible]
• Mosque	5,550	525	100%	[illegible]
• Elementary School	11,250	1,050	100%	[illegible]
F. Infrastructure & Site Work				
• 30% of Total Program	—	—	30%	[illegible]
Subtotal	450,600	43,882		[illegible]
Contingency @ 10%				[illegible]
Total				[illegible]
Less A, B, C Housing, Housing Support And Related Infrastructure				[illegible]
Net Phase II Total				[illegible]

Phase II Development

- New Building Development
- Existing Building Development
- New Site Improvements
- Existing Site Improvements



PHASE III DEVELOPMENT

Phase III design activity will commence in mid-1989. As in the case of the prior phase, Phase III will include an assessment of progress made on Phase II, and an evaluation of the need for reorientation of the project Master Plan. Construction will begin, after contractor selection, in spring of 1990 and continue until the end of 1993.

The final 20% of the Academic space program will be erected during Phase III, including the Animal Husbandry Faculty building. The remaining indoor recreation space will be built adjacent to the soccer field, and the Physical Plant Facility will also be completed.

A final group of three student residences will be constructed to provide accommodations for 170 male students. Renovation of the second existing student hostel for use by 200 male students will also be carried out.

Upon completion of the program for student housing, 400 male students will be housed in the renovated hostels, while 500 male and 60 female students will reside in newly constructed dwellings. This total of 960 students to be housed on campus represents 80% of the target enrollment of 1,200 students at the end of the 10-year development period.

Phase III will also see the completion of the final 60% of the A, B and C category housing (120 dwelling units). Upon completion, 200 A, B and C units will be in place, accommodating approximately 80% of the faculty and key staff.

Phase II construction costs total $8,591,000. A major portion of this amount, some $5,743,100, is estimated for completion of the faculty housing colony, leaving a net cost of $2,847,900 for the academic, student housing and related improvements.

FUTURE EXPANSION CAPABILITY

Although the three phases of development allow construction of all buildings and other improvements required by a 1,200 student enrollment University, the Master Plan has been developed in such a manner as to allow for considerable development flexibility in the years following completion of the initial 10-year program.

