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## ABBREVIATION

AICAD	African Institute for Capacity Development
AIJ	Architectural Institute for Japan
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers
BAHCB	Base for African human Capacity Building
BOD	Biochemical Oxygen Demand
BS	British Standard
CHE	Commission for Higher Education
COD	Chemical Oxygen Demand
EAC	East African Community
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
GDP	Gross Domestic Product
GOJ	Government of Japan
GOK	Government of Kenya
HWL	High Water Line
IT	Information Technology
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JKCAT	Jomo Kenyatta College of Agriculture and Technology
JKUAT	Jomo Kenyatta University of Agriculture and Technology
JWC	Joint Working Committee
LAN	Local Area Network
LWL	Low Water Level
M/D	Minutes of Discussions
MDF	Main Distribution Frame
MOE	Ministry of Education
NGO	Non-Governmental Organization
OHP	Overhead Projector
O&M	Operation and Maintenance
PABX	Private Automatic Branch Exchange
PC	Personal Computer
PCM	Project Cycle Management
PTTC	Project Type Technical Cooperation
RC	Reinforced Concrete
R&D	Research and Development
T/E	Training and Extension
TOR	Terms of Reference
TV	Television
UPS	Uninterrupted Power Supply
USAID	The U.S. Agency for International Development
WB	World Bank

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**CHAPTER 1**  
**BACKGROUND OF THE**  
**PROJECT**

## **CHAPTER 1 BACKGROUND OF THE PROJECT**

### **1-1 Background of the Request**

Since the independence in 1963, the Government of Kenya (GOK) has undertaken construction of education facilities for primary and secondary education. However, as only Nairobi university had been established before independence, the GOK was also concerned with the expansion of higher education in particular with improvement of the training of engineers, which was considered a priority for development of the country. Under such conditions, the GOK had requested Project Type Technical Cooperation (PTTC) and Japanese Grant Aid to the Government of Japan (GOJ) in 1977 to establish a new university to train practical skills.

Jomo Kenyatta University of Agriculture and Technology (JKUAT) was founded as Jomo Kenyatta College of Agriculture and Technology (JKCAT) by the GOK with assistance from the GOJ. The GOJ has provided the Japanese Grant Aid in 3 phases to provide facilities, equipment and technical cooperation, over twenty years to April 2000. In 1994 it was upgraded to a fully-fledged university, becoming as the fifth national university in Kenya.

In October 1998, an idea of the Base for African Human Capacity Building (BAHCB) was addressed during the TICAD II conference. In the TICAD II conference, the GOJ recommended that JKUAT be the core institution in the initial stage of the BAHCB, since JKUAT has established sufficient foundation for higher education (undergraduate level) and has brought about substantive results. After consultations between Japan International Cooperation Agency (JICA) and the Kenyan authorities concerned, it was agreed that the name of the base be the African Institute for Capacity Development (AICAD).

Under such conditions, the GOK has requested PTTC and Japanese Grant Aid. The Japanese Preliminary Study Team was dispatched to Kenya, Uganda and Tanzania to discuss the idea of BAHCB in February 2000, and a workshop was held to obtain consent on AICAD with attendance of the African universities in March 2000.

The Japanese Implementation Study Team was dispatched to Kenya for the purpose of working out the details of Project Type Technical Cooperation (PTTC) concerning the AICAD Project. After a series of discussion between the Kenyan authorities concerned and the Team, the concept of AICAD was agreed by both sides in June 2000. Under such circumstances, the Government of Kenya requested to the Government of Japan a Grant Aid program for the construction of the facilities, supply of equipment in relation with PTTC and renovation of the existing infrastructure of JKUAT. In response to these requests, JICA dispatched a Grant Aid Basic Design Study Team in November 2000.

**CHAPTER 2**  
**CONTENTS OF THE**  
**PROJECT**



## **CHAPTER 2 CONTENTS OF THE PROJECT**

### **2-1 Basic Concept of the Project**

#### **(1) Objectives of the Project**

The objectives of the Project are to establish African Institute for Capacity Development (AICAD), as an independent organization built in the campus of Jomo Kenyatta University of Agriculture and Technology (JKUAT), and to facilitate the functions of 'Joint Research and Development', 'Training and Extension' and 'Information' in order to contribute the qualitative and quantitative expansion of human resources in Kenya. The aim of the Project is to extend the network of AICAD to the East African Community (EAC: including Kenya, Tanzania and Uganda) and gradually extending its network with the other African nations and Asia by the application of south-south cooperation scheme and to establish an international base for Capacity Development. The Project is collaborating with the Project Type Technical Cooperation (PTTC) to construct the building facilities and procure and install the equipment to support AICAD's activities and to renovate water supply and sewerage facilities to support JKUAT's activities as a Japan's Grant Aid project.

#### **(2) Basic Concept of the Project**

AICAD, as a center for Capacity Development, will solve various problems of agricultural development, poverty eradication, industrial technology, and the private sector in relation with the social development in Africa. Furthermore, AICAD is not only solving the existing problems for social and economical development in African countries, but also focusing various issues which may occur in the future integration with development research, human resource training and collecting and dispatching information to related countries, government agencies, private sectors and NGOs. AICAD will also plan to implement those activities through the participation of beneficiaries.

It is expected that AICAD will grow and develop as a regional institution by enforcement of cooperative research with related countries and government agencies. Kenya, together with Tanzania and Uganda have formed the EAC in November 1999, in order for aiming at a cooperative system of economy within three national markets in conjunction with their uniqueness of industrial structure, culture, climate, and so on. Thus, the high potentiality & AICAD development is also enhanced by this formation. In the future, AICAD is expected to be the center of human resource development, development research and information dispatch within the African region, especially the English-speaking countries, and operated as a ownership for related countries in the region. Furthermore, AICAD will become a central institution in eastern Africa to

exchange information and to interchange network with a movement towards globalization.

In order to realize the above AICAD development, the Project has set a time schedule. The target year of the Project is considered as the commencement time of PTTC Phase III is 2007, however, provisions for minimum necessary facilities and equipment should be planned to enable smooth starting of PTTC activities of Phase-II in 2003. Based on the contents of the programs of joint research development, training and extension and information, the number of researchers and trainees are computed as the framework of design. In addition, the function and scale of facilities are also studied in conjunction with the number of experts dispatched by PTTC, and considered with minimum maintenance and management expenses in relation to equipment provision.

#### 1) Function of Joint Research and Development

Based on the demand of the community, social and industrial needs, AICAD tentatively established the following themes for joint research development which is expected to contribute to African society and economic development. These themes will be confirmed and finalized after the implementation of detailed studies by PTTC in the future.

##### a) Agricultural Development

- development of agriculture, forestry, marine products and livestock industries in half-arid regions,
- improvement of agricultural administrations (statistics, extension, distribution, research)
- development of small scale irrigations
- promotion of horticultural agricultures
- improvement of circulating systems
- research of crop damage measures
- development of environmental harmonized agriculture
- Research of agricultural chemical standards, etc.

##### b) Industry development

- development of proper technologies for useful local resources
- improvement of industry development administration
- improvement of agricultural industry
- development of proper farm machineries
- development of small scale hydraulic powers
- development of recyclable energies, etc.

##### c) Social development

- improvement of social insurance system
- improvement of farm life

- improvement of education for women in the farmer community
- promotion of organization for farmer
- electrical system plan for farming villages
- research of parasitism measures
- human resource development
- research of infection measures
- extension of polio and inoculations, etc.

d) Economic development

- improvement of the map textbook
- improvement of the obligation of administration
- improvement of the finance and taxation system
- improvement of the financing system
- improvement of the infrastructure in rural area
- improvement of the operation and management system for roads and harbor facilities
- electrical system plan for rural area, etc.

In order to implement those joint research/development themes, one chief researcher will be in charge of each theme. The chief researcher, together with a general researcher and a research assistant, will form a team. The plan is expected to adopt 5 chief researchers at a professor level, 10 general researchers with an assistant professor level and 5 research assistant with a masters degree.

2) Function of Training and Extension

With the existing research results from JKUAT and other research institutions, AICAD will establish concrete know-hows to apply them under a new 'joint research development program' through a training and extension activities and human resource development. As for the training program under the third country training currently consists of seven courses (applied food analysis, applied electronic industrial technology, water contamination analysis technology, gardening crops cultivation technology, fluid machine engineering, agricultural machine management and regional development). On the other hand, in-country training consists of one course in (life reform of the village women) are implemented.

AICAD is considered to be "the training themes in detail" which was carried out in the third country training, in-country training and NGO training. There is also a plan to further expand the training courses in the future. As for the NGO training course, a request base is adopted with NGOs, and other relevant group specialized in poverty eradication. Therefore, it is difficult to project the number of courses and attendants, thus, the NGO training course will be held by utilizing vacancy

periods of facilities and equipment with other programs. The estimated training program and number of attendants are shown in Table 2-1.

**Table 2-1 Training Programs**

Item	Third Country Training Course			Domestic Training Course			NGO Training Course
	30 pax			30 pax	30 pax	50 pax	30 ~ 50 pax
Training Course	5	5	1	3	2	1	
Training Period	45 days	45 days	30 days	30 days	45 days	30 days	Under consideration
No. of Training/Year	2 times	1 time	2 times	2 times	1 time	1 time	Under consideration
No. of Attendant/Year	50 pax	30 pax	50 pax	50 pax	30 pax	50 pax	Under consideration
Trainer	5-10 pax	5-10 pax	5-10 pax	5-10 pax	5-10 pax	5-10 pax	Under consideration

(Source: AICAD 2000)

### 3) Function of Information

AICAD will try to enforce an activity to jointly own results and information of research development which can be applied to other relevant research institutions in conjunction with the improvement of efficiency in the information exchange through the internet.