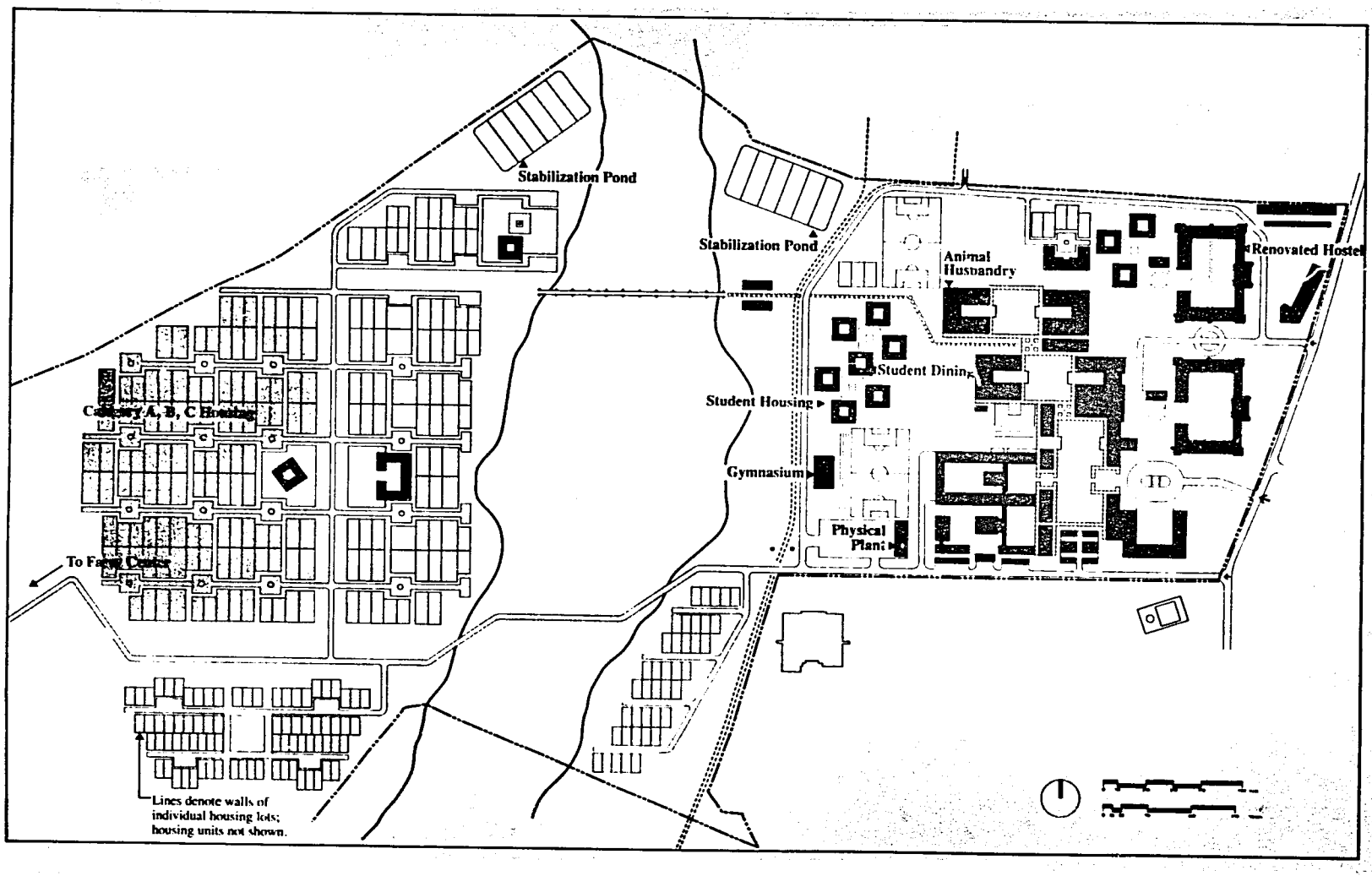
Each of the academic faculties can be expanded by the construction of extensions from the initial buildings. One or two new faculties can be added at the northern end of the courtyard spine. New student housing and recreation space can be located to the west of the perimeter road on land reclaimed from the nullah, through a proposed reconstruction of the nullah banks and backfilling with appropriate material. New student housing can also be constructed in the eastern portions of the campus at such time as it proves to be desirable to demolish and replace the existing hostels. Additional women students' housing can be located on the west bank of the nullah as female enrollments increase.

Each of these potential "future expansion" sites is indicated schematically on the Future Expansion Capability plan.

Program Element	Gross Square Feet	Gross Square Meters	% Total
A. Academic Space			
• Classrooms & Offices	13,665	1,200	20%
• Research & Teaching Labs	16,075	1,475	20%
B. Academic Support			
• (None in Phase III)	—	—	—
C. Other Support			
• Athletic/Recreation	13,675	1,275	[illegible]
• Physical Plant	9,000	825	[illegible]
D. Housing			
• Student Housing	79,150	7,375	41%
• A,B,C Housing	267,000	24,825	60%
E. Housing Support			
• (None in Phase III)	—	—	—
F. Infrastructure & Site Work			
10% of Total Program	—		[illegible]
Subtotal	398,625	37,185	[illegible]
Contingency @ 10%			
Total			
Less A, B, C Housing And Related Infrastructure			
Net Phase III Total			

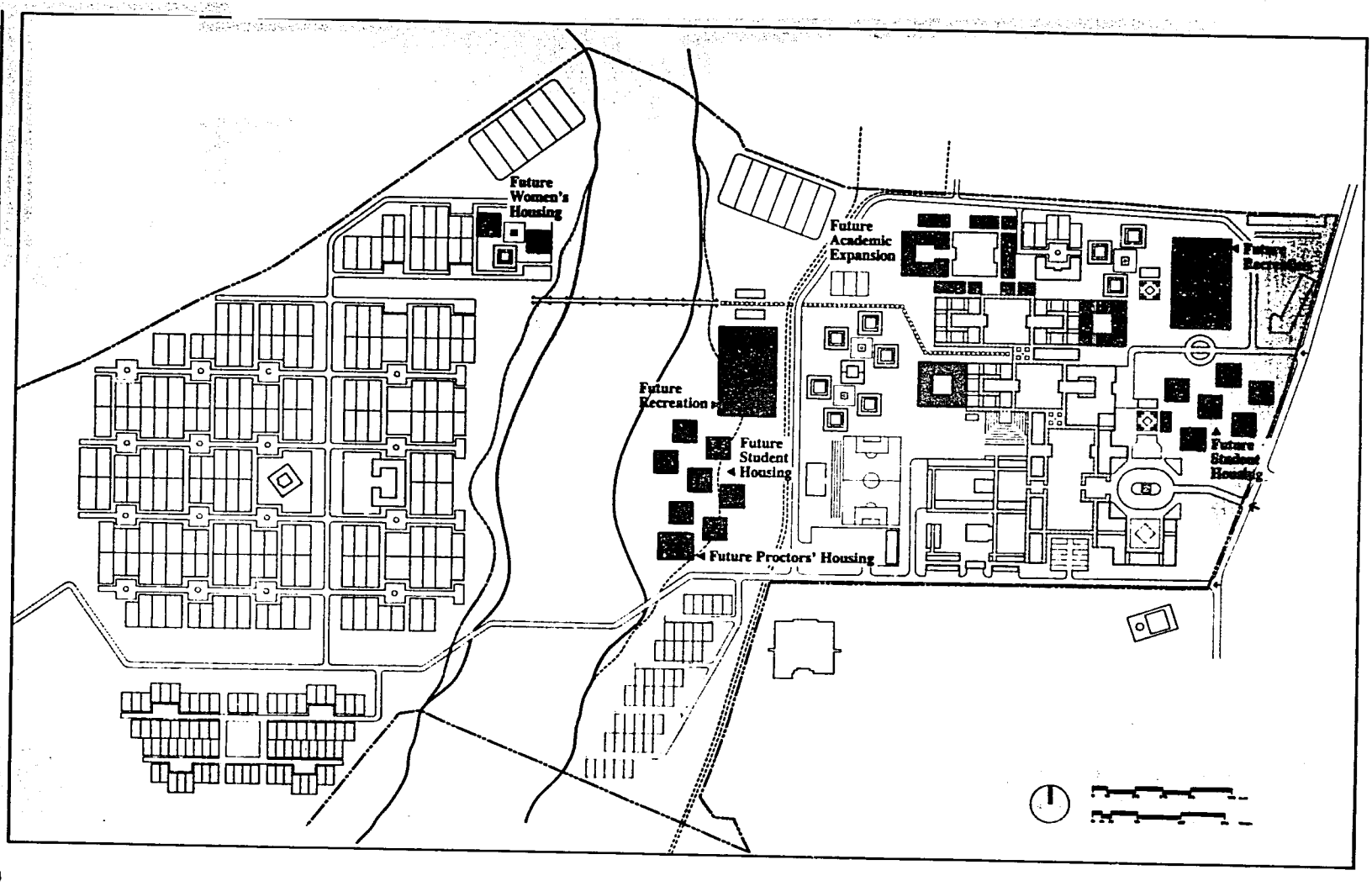
Phase III Development

- New Building Development
- Existing Building Development
- New Site Improvements
- Existing Site Improvements



Expansion Capability

- Future Expansion
- Future Site Improvements
- Nullah Reclamation



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APPENDIX I

BUDGETARY COST ESTIMATES

This section presents detailed back-up for the summary cost estimates presented in earlier chapters. In addition, the phasing of costs over the ten-year development period is shown.

The cost figures presented here cover building construction, on-site infrastructure, and other site improvement costs. Specifically *excluded* are the costs of furnishings, movable equipment, laboratory equipment other than built-ins, telephone equipment other than communications distribution wiring, the cost of extending electrical service to the campus from off-site grid stations, and the cost of nullah bank reconstruction and reclamation and other "future expansion" options.