The main activities for the information section in AICAD are as follows:

Activity	Content of Activity
a) Tele-communication	<ul style="list-style-type: none"> <li>- Internet Environment System Management</li> <li>- System Monitoring</li> <li>- Hardware Repair Management</li> <li>- Implementing PC Training</li> </ul>
b) Information Dispatch	<ul style="list-style-type: none"> <li>- Preparation of Fiscal Year Business Plan</li> <li>- Homepage Preparation</li> <li>- Electronic Library Business Promotion and Database Management</li> <li>- Overseas Electronic Library Linkage Promotion</li> <li>- Digital Library Preparation and Popularization for Regional Library</li> <li>- Implementing Overseas Net Information Preparation and Delivery Service</li> </ul>
c) Teaching Material Preparation	<ul style="list-style-type: none"> <li>- Investigation and Research of Training and Popularizing activity for teaching material contents</li> <li>- Preparation of Training and Popularization Activity, Teaching Materials and Electronic Library Copy</li> <li>- Micro-film Preparation</li> <li>- Film Developing</li> </ul>
d) Extension Activity	<ul style="list-style-type: none"> <li>- Net User Popularization Activity</li> <li>- Net Diagnosis Service</li> <li>- Regional Contents Preparation Promotion</li> </ul>
e) Operation and Maintenance	<ul style="list-style-type: none"> <li>- PC and Accessories Maintenance</li> <li>- Building and Utility Maintenance</li> <li>- Equipment Storage Management</li> <li>- User PC Maintenance Service</li> </ul>

### **(3) Study Result and Examination of the Contents of the Request**

#### 1) Facility Construction

##### a) Contents of the Request

The result of the study and examination of the contents of the request through Basic Design Study is described as follows. The basic design is based on the following contents of the facility.

**Table 2-2 Contents of the Request Regarding Facility from Kenyan Side**

Division	Facilities
1. Administration Section	1-1 Deputy Manager's Office 1-2 Director's Office 1-3 Chief Advisor's Office 1-4 Deputy Director's Office 1-5 Project Coordinator's Office 1-6 Secretaries' Office 1-7 Audit Section Office 1-8 Meeting Room 1-9 Administration Office 1-10 Maintenance Office 1-11 Others
2. Joint Research and Development Section	2-1 R&D Coordinator's Office 2-2 JICA Advisor's Office 2-3 Assistant Coordinator's Office 2-4 Secretaries' Office 2-5 Senior Researcher's Office 2-6 Junior Researcher's Office 2-7 Meeting Room 2-8 Others
3. Training and Extension Section	3-1 T/E Coordinator's Office 3-2 JICA Advisor's Office 3-3 Assistant Training Coordinator's Office 3-4 Assistant Extension Coordinator's Office 3-5 Secretaries' Office 3-6 Computer Laboratory 3-7 Meeting Room (Small/capacity 30) 3-8 Meeting Room (Large/capacity 50) 3-9 Seminar Room (capacity 150) 3-10 Others
4. Information Section	4-1 Information Coordinator's Office 4-2 JICA Advisor's Office 4-3 Secretaries' Office 4-4 Hardware Maintenance Room 4-5 Server Room 4-6 E-contents Room 4-7 Electrical Information Store 4-8 E-laboratory, Internet Room & Library 4-9 Procurement Room 4-10 Printing Room 4-11 Photo Room 4-12 A/V Edition Room 4-13 Production Store 4-14 Others
5. Accommodation Section	5-1 Bedroom 5-2 Lounge 5-3 Mini-Kitchen 5-4 Administration Office 5-5 Others
6. Others	6-1 Drivers' Room 6-2 Driver Mechanic Room 6-3 Head Guard's Room 6-4 Guard's Room 6-5 Entrance Guard House 6-6 Others

b) Study and Examination of the Contents of the Request (Details and Negotiation Result)

For each facility, detailed discussions were made with AICAD in terms of number and scale of each room, and they have been confirmed. The main discussion points are described as follows:

**Administration/Training/Research/Information Building**

A administration/training/research/information building is composed of a) administration section, b) joint research and development section, c) training and extension section and d) information section. Through various examinations of the activity plan of AICAD, those facilities which can be shared with the existing JKUAT facility shall be omitted. A series of discussions and studies have been commenced in order to obtain and determine functions of the facilities and a rational utilization method. After the determination of the number and scale of each room, the total facility plan has been studied considering the operation and maintenance capability of AICAD. In order to establish the rational arrangement of rooms and their scale, detailed discussions and studies were made in relation to the training program, function, number of researchers and trainees, and number of staff. Furthermore, these functions have been integrated and rationalized as much as possible so as to reduce the space for common use.

**Hostel**

As AICAD is located 40 km from Nairobi, it is difficult and costly to get to, and it is also difficult to maintain security for researchers and trainees during their commuting from Nairobi. Although there are some lodging facilities around AICAD, those facilities are in a bad condition and are not suitable for long-term accommodation. Therefore, a hostel utilization is indispensable in AICAD. In this regard, a hostel was one component of important facilities to be included in the Project and it was confirmed that its necessity is very high.

A scale of the hostel was planned based on the discussions and studies of its rational utilization method and an operation and maintenance capability. Three types of bedrooms were established to correspond to multiple use method. The flexibility usage of the building shall also be considered in case of room shortage in future.

The Kenyan side requested guesthouses for professors who accompany their family. However, it was understood and agreed by the Kenyan side that two adjacent rooms will be connected for family use. Therefore, a guesthouses were excluded from this project.

## Others

As for the requested gatehouse and garage, it was confirmed that these facilities are necessary in consideration of the situation of society, security and climate in Kenya, and a minimum provision for satisfy the need will be included in this project.

As for the requested recreation facilities, it was agreed by the Kenyan side that a courtyard between buildings will be created as an integration space which symbolizes the academic characteristic of AICAD. Therefore, the recreation facilities were excluded in this project.

### 2) Water supply and sewerage plan

#### a) Contents of the Request

Kenyan Side requested to renovate the existing facilities of water supply and sewerage system, with installations of required water supply and sewerage facilities for the AICAD activities.

#### b) Study and Examination of the Contents of the Request (Details and Negotiation Result)

## Water Supply System Plan

In order to renovate existing water supply facilities, following are requested, 1) improvement of water intake facilities affected by siltation, 2) counter measures to outbreaks of water bloom happened in the storage pond, 3) counter measures to shortage of water supply.

## Sewerage System Plan

In order to renovate existing sewerage facilities, the following are requested: 1) rehabilitation of existing superannuated sewerage facilities, 2) improvement of existing wastewater treatment plant, and 3) introduction of separate collection of laboratory wastewater including toxic substances.3) Equipment Plan

### 3) Equipment Plan

#### a) AICAD Activity Contents and Required Equipment

Table 1-3 shows AICAD activities and necessary equipment.

As shown in Section 1 (2), AICAD consists of;



The Joint Research and Development Section which studies theme contributing for poverty eradication in African region, the Training and Extension Section which execute training and extension project mainly for staff in regional public governments in order to development their duties of policy decision and methodologies, the Information Section which creates and distributes such information contents, and the Administration Section which supervises and manage these three sections.

These activities will require IT related equipment.

On the other hand, JKUAT will provide human resources and technical expertise including equipment to assist the activities of AICAD. And to do so, additional equipment resources will be necessary to fulfill the other function of a university which contributes to the society and the region. Since the past activities of JKUAT are considered to having been geared on University education or academic research.

**Table 2-3 AICAD Activities and Required Equipment**

		Section	Contents of Activities	Equipment Required
I	AICAD	Administration	a) Marketing of Activities	PC, Printing machine, Binding Machine, Furniture, Appliances and Office equipment
		Joint Research and Development	a) Project Formulation b) Research Coordination	PC, LAN equipment and Web equipment
		Training and Extension (T/E)	a) Project Formulation b) T/E Coordination	PC, LAN equipment and Web equipment, Audio-visual educational equipment and Distance education equipment
		Information	a) Inter communication between Targeted Universities b) Production of Data base and Educational Materials c) Contents Preparation d) Information Distribution of JICA and International Organization	PC, LAN equipment, Web Equipment, Server, Video Equipment and library
II	JKUAT	Existing Training/ Extension Program	a) Applied Plant Propagation Technology in Horticultural Crops (Horticulture) b) Agricultural Machinery Management (Agricultural Engineering) c) Applied Food Analysis (Food Science and Post-harvest technology) d) Water Pollution and its Analysis (Civil Engineering) e) Design, production and Maintenance of Fluid Flow Machinery (Mechanical Engineering) f) Applied Electrical and Electronic Engineering Technology (Electrical and Electronics Engineering) g) Farm Cultivation Technology Training for Women Group under Agricultural Cooperatives in Rural Area (Farm Dept.)	Experiment, Research and Training Equipment
III		Training Program planned in 2001	28 Training programs are to be planned in 2001 in six Dept's of Science and Dept. of Architecture, RCED and IEET	Experiment, Research and Training Equipment

b) AICAD Equipment

i) Requested Equipment

Requested equipment from AICAD is summarized as follows;

- Office equipment; PC, Printing machine, Binding machine, Furniture, Appliances
- Equipment for Training and Extension; Vehicle, White board, PC, LAN and Web equipment
- PC;Server, for Internet Cafe use, for PC training use
- Equipment for educational material production; PC, LAN and Web equipment, Photo development equipment, Audio-visual and Distance education equipment, etc.
- Library; PC, LAN and Web equipment, library relating African matters and Micro-film production equipment, etc.
- Vehicle; for training use, for extension use, for guest pick up and for equipment transfer use
- Others

ii) AICAD Organization and Contents of Activities

Organization and contents of activities in AICAD has been elaborated and agreed in the JCC and are shown in Table 2-4