The first table presents, by Program Element, the total gross building area for each building or program use type, times and average construction cost per square meter. This yields an estimated construction cost by Program Element in 1983 Dollars.

The second table presents annual cash flow requirements (also in 1983 dollars) based on the project phasing strategy presented in Chapter D, for the entire project.

Program Element	Gross Square Feet	Gross Square Meters	Cost/ Square Meter	Construction Cost ($1983)
A. Academic Space				
• Classrooms	21,000	1,950	$300	$ 585,000
• Teaching Labs	40,325	3,750	$350	$1,312,500
• Research Labs	40,150	3,725	$350	$1,303,750
• Faculty/Staff Offices	47,325	4,400	$300	$1,320,000
• Farm Center	58,125	5,400	$200	$1,080,000
Subtotal	**206,925**	**19,225**	—	**$5,601,250**
Less: Savings realized through renovation of existing academic buildings (5,150 square meters renovated @ $150/square meter rather than newly constructed @ $300/square meter)				**($772,500)**
Subtotal	**206,925**	**19,225**		**$4,828,750**
B. Academic Support				
• Library	60,000	5,575	$300	$1,672,500
• Communications Production	17,150	1,600	$350	$ 560,000
• Communications Teaching	3,775	350	$350	$ 122,500
• Computer Center	4,500	425	$350	$ 148,750
• Auditorium	7,200	675	$350	$ 236,250
• Continuing Education/ Outreach Center	16,200	1,500	$300	$ 450,000
• Central Administration	16,350	1,525	$300	$ 457,500
Subtotal	**125,175**	**11,650**	—	**$3,647,000**

[illegible]	Gross Square Feet	Gross Square Meters	Cost/ Square Meter	Construction Cost ($1983)
[illegible] Support				
[illegible]/Recreation	20,475	1,900	$300	$ 570,000
[illegible] (2)	3,375	325	$250	$ 81,250
[illegible]/Faculty Center	20,625	1,925	$300	$ 577,500
[illegible]	18,000	1,650	$200	$ 330,000
[illegible]	11,250	1,050	$100	$ 105,000
[illegible]	73,725	6,850	—	$1,663,750
[illegible]				
[illegible]	203,200	19,100	$200	$ 3,820,000
[illegible]	13,500	1,250	$300	$ 375,000
[illegible] Housing	18,000	1,675	$200	$ 335,000
[illegible] Housing	21,750	2,025	$200	$ 405,000
[illegible]/Staff Housing				
[illegible] level	90,000	8,400	$200	$ 1,680,000
[illegible] level	250,000	23,225	$200	$ 4,645,000
[illegible] level	105,000	9,750	$200	$ 1,950,000
[illegible] level	40,000	3,725	$155	$ 577,375
[illegible] level	24,000	2,225	$155	$ 344,875
[illegible] level	20,800	1,925	$155	$ 298,375
[illegible]	768,250	73,300	—	$14,430,625
[illegible] through [illegible] of existing [illegible] to [illegible] 65% of [illegible] [illegible] 40% of [illegible] housing @ [illegible] square meter rather than [illegible] square meter)				($649,400)
[illegible]		73,300		$13,781,225
[illegible] Support				
• Commercial Center	6,675	625	$200	$125,000
• [illegible]	3,500	325	$250	$131,250
• Elementary School	11,250	1,050	$250	$262,500
[illegible]	23,475	2,200	—	$518,750

[illegible] AGRICULTURAL UNIVERSITY PROGRAM AND BUDGET COSTS (cont'd)

Program Element	Campus Area	Housing Area	Farm Center	Total Construction Cost ($1983)
F. Infrastructure & Site Work				
• Roads & Lighting	$ 520,000	$ 555,000	$ 60,000	$1,135,000
• Vehicular Ford	90,000	—	—	90,000
• Pedestrian Bridge	—	205,000	—	205,000
• Sanitary Sewage System	225,000	175,000	10,000	410,000
• Water Distribution	400,000	300,000	60,000	760,000
• Power Substations & Distribution *	1,490,000	820,000	20,000	2,330,000
• Telephone (Distribution Only)	300,000	140,000	10,000	450,000
• Landscaping, Paving & Grading	800,000	150,000	80,000	1,030,000
Subtotal	$3,825,000	$2,345,000	$240,000	[illegible]
Additional Cost Element Not Included in 10-Year Program:				
• Nullah Restoration (Bank Reconstruction Only)				830,000
				$7,000,000