**Table 2-4 AICAD Organization and Contents of Activities**

No.	Section	Functions	Contents of Activities
1	Administration	a) General Affairs	- Overall management and planning/evaluation of annual activities - Linkage promotion with Kenyan authority and Uganda/Tanzania - Linkage promotion with International organizations in Kenya - Marketing of AICAD activities
		b) Finance	- Management of finance, budgeting and accounting - Income/expense management - Contract and procurement
		c) Personnel	- Staffing, recruitment and Evaluation - Database of consultants - Database of teaching staff - Consultants/teaching staff contracting
		d) Hostel	- Management planning - Management of appliance/consumable
		e) Transportation	- Vehicles and transportation management
2	Joint Research and Development	a) African Tradition	- Overall supervision on social science research - Collection and management of social science information
		b) Advanced Technology Application	- Research on advanced technology application in the regional issues - Management of annual activities - Collection and management of research information

No.	Section	Functions	Contents of Activities
		c) Screening	- Annual planning - Preparation/management of web-site - Preliminary investigation on joint research
		d) Monitoring	- Annual planning/implementation/evaluation of project - Monitoring/preparation of report - Preparation of manuals
		e) Evaluation	- Promotion of PCM training - Preparation of manuals - Preparation of evaluation report
3	Training and Extension	a) Planning	- Preparation of annual training /extension project - Preliminary study of the project
		b) Implementation	- Supervision of budget - Coordination of reports
		c) Monitoring	- Implementation/monitoring of the projects - Preparation of monitoring report
		d) Evaluation	- Preparation of evaluation report - Planning of annual activities - Dissemination of PCM method
		e) Analysis	- Research on analysis method - Preparation of report
		f) Extension	- Planning of annual activities - Marketing of extension services - Preparation and management of Web-site
		g) Training	- Planning of annual activities - Marketing of training services - Preparation and management of Web-site
4	Information	a) Communication	- System management of Internet infra-structure - Monitoring of the system - Supervision of maintenance of hardware - Implementation of PC training course
		b) Information dissemination	- Planning of annual activities - Marketing of ICT services - Preparation and management of Web-site - Promotion of e-library and management of database - Linkage promotion with overseas e-library - Production and marketing of digital library in the region - Coordination and dissemination of overseas web-information
		c) Contents Production	- Research and study on contents/materials of training and extension services - Production of contents materials of services - Photo developing services
		d) Extension	- Management of promotion of clients increasement - Promotion of miscellaneous Web-site consultation and diagnosis - Promotion of regional contents production
		e) Maintenance	- Maintenance of PC and peripherals - Maintenance of buildings and facilities - Inventory control of equipment - Maintenance services for client's PC

In order to promote AICAD activities based on IT technology, it is required to facilitate IT Infrastructure in each section, These contents are shown in Table 2-5;

**Table 2-5 Basic Contents of AICAD LAN System**

No.	Section	Major Function	Outline of Contents	Remarks
1	Administration	Budgeting	Slip, book keeping, Annual Report and Assets management	Exclusive server
		Personnel	Recruit, Evaluation, Wage management	
2	Joint Research and Development	Database	Research organization, Researcher, Research paper/publication, Sector wise advanced technology, Academic software etc.	Server
		Information dissemination	Dissemination of Library, Report, Important Research report on the Journal	
		Public request for research theme, Theme evaluation system	Pre-qualification, Public announcement, Evaluation, Implementation procedure, Guideline of report preparation, Budget management system	
3	Training and Extension	T/E Management	Manual, Evaluation system, Budget management	
		PC Training	Training materials, Skill evaluation system	
		Data base	Project record, T/E report	
4	Information	System Management	Mailing, Internet, Web, Database, Monitoring	100Mbps
		Security System	Security management in / outside AICAD including password control	
		Monitoring System	Monitoring of communication	
		Boarding system	For AICAD, JKUAT and participating Universities	
		Mail system	Mail and internet management	Mail server
		Reporting and Communication system	Job procedure in AICAD	
		e-Library system	Linkage promotion with JKUAT, targeted Universities, Sub-Saharan Africa and overseas e-Library	Exclusive Server
		Materials Production System	For Voice, State and motion picture	Exclusive Server
		Database System	AICAD Report, Country Economic and Social Statistics, Inventory of JICA project experience, Overseas donor project experience, Public educational and Research Institution, T/E materials, Research and T/E Equipment	Database Server
Information Dissemination System	For Kenya, Uganda, Tanzania and Sub-Saharan Africa	Server Exclusive		

iii) Personnel plan of AICAD

AICAD project is divided into two periods; the first period from August 2000 to December 2002, and the second period from January 2003 to December 2007. The personnel plan, which is subject to this equipment plan, is as shown below Table 2-6 including AICAD project coordinator, long term specialist advisor from JICA and permanent staff excluding any consultant or instructor that are assigned for each project.

**Table 2-6 AICAD Man-power Planning**

No.	Dept.	~ Dec. 2002	~ Dec. 2007
1	Administration Section	13 (13)	23 (77)
2	Joint Research and Development Section	3 (3)	5 (5)
3	Training/Extension Section	3 (3)	8 (8)
4	Information Net-work and Dissemination	2 (2)	16 (16)
	Total	15 (21)	50 (106)

Source: AICAD Personnel Plan of Dec. 2000. The table shows the number of dedicated personnel and the numbers in brackets show the total number of workers for each section.

Because of the nature of AICAD, the above plan only indicates the number of personnel necessary for monitoring of AICAD activity, and it does not include personnel necessary to carry out the joint research and development, program implementation, information communication and other outside researchers and instructors. Therefore, in deciding the specification and quantity of necessary equipment, following factors should be considered.

- (a) The capacity of LAN and local server is based on the projected number of personnel up to year 2007.
- (b) The quantity of PC and ancillary equipment to be used by the Administration Section, Training and Extension Section, is derived from the personnel plan applicable for the middle of the second period, and the quantity for the Joint Research and development Section and Information Section is for the coordination personnel only, which is applicable at the end of the first period not taking into account any outside instructors who may be present then.
- (c) Other fixed equipment, such as PC for training, Internet café, Film developing equipment, Vehicles, is based on specification in the activity plan.

### 3) JKUAT Equipment

- a) JKUAT's Training & Research related to AICAD activities

AICAD activities and cooperative human resources will target not only the eight universities but will be provided widely for cooperation to other Institutions. The dedicated staff and coordinators of AICAD, therefore, will only monitor the activities and not necessarily limited to using those equipment existing at JKUAT campuses, JKUAT instructors and facilities. It is, however, recognized that JKUAT, through its years of activities and project assistance from JICA, has strengthened human resources, technological and academic expertise, facilities and equipment. It is, therefore, desirable that JKUAT assets be utilized in project formation, training and for educational purposes whenever possible, even in the event that JKUAT is not directly participating in

a given project, for efficient conduct of AICAD program. Such utilization of JKUAT assets will enhance the purpose of JKUAT.

**Table 2-7 JKUAT’s Training & Research related to AICAD activities**

No.	Faculty Dept.	Contents of Experiment/Training/Research	Equipment Required
1	Faculty of Agriculture Horticulture	Training program of “Applied Plant propagation Technology in Horticultural Crops”	Portable Photosynthetic System, Growth Chamber, Plant sample miller, Spectrophotometer, Green house
2	Faculty of Agriculture, Agricultural Engineering	a) Analysis of waste water together with Master course environmental practice b) Existing training program “Agricultural Machinery Management”	BOD analyzer, Triaxial test equipment, EC meter, pF meter, Tractors, Engine Dynamometer, Computer
3	Faculty of Agriculture Food Processing and Post Harvest Technology	a) Training program “Applied Food Analysis” b) Student Experimental Practice on food analysis, micro-biology and food Additives	AA/FE Spectrophotometer, HPLC, IR-Spectrophotometer, UV-VIS Spectrophotometer, Color Difference meter, Gas Chromatography, GC-MS, Abbe Refract meter, Kjeldhal Apparatus
4.	Faculty of Engineering Civil Engineering	a) Training program ”Water pollution and its Analysis” using Gas Chromatography, DO meter etc. b) Experimental Practice; Soil, Concrete, Asphalt, Structure, measurement	SS meter, pH meter, BOD measuring unit, COD meter Jaw crusher
5.	Faculty of Engineering Mechanical Engineering	a) Training program “Design, Production and Maintenance of Fluid Flow Machinery” b) Experimental Practice Energy related experiment among many fields of Curriculum	Centrifugal pump Sets, Mechanical tool sets, Air Compressor, Combined Bending and Torsion Apparatus Bomb Calorimeter, Boys Gas Calorimeter, Solar Distillation Apparatus
6.	Faculty of Engineering Electrical & Electronics Engineering	a) Training program “Applied Electrical and Electronic Engineering Technology ” b) Experimental practice; Computer simulation and Antenna	V-A meter, 3 PH Wattmeter, Digital Tachometer, Microwave Trainer, Antenna Trainer, Motor winding kit
7.	Faculty of Architecture	a) Training program “Basic Architectural Drafting”, “Archicad” b) Drafting practice	Drafting Machine, Computer
8.	Faculty of Science Zoology	a) 2001 Training program “Fish Parasites”, “Integrated Management of Vegetable Pests”, “Aquaculture”	Microscope, VIS Spectrophotometer, Centrifuge, Autoclave, Electrophoresis kit
9.	Faculty of Science Chemistry	2001 Training program “Use and Application of Analytical Techniques on Quality Control and Environmental Monitoring”	Atomic Absorption Spectrophotometer, UV-VIS Spectrophotometer
10.	Faculty of Science Botany	2001 Training program “Plant Biotechnology”, “Enthnobotany”, “Crop Pest and Disease Identification and Prevention”	Laminar Flow Hoods, Microscope, Centrifuge, Growth Chamber, Eliza kit
11.	Faculty of Science Biochemistry	2001 Training program “Application of Molecular Biology in Diagnosis of Disease and in Forensic Science”	pH meter, Incubator, Spectrophotometer
12.	Faculty of Science Physics	2001 Training program “Ground Water Exploration” and Research theme for Vacuum printing	Chiller, Water still Aquatron, Electrical Balance,
13.	Faculty of Science Maths & Statistic	2001 Training program ”Forecasting Price Indices and Design and Analysis of Surveys”	PC, Software
14.	Institute of Computer Science & Information Technology	Domestic Training program of PC	IT Tool Sets, PC

No.	Faculty Dept.	Contents of Experiment/Training/Research	Equipment Required
15.	Institute of Energy & Environmental Technology	Research on Energy and Environmental technology	Solar Energy Demonstration Kit, Solar Pump, Solar Still, Solar pump
16.	Institute of Human Resources Development	Training and Extension program for Small and Medium scale Enterprises	PC
17.	Center of Regional Enterprise Development	2001 Training program "Marketing Strategies for Small Enterprises in Liberalized World Economy", "Identification and Utilization of Rural- based Self-employment Opportunities"	PC
18.	Farm Dept.	Training program; "Strengthening of Rural Women's Capacity for Community Development"	Green House, Tractor
19.	Library	Supporting for Data input of AICAD Library	PC, African Economic and Social Library
20.	Workshops	- Maintenance & Repair support for AICAD in Wood working, machinery processing, Fabrication, Welding, Vehicle, Electrical installation and concrete manufacture etc.	Lathe, Drilling Machine, Welding Machine, Tool Kit, Electric Furnace, Disc Grinder

b) Requested Equipment from JKUAT

Requested Equipment from JKUAT is classified as follows;

- i) Six Departments in Faculty of Agriculture and Faculty of Engineering
- ii) Nine Departments in Faculty of Science and Faculty of Architecture
- iii) Seven division; Campus research Institute, i.e. ICSIT, IEET, IHRD and RCED, and Farm etc.

These outline are shown in Table 2-8 and details are shown in the attachment together with their present situation of activities and equipment.

**Table 2-8 Outline of JKUAT's Requested Equipment**

No	Faculty/Department	Contents	Outline of Requested Equipment
I	Agriculture / Engineering	Three depts. each	total 583 equipment relating to past grant aid /existing training programs
II	Science / Architecture	Nine depts.	total 167 equipment required for planed training programs
III	Common	Institutes and Workshops etc.	151 equipment required for planed training program

c) List of Equipment to be scheduled for procurement by PTTC Scheme

AICAD's PTTC was started from August 2000, and procurement plan was settled for Table 2-9.

Therefore, Equipment plan in the Project shall confirm to this PTTC procurement plan, but, this PTTC procurement are understood for the purpose

of required equipment up to the time of completion of AICAD building and for two years operation.

**Table 2-9 List of AICAD Equipment planned for Procurement by PTTC**

No.	Items	Quantity	No.	Items	Quantity
I.	<b>Research/Development</b>		II.	<b>Training/Extension</b>	
	PC	8		Video projector	2
	Note PC	2		OHP	2
	Printer	2		Slide projector	2
	Scanner	1		Screen	4
	Software	4		Photo copy machine	1
III.	<b>Information Network</b>			Color Copier	1
	Satellite	1		Printing Machine	1
	Equipment for Lease Line	1		Digital Camera	2
	Server	1		TV	2
	Software	2		Video Deck	2
	Binding Machine	1		White Board	22
IV.	<b>Common Equipment</b>				
	System Desk	17			
	Book Shelf	10			
	UPS	1			
	Vehicle	2			



## **2-2 Basic Design of the Requested Japanese Assistance**

### **2-2-1 Design Policy**

#### **(1) Contents of Project and Basic Direction**

The contents of the project include following 3 components; a) The construction of AICAD facilities consisted of Administration Section, Joint Research and Development Section, Training and Extension Section, Information Section and Hostel Section; b) The renovations of existing JKUAT water and sewage facilities, c) Procurement of equipment for AICAD facilities and of the equipment installed in existing JKUAT facilities and used for activities of AICAD such as joint research development, training and extension activities.

##### **1) Facilities Plan**

The main contents of new facilities construction for AICAD are Administration, Joint Research and Development, Training and Extension, Information and Hostel Sections. And IT plan shall be considered so as to promote the 3 main functions of AICAD such as the joint research and development, training and extension, and information. At the same time IT plan for JKUAT for the improvement of the Backbone system of Internet connection in the campus shall also be considered.

##### **2) Water and Sewage Facilities Plan**

Renovation plan shall be considered in order to correspond to an increase of the demand for new facilities of AICAD and an improvement of the existing JKUAT water and sewage facilities.

##### **3) Equipment Plan**

The contents of equipment shall be considered based on the priorities mentioned in the Minutes of Discussion as follows: ((a) equipment for AICAD facilities, (b) equipment used for second and third country training purpose in JKUAT, (c) equipment provided by previous Grant Aid planned to be used for AICAD activities and need replacement.

#### **(2) Points to be Noted for the Basic Design:**

The following points are to be noted for the implementation of the Basic Design.

- 1) The facility plan and equipment plan should be considered based on the functions and activities requested by AICAD, and on discussions with persons considered with PTTC for further detail studies.

- 2) The new facilities and procurement of the equipment should be planned giving consideration to minimize operation and maintenance costs, to ease their maintenance and to reduce the utilities costs such as waters and electricities.
- 3) The implementation schedule for this Grant Aid project should be planned considering smooth relations with that of PTTC.
- 4) The equipment which brand to be specified should be confirmed with PTTC whether it is possible to be provided by PTTC or not.
- 5) The responsibilities for the operation and management of the procurement equipment by the project shall be confirmed whether to be by AICAD or JKUAT.
- 6) The renovation of water and sewage facilities should be planned through enough analysis and studies on the present problems such as shortage of water, occurrence of water bloom and sediment of silt. And the most appropriate plan shall be established comparing several alternatives which inclusively solve these problems.
- 7) 'Soft Component' should be considered in Water and Sewerage Facilities Plan in order to enable the appropriate future maintenance by Kenyan side. Especially, the treatment system of the experimental wastewater of JKUAT should be considered to use a 'collecting and storage' method. For this purpose, it is important to establish the manual of the collecting method and the maintenance organization. A cooperation for this point should also be considered in the project.
- 8) The result of cost estimation for the portions to be taken by Kenyan Side such as site preparation, infrastructure preparation (water, power, telephone etc) has been confirmed and requested to Kenyan side for their budgetary preparation. And it was confirmed that Kenyan side shall prepare these necessary budgets and keep their implementation schedule to complete those portions by Kenyan side before the start of the construction by the project.

### **(3) Design Policies**

The basic design of the facilities for AICAD, water and sewage facilities and equipment in this project is based on the following design policies with due consideration of the result of the field survey, the environmental and social conditions of Kenya, the construction and procurement conditions, the maintenance and management capability of the Implementation Agency and construction schedule under the Japan's Grant Aid Project.

- 1) The new facilities and equipments should be planned giving considerations to the contents and level of the functions and activities of AICAD as the Institute of African Capacity Development, based on the results of the Basic Design Study.

- 2) The new facilities and equipment should be planned in smooth coordination with the PTTC. Also, regarding selection of equipment, coordination and/or cooperation with equipment procured under PTTC should be considered.
- 3) The circulation flow line and external plan should be planned to meet the functional concept of the existing facilities based on the field survey and analysis result of the existing JKUAT facilities.
- 4) The layout plan and architectural plan should be planned in consideration with the originality and own maintenance and management system of AICAD as an independent institution from JKUAT as well as with smooth relation with existing JKUAT facilities.
- 5) The good design points of relevant facilities in Kenya and Japan should become a reference for the design, while the existing problems in these buildings should be improved in the plan.
- 6) The local weather conditions (rain, sun and wind) and customs (security, life style) should be taken into consideration.
- 7) The facilities design and equipment selection should be considered to enable an easy maintenance and to reduce maintenance and operation cost considering technical level and maintenance and management system in Kenya.
- 8) Local construction methods, local materials and neighboring countries material should be considered to be used as much as possible in order to reduce the construction costs and to establish proper construction methods.

#### **2-2-1-1 Facilities Plan**

##### **(1) Basic Concept for Determination of Contents and Scale of Facilities**

The determination of the contents and scale of the facilities is based on the study of the number of rooms and the scale of each room. The design concept and determination of the facilities' scale may have an important impact not only on the function for the facilities but also on the construction cost and project cost of AICAD. The determination of the facilities scale is based on the following policies.

- 1) The contents of the facilities and their assumed scale are based on the contents of Minutes of Discussions signed by the Kenyan side and the Basic Study Survey Team and rational number and scale of facilities should be designed and established.
- 2) As the typical floor areas of room per person for education and research purposes have various sizes, the size of major rooms is to be confirmed through discussions with the Kenyan side considering the layout plan of the required minimum space for equipment and usage of the rooms on the drawing. The number of necessary

rooms should be minimized by adopting multiple usage as much as possible. An optimum facility design shall be established through studies of existing facilities in Kenya and other similar facilities as a reference for the project.