NOTE: Costs exclude certain off-site infrastructure costs, such as extension of electrical power supply to site, and equipment costs, such as telephone switching equipment costs, emergency power generator, and similar items.

*In the event that adequate supplies of natural gas are projected to be available to the campus, the cost of gas service installation will be approximately offset by a reduction in the cost of providing electric service.

	PHASE I		PHASE II		PHASE III		TOTAL
	Academic Campus	Housing Colony	Academic Campus	Housing Colony	Academic Campus	Housing Colony	Academic & Housing
1984	—	—	—	—	—	—	—
1985	$ 2,840,455	$ 733,150	—	—	—	—	3,573,605
1986	3,917,210	1,026,410	—	—	—	—	4,943,620
1987	3,378,825	879,780	$1,570,125	$1,229,875	—	—	7,058,605
1988	1,126,275	293,260	2,180,265	1,721,850	—	—	5,321,650
1989	—	—	1,856,010	1,475,850	—	—	3,331,860
1990	—	—	622,935	491,950	$ 569,580	$1,148,620	2,833,085
1991	—	—	—	—	854,370	1,722,930	2,577,300
1992	—	—	—	—	711,975	1,435,775	2,147,750
1993	—	—	—	—	711,975	1,435,775	2,147,750
Sub-total	$11,262,765		$6,229,335		$2,847,900		20,340,000
		$2,932,600		$4,919,525		$5,743,100	13,595,225
Total							$33,935,225

APPENDIX II

SELECTED LANDSCAPE SPECIES

The following listing of landscape materials is organized by function of application and is intended to serve as a source for selection of specific plant types during the detailed landscape design phase, as well as a guide for initiation of the on-campus nursery.

Name	Family	Size	Remarks
Acacia sp. Acacia	Leguminosae	40' (12m)	Yellow fragrant flower, low water requirement.
Albizia julibrissin Silk Tree	Leguminosae	50' (15m)	Good shade, beautiful flowers, umbrella shape.
Albizia lebbek Siris	Leguminosae	60' (20m)	Good shade tree.
Cercis chinensis Chinese Redbud	Leguminosae	20' (6m)	Brilliant cluster of pink flowers, small tree.
Ficus religiosa Banyan	Moraceae	90' (30m)	Very large, dense shade, aerial roots and wide spreading.
Gleditsia triacanthos inermis Honey Locust	Leguminosae	60' (20m)	Fine texture, light shade, broad habit.
Jacaranda acutifolia Jacaranda	Bignoniaceae	50' (15m)	Blue/violet bell-shaped flowers.
Melia azedarach Chinaberry	Meliaceae	50' (15m)	Fine texture, lilac fragrant flower, good shape.
Olea europea Olive	Oleaceae	60' (20m)	Low water requirement, long-lived.
Platanus orientalis Oriental Plane Tree	Platanaceae	80' (25m)	Medium texture, interesting bush, good shape, broad spreading.
Sophora sp. Sophora	Leguminosae	25' (8m)	White fragrant flower, fine texture, light shade.
Tabebuia chrysotricha Golden Trumpet Tree	Bignoniaceae	20' (6m)	Large yellow flower before leaf, small tree.