- 3) The computation for scale of each room should be planned giving consideration to the basic unit of each room based on 3 functions of AICAD such as joint research and development, training and extension, and information. Space design for utilities and equipment is to be planned by taking into consideration on the safety and functions of training and educational facility.
- 4) The flow line plan, zoning plan and facilities plan should be planned giving consideration to the internal flow lines of trainee, staff, equipment and services etc, and external flow lines of guest and equipment, etc. Especially, the flow line connecting with existing JKUAT facilities should carefully be studied.
- 5) The scale of facilities for joint research and development, training and extension plan (contents and capacity) should be calculated on basis of the activity programs confirmed during the Basic Study.
- 6) The scale of the facilities in terms of operation and maintenance should be formulated rationally based on the number of staff and the organization of AICAD prepared by Kenyan side.

## **(2) Study for the Number of Rooms**

The number and scale of each room have been determined in accordance with a series of discussions and examinations.

The following show the detailed examination result of each room. (New facilities of AICAD are arranged as Building A, B, C, D and E from the main approach to the north side of the site: Refer to the attached drawing of Ground Floor Plan)

### **1) Administration Section**

The Administration Section is planned for smooth operation and management of the facilities as a center of the management of AICAD. In order to have a rational and high efficient management and operation of AICAD, this Section is arranged in ground and 1st floor of Building A, a front block of whole facilities.

#### **Main Rooms**

Entrance, Executive Secretary's room, Chief Adviser's Room, Deputy Executive Secretary's Room, Project Coordinator's Room, Secretaries Room-1, 2, 3, Auditor's Room, Meeting Room, Administration Coordinator's Office, Registry & Personnel Office, Accountant Office, Public Relation Office, and Maintenance Staff Office; Each room has one room only.

## 2) Study for the Number of Rooms of Training and Extension Section

The training and extension section is planned for training and practice of every section, IT training and extension activity. This section is arranged in the ground and 1st floor of Building B, north side of Building A. The seminar Room is arranged as Building C between Building B and D.

### Main Rooms

T&E Coordinator's Room, JICA Advisor's Room, Assistant Training Coordinator's Room, Assistant Extension Coordinator's Room, Secretaries' Room, Computer Laboratory, Preparation Room, Meeting Room (small), Meeting Room (large), Seminar Room:  
Each room has one room only except 2 rooms for Computer Laboratory and 3 rooms for Meeting Room (small).

The training program with the number of course and attendance for this project provided by AICAD during the field survey is as shown in Table 1-1. Moreover, AICAD is planned to implement 17 training courses for In-country programs in a total 28 training courses. Although the number of required rooms is studied based on these numbers of training courses, the consideration for the number of actual training courses is as shown in Appendix-3.

In adaptation to the training course as mentioned above, 2 Computer Laboratories (with 30 person capacity), 3 small Meeting Rooms (with 30 person capacity) for lecture, one large Meeting Room (with 50 person capacity), Seminar Room (with 162 person capacity) are planned. A large Meeting Room can be separated into 2 rooms by a moveable partition according to the demand of the capacity.

For the computer laboratory, all the courses carried out by AICAD will have an IT training, and as a part of extension activities, some of NGOs related with poverty eradication will have training program of IT according to their requirements. Based on such conditions, 2 Computer Laboratories for 30 persons are requested by Kenyan side. The number of rooms is considered as follows.

The number of capacity for Computer Laboratory is 30 person, IT training period is 14 days, the operation rates is considered as 65% which is lower than the lecture room due to the maintenance time for computers.

When Computer Laboratory have 2 rooms,  
 $\Sigma c = 365 \times 0.65 \times 60 / 30 \times 14 \times 2 = 14,235 / 840 = 17$  courses  
It can correspond to 17 courses in maximum.

In case only 1 Computer Laboratory with 30 person capacity,  
 $\Sigma c = 365 \times 0.65 \times 30 / 30 \times 14 \times 2 = 7,118 / 840 = 9$  courses  
It can only correspond to 9 courses in maximum.

As the result, the number of the Computer Laboratory is considered as 2 room in maximum and as 1 room in minimum considering about the wide range of training program and its course. In case only 1 room is used as the Computer laboratory, the remaining room can be used for classroom or Meeting Room.

As for the Meeting Room, 3 Meeting Rooms with 30 person capacity and 2 Meeting Rooms with 50 person capacity are requested by Kenyan side. The number of rooms have been examined based on the number of course, period, number of attendance indicated in the scheduled training program by AICAD shown in Table 1-1. In case the assumption of operation rate is 70% for the requested number of Meeting Rooms, the training course should hold 20 courses for 45 days training course and 27 courses for 30 days training course. However, the training course is planned as only 17 courses, even though the current training course are added, it becomes only 20 courses. Therefore it is difficult to operate efficiently because of the insufficient numbers of training courses. In case that Meeting Room with 50 persons capacity is reduced to 1, the remaining Meeting Rooms are 3 Meeting Rooms with 30 persons capacity and 1 Meeting Room with 50 persons capacity. And if the operation rate is 70%, it can hold 13 courses for 45 days training course, 20 courses for 30 days training course and 16~17 courses can be hold as the result.

According to the analysis of numbers of Meeting Rooms mentioned above, it is considered to be able to carry out the proposed training courses and to operate them providing 3 Meeting Rooms with 30 persons capacity and a Meeting Room with 50 person capacity and is agreed by Kenyan side through series of discussions.

Based on the content, objective and number of attendees of the training course, either by AICAD or NGO and private sector, a Large Meeting Room is planned to be able to separate into 2 Meeting Rooms for 25 persons capacity by moveable partition, in consideration of the flexible and multi-purpose utilization. As the result, the numbers of Meeting Rooms are minimized and effective and intensive utilization of the spaces is rationally arranged.

### 3) Study for the Number of Rooms of Joint Research and Development Section

The joint research and development section is mainly used for joint research and development by regular chief researcher (professor level), general researcher (assistance professor level) and research assistant (graduate degree). This section is arranged on the 1st floor of Building D above Information Section on the ground floor.

### Main Rooms

R&D Coordinator's Room, JICA Advisor's Room, Assistant Coordinator's Room, Secretaries' Room, Senior Researcher's Room, Junior Researchers' Room, Meeting Room:

Each room has one unit only, except Senior Researcher's Room of a single room type is 5 rooms.

The number of researcher rooms is based on the discussions with AICAD and PTTC in consideration of the joint research activities plan, contents of research, necessary equipment etc. 5 researcher rooms with single type are provided for Senior Researcher for joint research and development, and 1 room for general researcher and research assistant. In accordance with the joint research and development theme, the utilization rate of researcher rooms will be high, the proposed numbers of the researcher rooms are considered as the minimum requirement so as to attain the requested research function.

#### 4) Study for the Number of Rooms of Information Section

The Information Section is used for management of the computers of AICAD facilities, maintenance and teaching material collecting and editing function. Besides for the function to provide information, an Internet reading room and library are planned. This section will be planned together on the ground floor of Building D under the Joint Research and Development section on the ground floor.

### Main Rooms

Information Coordinator's Room, JICA Advisor's Room, Secretary's Room, Workshop, Server Room, IT Engineer's Room, E-contents Room, Electric Information Store, Internet Library/Library/Librarian Office, Printing Room, Editor's Room, Teaching Materials Preparation Room 1 & 2, Production Store:

Each room has one unit only.

E-contents Room for homepage and software development, IT Engineer's Room for office space of maintenance engineers, Workshop for computer repairing, Server Room, Electric Information Store for storage computer and spare part are planned in this section. As the minimum requirements for IT related database making, management, maintenance and storage of AICAD facilities: one room for each function is planned.

Editor's Room for editing training report and pamphlet, Teaching Material Preparation Room 1 & 2 for preparing the contents of multimedia and vision teaching materials, printing room for printing reports and pamphlets, Production Store for storage the products are also arranged in this section. These rooms are

planned as one room for each function to prepare and store of the teaching material and manual.

As Internet Library is used for information supply function, the Internet accessible computers will be installed for searching the research results and reports through access of the homepages of other institution, and this room also can be used for Internet practice room. The library will store the results of joint research results by joint research and development in AICAD, and collect books, magazines and pamphlets related to poverty eradication in Africa. A Librarian Office is also planned. As these essentially rooms are the necessary rooms so as to support information function of AICAD, one room for function is planned.

#### 5) Study for the Number of Rooms of Hostel Section

The hostel in this project is planned as an accommodation for researcher and trainee. In considering the distance from the city of Nairobi, service and security level of surrounding hotels, most of the researcher and trainee are expected to stay in this hostel. Initially, Kenyan side requested as each room for one person, however after the consideration of the appropriate grade of the facility as a Grant Aid Project, the idea of each room for 2 persons was agreed by Kenyan side. As for the number of rooms, 100 rooms are requested, however 40 rooms is considered to be suitable based on the result of the examination of AICAD activity plan.

#### Main Rooms

Guest Room-A, Guest Room-B, Guest Room-C, Lounge, Mini-kitchen, Administration Office:

10 rooms are planned to be used for Chief researcher with regular professor level, assistant professor and general researcher. However, it is assumed that the chief researcher will stay with their family, therefore, 6 rooms are provided with extension door which connecting it with next room, as the result 3 connecting rooms whit 2 rooms are available. 29 rooms are planned for research assistant and trainee and 1 room is arranged for disabled researcher or trainee. As this hostel is planned to accommodate 2 persons in each room in average, the total capacity is 40 rooms x 2 person = 80 persons.

Expected guests in this hostel will be socially high lanked persons such as Professor, assistant professor, lecturer, graduates degree holders, Some of them will accompany with their family. Besides it is expected that most of the trainees will be well-experienced person or the managerial position class engineers. In order to provide a proper living environment for these high statues guests, the room for professor and assistant professor should include a restroom with bath and the room for graduate degree holder and trainee should include a restroom with shower. As



to secure sufficient privacy for female guests becomes an important issue in the Hostel, the room with shower and restroom enable for female guests to accommodate securing their privacy.

The closed existing dining room in JKUAT can be used for the guests in the hostel and take-out service from existing kitchen in JKUAT is available. Therefore, the hostel is only planed with Mini-kitchen and Lounge which enable to provide a light meal for breakfast. As the related facilities to this hostel, an Administration Office, a washing room for washing sheets and iron and each lavatory for male and female are planned.

#### 6) Garage Section and Others

The garage section consists of drivers' waiting room, automobile part warehouse and garage. A guardhouse is located at the main gate of AICAD.

### **(3) Computation of the Scale of Each Room**

The floor area for each room is estimated in accordance with the scale of the project mentioned in paragraph (2) "Study for Number of Rooms". The facility size will be formulated based on similar facilities in Kenya, the standard of Commission for Higher Education: CHE, and other projects undertaken with Japan's Grant Aid assistance, as well as the results of discussions with the Kenyan side.

The initial proposal by AICAD included only the name and total floor area of the required facilities, without their exact contents and functions. While the Basic Study Design Team carried out their survey, AICAD proposed the number, size and function of each room. Based on this proposal, each room area has been estimated with consideration on planned activities of AICAD such as the style of lectures and number of trainees.

#### 1) Administration Section:

##### a) Executive Secretary's Room, Deputy Executive Secretary's Room, Chief Advisor's Room

Taking into consideration on the style and system of the public office in Kenya, the rooms for persons ranked higher than managers are planned as independent offices with reception space. The area of the Executive Secretary's Room and Deputy Executive Secretary's Room are calculated  $6.0\text{m} \times 8.0\text{m} = 48.0\text{m}^2$ , considering the layout of individual office furniture and working space. The Chief Advisor's Room of the team leader of PTTC is also considered as the same area and is planned as an individual room, with an area of  $6.0\text{m} \times 8.0\text{m} = 48.0\text{m}^2$ . In other similar facilities, the space allocated for these kind of rooms

range from 27m<sup>2</sup> to 54m<sup>2</sup>. Therefore above mentioned room area in this project is considered to be reasonable.

b) Administration Finance Coordinator's Office, Project Coordinator's Room

Taking into consideration the style and system of the public office in Kenya, the rooms for persons ranked higher than managers are usually planned as independent offices with reception space. The area of the Administration Finance Coordinator's Office is calculated as 4.0m x 8.0m = 32.0m<sup>2</sup> by the layout of individual office furniture and working space. The Project Coordinator's Room and Short-Term Experts of PTTC, for the project is planned by the layout of individual office furniture and working space as a coordinator's and two experts' office space. This room area is also 6.0m x 8.0m = 48.0m<sup>2</sup>.

c) Auditors' Room

This room is planned as an office space for two auditors. The area of this room is calculated to be 4.0m x 8.0m = 32.0m<sup>2</sup> by the layout of individual office furniture and working space.

d) Meeting Room

This meeting room is the main conference room in AICAD, and it is not only utilized for internal meetings, but also for multi-purpose use such as overseas university staff who conduct joint research, government related staff and private sector staff and others. The capacity of this room will be 26 persons. The area is 6.0m x 8.0m = 48.0m<sup>2</sup>, which provided 1.85 m<sup>2</sup> for each person.

e) Registry & Personnel Office, Accountant Office

The Administration Section of AICAD consists of personnel in general affairs, public relations, accounts, finance, salary. The Registry & Personnel office adopts one large office space in order to correspond to the fluctuation of staff, in spite of providing individual rooms for each staff, which is conventional in Kenya. The area provided is 8.0m x 8.0m = 64.0m<sup>2</sup>, which provides 9.14m<sup>2</sup> per person. In accordance with the standard of CHE, office area for one staff is estimated over 7.00m<sup>2</sup> per person plus additional storage and working space, therefore the proposed size is appropriate. The Accountant Office space will accommodate 6 staff. This office adopts one large office space in order to correspond to the fluctuation of staff. The area allowed for this room is 8.0m x 8.0m = 64.0m<sup>2</sup>, which provides 10.67m<sup>2</sup> per person.

f) Public Relations & Reception Office, Maintenance Staff Office

The Public Relations & Reception Office space will accommodate 2 staff. Taking into consideration of the style and system of the public office in Kenya, the area of this room is planned by the layout of individual office furniture, working space and reception space. The area allowed is  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ . The floor area is  $16.0\text{m}^2$  per person.

The Maintenance Staff Office Space will accommodate 8 staff. This space adopts one large office space in order to flexibly correspond to fluctuation of staff, and the area including toilet allowed is  $4.0\text{m} \times 8.0\text{m} + 8.0\text{m} \times 1.8 \div 2 = 39.2\text{m}^2$ . The average floor area is  $4.90\text{m}^2$  per person.

2) Training and Extension Section

a) Training and Extension Coordinator's Room, JICA Advisor's Room

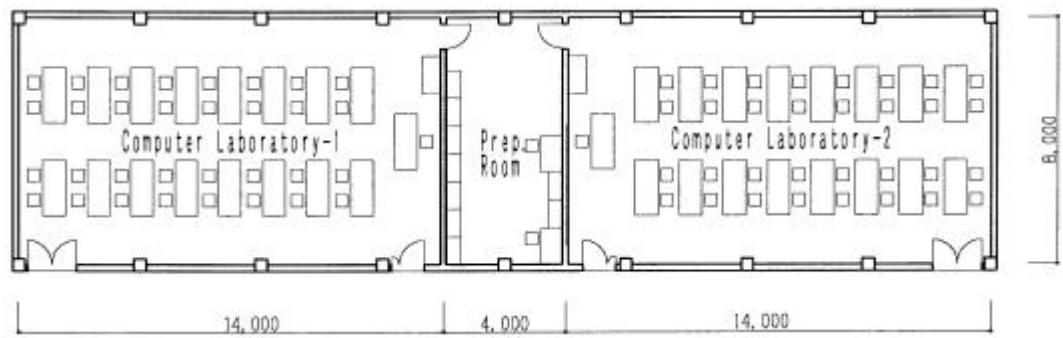
Taking into consideration the style and system of the public office in Kenya, the rooms are planned as independent offices with reception space. The area of the Research and Extension Coordinator's Room is calculated to be  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$  by the layout of individual office furniture and working space. The Advisor's Room of PTTC, who will be dispatched by JICA is planned as the same level the Coordinator's Room. The area is also planned as  $5.0\text{m} \times 6.0\text{m} = 30.0\text{m}^2$ .

b) Assistant Training Coordinator's Room and Assistant Extension Coordinator's Room

Taking into consideration the style and system of the public office in Kenya, both Coordinator's rooms are planned as independent offices with reception space, in basically. However, these rooms are planned continuous space by flexibly correspond to fluctuation of space. The area of each room is calculated as  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$  by the layout of individual office furniture and working space

c) Computer Laboratory

This Computer Laboratory is the most important facility for IT training, using personal computers for training and computer operation. This room layout is for 30 personal computer stations. The maximum capacity of this room will be 32 persons. The area is  $8.0\text{m} \times 14.5\text{m} = 116.0\text{m}^2$ , which is  $3.63\text{m}^2$  per person. Preparation room is planned as a staff room between the two Computer Rooms with storage for educational materials and installing the switching hub rack. The area is  $3.0\text{m} \times 8.0\text{m} = 24.0\text{m}^2$ . For effective use of computer rooms, air conditioners, stabilizer and free access floor should be provided.

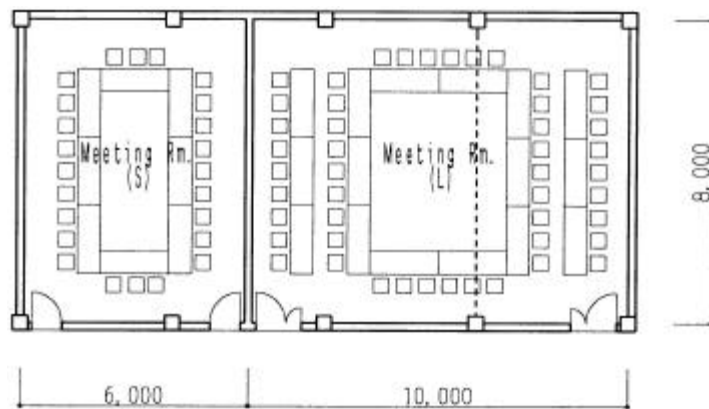


**Fig. 2-1 Computer Laboratory**

d) Meeting Room (S) and Meeting Room (L):

The requested capacity of the meeting rooms was 30 participants [Meeting Room (S)] and 50 participants [Meeting Room (L)] for use by the three training programs in AICAD. Meeting Room (S) will be used by courses with 30 participants and Meeting Room (L) will be used by courses with 50 participants. The courses are for third country and in-country training. As the NGO courses are to be held on a request basis and the number of participants of each course is undecided, the Meeting Room (L) is planned to have a movable partition which can divide the room into two rooms for each 25 participants.