Name	Family	Size	Remarks
Asparagus sprengerii Asparagus Fern	Convolvulaceae	2' (.5m)	Vine or ground cover.
Hedera canariensis Algerian Ivy	Araliaceae	12" (.3m)	Vine or ground cover.
Ipomoea pes-caprae Goats Foot Morning Glory	Convolvulaceae	2' (.5m)	Vine or ground cover.
Lantana montevidensis Trailing Lantana	Verbenaceae	4' (1.3m)	Wide-spreading, good for banks, lavender flower year-round.
Liriope muscari Lily Turf	Liliaceae	12" (.3m)	Fine textured tub material.
Lampranthus spectablis **Mesembryanthemum sp.** **Caprobrotus sp.** Ice Plant	Aizoaceae	12" (.3m)	Full sun, no traffic succulent.
Rosmarinus officinalis prostrata Prostrate Rosemary	Labiatae	2' (.5m)	Low-growing, fine textured plant for full sun.

Name	Family	Size	Remarks
Casuarina equisetifolia Beefwood	Casuarinaceae	50-65' (15-20m)	Fast growing, drought resistant, can be clipped as hedge.
Citrus aurantium Sour Orange	Rutaceae	20' (6m)	Fragrant flower, thorns provide good security screen.
Citrus sp. Citrus	Rutaceae	20' (6m)	Fragrant, glossy, formal application.
Cupressus sempervirens Italian Cypress	Cupressaceae	30-90' (10-30m)	Formal evergreen for walk windbreak.
Eucalyptus camaldulensis Red Gum	Myrtaceae	100' (30m)	Fast-growing, large tree to line roadways.
Eucalyptus sp. Eucalyptus	Myrtaceae	60' (20m)	Fast-growing, large tree to line roadways.
Hibiscus mutabilis Hibiscus	Malvaceae	10' (3m)	Many colored, medium-high screen, may be clipped for hedge.
Ixora coccinea Maltese Cross	Rubiaceae	4' (1.5m)	Low red to white flowering screen or hedge.
Murraya exotica Orange Jasmine	Rutaceae	6' (2m)	Medium hedge with fragrant flowers.
Nerium oleander Oleander	Apocynaceae	10' (3m)	Tall hedge and windbreak, white to red color.
Pittosporum tobira [illegible]	Pittosporaceae	10' (3m)	Very fragrant evergreen hedge.
[illegible] [illegible] Oleander	Apocynaceae	25' (3-10m)	Yellow flowering, medium hedge.
[illegible] Shrubby Laurustinus	Caprifoliaceae	10' (3m)	White fragrant flowers, medium hedge, some light shade.

Name	Family	Size	Remarks
Acacia sp. Acacia	Leguminosae	20-30' (10m)	Drought tolerant, yellow fragrant flowers.
Cistus Rock Rose	Cistaceae	3' (1m)	Drought tolerant, white to red rose-type flower.
[illegible] Trailing Lantan	Verbenaceae	2' (.6m)	Mounding, light purple flower.
Rosmarinus prostratus Dwarf Rosemary	Labiatae	2' (.6m)	Wide spreading, lavender flower, year round.
[illegible] Point Morning Glory	Convolvulaceae	12" (.3m)	Sprawling creeper with pink Morning Glory-type flower.
[illegible]	Aizoaceae	12" (.3m)	Succulent, many colors, drought tolerant.

D) Suitable Species for Vines

Name	Family	Size	Remarks
Bauhinia galpini Bauhinia	Leguminosae	20' (6m)	Salmon colored flower, summer/fall.
Beaumontia grandiflora Herald's Trumpet	Apocynaceae	20' (6m)	White fragrant flowers, coarse texture.
Bougainvillea spectabilis Bougainvillea	Nyctaginaceae	20' (6m)	Many colored cultivars.
Gelsemium sempervirens Carolina Jessamine	Loganiaceae	10' (3m)	Yellow funnel flowers, sun or light shade.
Quisqualis indica Rangoon Creeper	Verbenaceae	10' (3m)	Red and white bi-colored, creeper for sun or shade.
Tecomaria capensis Cape Honeysuckle	Bignoniaceae	10' (3m)	Glossy leaf, orange-red flowers.
Trachelospermum jasminoides Star Jasmine	Apocynaceae	15' (4m)	White fragrant star flowers.
Wisteria sinensis Chinese Wisteria	Leguminosae	25' (8m)	Medium texture, lilac cluster of flowers for sun or light shade.