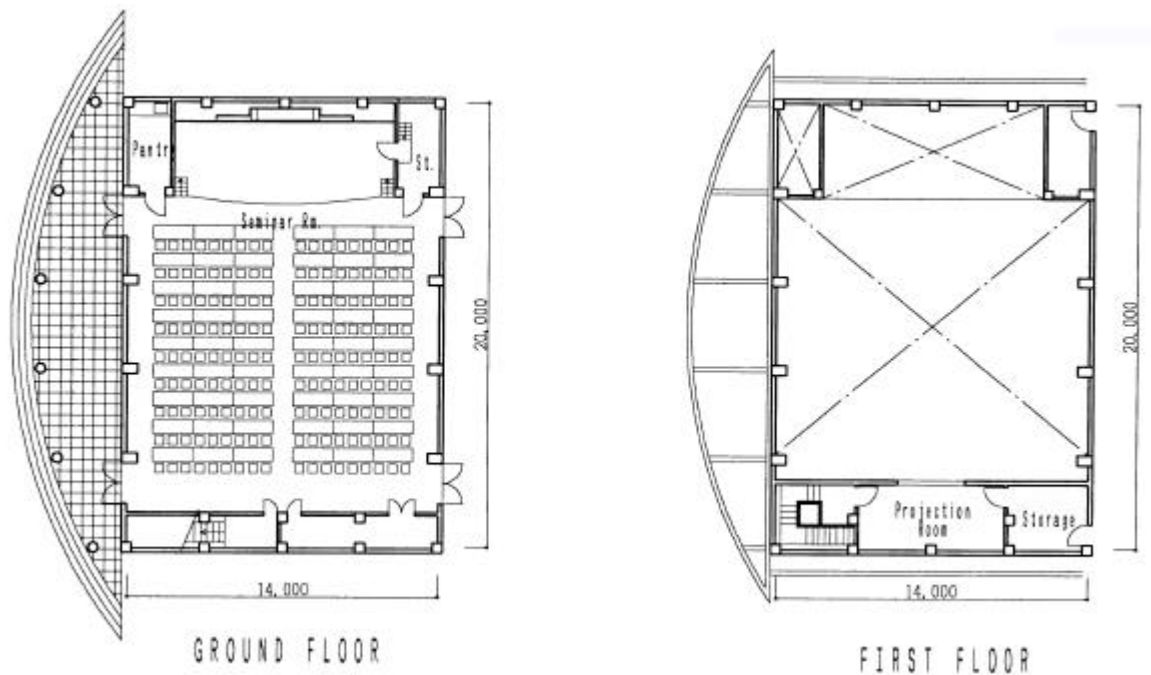
These meeting rooms will be used for lectures and other purposes, such as discussions and practical training. Taking into consideration the layout of furniture and equipment, the area of Meeting Room (S) is planned as 6.0m x 8.0m = 48.m<sup>2</sup>, and the area of Meeting Room (L) is planned as 10.0m x 8.0m = 80.0m<sup>2</sup>. The floor space occupied by a participant for both meeting rooms is 1.6m<sup>2</sup>. In other similar facilities of Grant Aid projects, the space allocated for classrooms is 40.0m<sup>2</sup> and 20 persons per classroom, so the area allocated in this project is reasonable.



**Fig. 2-2 Meeting Room**

e) Seminar Room

Since the Seminar Room is needed for various activities and training, particular consideration must be given to its capacity and flexibility. According to the seminar and training program, both chairs and desks or only chairs will be arranged in the Seminar Room so as to meet with frequent changes of the use of the space. The three person desks will be recommended. The dimensions of the seating area in the Seminar Room are  $14.0\text{m} \times 16.0\text{m} = 224.0\text{m}^2$ , for 162 participants (in case of only chairs: 220 participants). Basically the appropriate unit scale for the hall and large conference space is approximately  $0.8$  to  $1.2\text{m}^2$  per person with chairs, and approximately  $1.5$  to  $2.0\text{m}^2$  per person with chairs and desks. The floor area occupied by one person with chair and desk is calculated as  $1.38\text{m}^2$  and  $1.02\text{m}^2$  without desks. Therefore the scale of the room is considered reasonable. The total areas of the Seminar Room, including stage and lobby, is  $14.0\text{m} \times 20.0\text{m} = 280.0\text{m}^2$ , so that the scale of the



**Fig. 2-3 Seminar Room**

3) Joint Research and Development Section:

a) Research and Development Coordinator's Room, JICA Advisor's Room

Taking into consideration the style and system of the public office in Kenya, the rooms are planned as independent offices with reception space. The area of the Research and Development Coordinator's Room is calculated as  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$  by the layout of individual office furniture and working space. The Advisor's Room of PTTC, who will be dispatched by JICA is planned as

the same level of the Coordinator's Room. The area is also planned to be  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ .

b) Assistant Coordinator's Room

Taking into consideration the style and system of the public office in Kenya, the room is planned as two coordinators offices with reception space. The area of the Assistant Coordinator's Room is calculated  $6.0\text{m} \times 8.0\text{m} = 48.0\text{m}^2$  by the layout of individual office furniture and working space which is  $24.0 \text{ m}^2$  per person.

c) Senior Researchers' Room, Junior Researcher's Room

It is necessary to calculate the size of the Researcher's Room in accordance with the contents of research, working space and layout of equipment. Since the Researchers' Rooms are five individual rooms for professors, these rooms are calculated as  $6.0\text{m} \times 8.0\text{m} = 48.0\text{m}^2$ .

Junior Researchers' Room is calculated  $8.0\text{m} \times 8.0\text{m} = 64.0\text{m}^2$  and one room style is planned, taking into considerations the research space, meeting space and equipment.

d) Meeting Room

This meeting room is planned to mainly for internal conferences in AICAD attended by researchers who conduct joint research and manager staff training. This room is calculated to be  $8.0\text{m} \times 8.0\text{m} = 64.0\text{m}^2$  for 30 people which is  $2.13\text{m}^2$  per person.

4) Information Section:

a) Information Coordinator's Room, JICA Advisor's Room

Taking into consideration the style and system of the public office in Kenya, the rooms are planned as independent offices with reception space. The area of the Information Coordinator's Room is calculated to be  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$  by the layout of office furniture for the individual working space. The Advisor's Room of PTTC, who will be dispatched by JICA is also planned as the same level of the Coordinator's Room of the same area, and it is planned as an individual room. The area is also  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ .

- b) Workshop, Server Room, IT Engineer Room, e-contents Room, Electrical Information Store

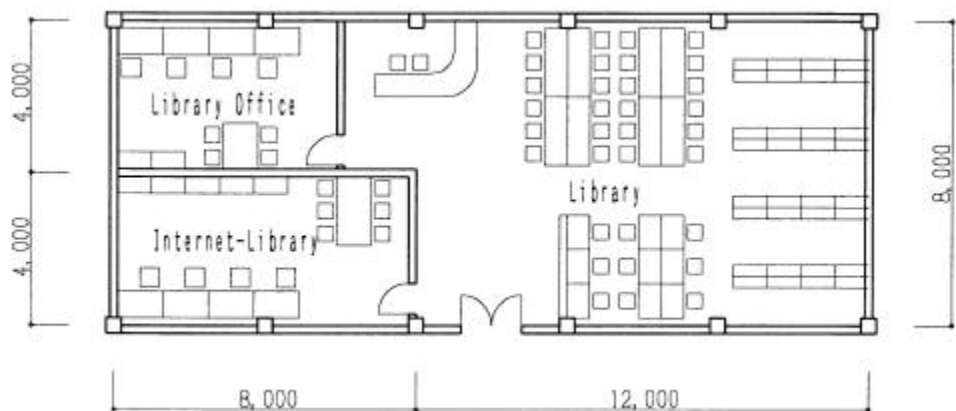
These computer related rooms and workshop are utilized to repair and maintain the computer and spare parts, and their size are determined based on the working space and layout of equipment. The area is calculated to be  $4.0\text{m} \times 10.0\text{m} = 40.0\text{m}^2$ . The server room shall be installed with computer servers. In consideration of the layout of equipment, the area is calculated to be  $4.0\text{m} \times 4.0\text{m} = 16.0\text{m}^2$ . The IT Engineer Room is for the maintenance of computers. The area is calculated to be  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ . The e-contents room is planned for an engineer who makes homepages and develops software. Considering the work space and equipment layout, the area is calculated to be  $4.0\text{m} \times 4.0\text{m} = 16.0\text{m}^2$ . Electrical Information Store is for storage of computers and spare parts. The area is calculated to be  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ .

For effective use of e-contents and server room, air conditioners, stabilizer and free access floor should be provided.

- c) Internet Library, Library, Librarian Office

The Computer library will be used for joint research and thesis research by internet. Taking into consideration the layout of 4 computers, the area is  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ .

The library will be open style for the use of staff and trainees with a capacity of 24 seats and storage space for 10,000 books. The area should be  $12.0 \times 8.0\text{m} = 96.0\text{m}^2$ . The Librarian Office is occupied by 3 librarians, and the area is calculated to be  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ , which is  $10.7\text{m}^2$  per person for each room.



**Fig. 2-4 Internet Library, Library, Librarian Office**

d) Print Room, Edit room, Education Material Product Room, Procurement Office

The scale of the Print Room is estimated considering the printing machine, a cutter, a binder machine and working space for 5 persons. The area is calculated as  $4.0\text{m} \times 8.0\text{m} + 8.0\text{m}^2 = 40.0\text{m}^2$ . The scale of the Edit Room is estimated considering working space for making reports and pamphlets of research and training. The area is calculated as  $4.0\text{m} \times 6.0\text{m} = 24.0\text{m}^2$ . The scale of the Education Material Product Room-1 is estimated considering working space for making the visual education materials and equipment layout. The area is calculated to be  $4.0\text{m} \times 4.0\text{m} = 16.0\text{m}^2$ . The scale of the Education Material Product Room-2 is estimated considering the work space for making the various contents of education materials and equipment layout. The area is calculated to be  $4.0\text{m} \times 8.0\text{m} = 32.0\text{m}^2$ . The scale of the Procurement Office is estimated considering office space and checking space of supplies. The area is calculated to be  $4.0\text{m} \times 4.0\text{m} = 16.0\text{m}^2$ .

5) Hostel:

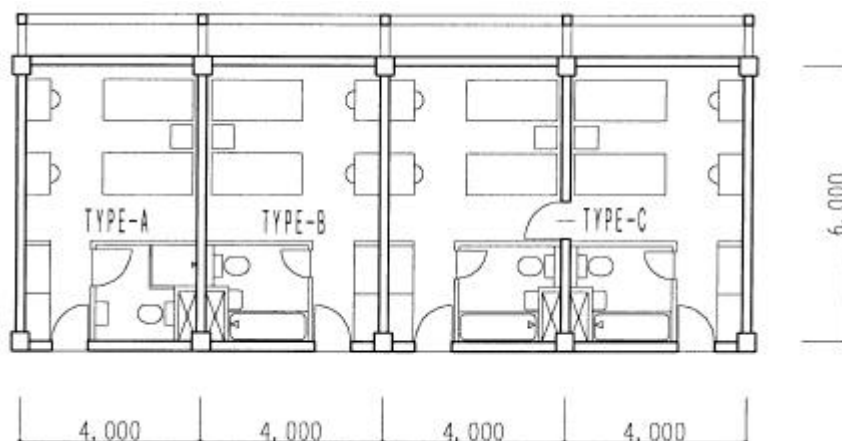
a) Guest Room

Thought the series of discussions in Basic Design Study, 2 persons per one guest room was agreed to by the Kenyan side. The standard Guestroom-A will be provided with a shower room (shower and water closet).

Ten Guestroom-B for 2 persons in one room for professor level will be provided with the same floor area as the standard Guestroom including a bathroom (bath tub and water closet), according to the strong request by Kenyan side. As some professors with their families are expected to stay in this Hostel, the Guestroom-C provides extension doors to connect two Guestrooms of Type B. It is to say, six members of Guestroom-C are planned within the ten Guestroom-B, and a maximum of 3 families can stay in this Hostel.

The size of all guestrooms will be  $4.0\text{m} \times 6.0\text{m} = 24.0\text{m}^2$ , with floor area of  $12.0\text{m}^2$  per room per person. In another similar facility by Grant Aid Project such as "The Project for Training Institution Development at North Sulawesi and South Sulawesi in The Republic of Indonesia in 1998," the space allocated for guestrooms was  $12.0\text{m}^2$  per person and 2 persons per guest room, so the area allocated in this project is reasonable.



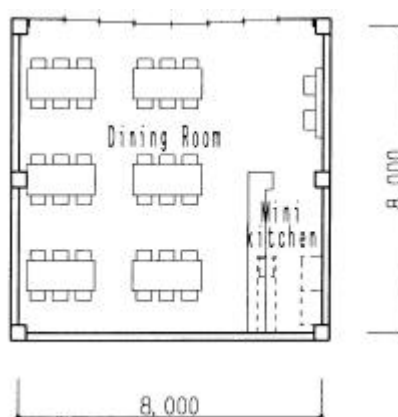


**Fig. 2-5 Guestroom of Hostel**

b) Dining Room:

Meal service for this Hostel can be considered to use the closed existing canteen of JKUAT or the catering service from the existing kitchen of JKUAT. The Dining Room in this Hostel is planned with 2 shifts with mini-kitchen for the use of simple food like a breakfast.

The scale of the dining area is estimated considering the capacity, table layout and Kenyan customs. In relation to the capacity of the Hostel, the dining room should have a seating capacity for 36 such that all persons can be accommodated in 2 shifts. The area of the dining room should be  $8.0 \times 8.0\text{m} = 64.0\text{m}^2$  including mini-kitchen, and the floor area of at least  $1.78\text{m}^2$  per person should be considered. The area allocated in this project is reasonable.



**Fig. 2-6 Dining Room**

6) Garage and Others

a) Garage, Mobile Mechanic Store

Taking into consideration on the security of Kenya, the Garage should be planned with space for three vehicles which will be supplied by PTTC for the extension program. The area required is estimated as  $7.5 \times 6.0\text{m} = 45.0\text{m}^2$ .

A Mobile Mechanic Store is planned to store the spare parts and tools. The area is  $2.5 \times 6.0\text{m} = 15.0\text{m}^2$ , and the proposed scale should be additional to be vehicle space.

**(4) Required Rooms and Their Floor Areas**

Based on the discussions and studies, the proposed floor areas of the required rooms described in the previous sections are summarized in Table 2-10.

**2-2-1-2 Water Supply System Plan**

**(1) Planning Condition**

Purpose of the system is to recover the function of the existing JKUAT water supply facilities and installation of the water supply facilities for the AICAD facilities. The target year is 2007.

1) Water Demand

a) Planned population

In year 2000, population of JKUAT students is 2,810 (residents: 2,315, commuters: 495), population of JKUAT staff is 1,103 (residents: 595, commuters: 984) and population of AICAD staff is 8 (commuters) as shown in Table 2-10.

Number of the JKUAT students and the staff in the target year 2007 is as same as the present population based on the following condition, although JKUAT estimates the population of the JKUAT students is 4,860 (residents: 3,320 and commuters: 1,540) in 2007. a) There is a under construction dormitory, the capacity is about 950 population, but it is doubtful whether the dormitory will be constructed by the target year because the budgetary schedule is not fixed. b) There is no extra rooms in the JKUAT dormitories for increasing students. So, the increase of the student population in future is not practical. However if the dormitory is constructed, it will be possible to receive the planned population, so the case is also studied. The former is Case 1 as the planning condition and the latter is Case 2 as the supplemental case.

Population of the AICAD users is 430 (residents: 80 and commuters: 350) and population of the staff is 95 (commuters) in the target year as shown in Table 2-10.

**Table 2-10 Existing and Future Served Population**

(unit: people)

Year	JKUAT						AICAD					
	Student			Staff			User			Staff		
	Residents	Commuters	Total	Residents	Commuters	Total	Residents	Commuters	Total	Residents	Commuters	Total
2000	2,315	495	2,810	595	984	1,103	0	0	0	0	8	8
2007 (CASE 1)	2,315	495	2,810	595	984	1,103	80	350	430	0	95	95
2007 (CASE 2)	3,320	1,540	4,860	595	984	1,103	80	350	430	0	95	95

(CASE 1): Case 1 is the project plan, as JKUAT students will not increase in future.

(CASE 2): Case 2 is a supplemental case as JKUAT students will increase in future based on the JKUAT estimation.

Detail of the population, water demand and water supply is calculated in Attachment A

b) Estimation of water demand

i) Unit water consumption rate

Based on the design manual of Ministry of Water Resources in Kenyan, unit water consumption rate is as follows,

**Table 2-11 Unit Water Consumption Rate of Kenyan Standard**

(unit: Litter/capita/day)

Item	Rate	Item	Rate	Item	Rate
House (high)	250	Hotel (high)	600	Students in dormitory	50
House (middle)	150	Hotel (middle)	300	Students (commuter with toilet)	25
		Hotel (low)	50		

The unit water consumption rate is estimated for the project in reference to the manual. The figure of the rate for the students in dormitory is not referred, as it is too low because the figure includes the rate for the primary and secondary school students. Adopted unit water consumption rate for the project is shown in Table 2-12.

It is found that the rate of the figures are adequate, based on the field survey, as average distributed water amount measured at the existing water purification plant is equal to the distributed water amount calculated with present population and the rate, both figures are approximately 700m<sup>3</sup>/day.

**Table 2-12 Unit Water Consumption Rate in the Project**

(unit: Litter/capita/day)

JKUAT				AICAD			
Students		Staff		Users		Staff	
Residents	Commuters	Residents	Commuters	Residents	Commuters	Residents	Commuters
160	30	200	30	200	30	200	30

ii) Estimation of water demand

Water demand is calculated based on the population in 2007 and the unit water consumption rate. The estimated water demand is shown in Table 2-13.

**Table 2-13 Water Demand Estimation in 2007**

	Unit	JKUAT					AICAD				Total
		Students		Staff		Labo. & Other	User		Staff		
		Residents	Commuters	Residents	Commuters		Residents	Commuters	Residents	Commuters	
Population (CASE 1)	People	2,315	495	595	984	-	80	350	0	95	-
Population (CASE 2)	People	3,320	1,540	595	984	-	80	350	0	95	-
Unit water consumption rate	L/c/day	160	30	200	30	-	200	30	200	30	-
Water demand (CASE 1)	m <sup>3</sup> /day	370	15	119	30	50	16	11	0	3	614
Water demand (CASE 2)	m <sup>3</sup> /day	531	46	119	30	50	16	11	0	3	806

2) Design Water Supply

Design water supply is calculated, taking into account the water demand and water leakage ratio. The water leakage ratio is estimated based on the field survey at the existing water purification plant as follows,

Water leakage ratio =

$$\frac{\text{(Water supply surveyed in mid night – Estimated water use at mid night)}}{\text{Surveyed daily water supply}} = \frac{(180 - 60)}{700} = 17.5\%$$

Design water supply is shown in Table 2-14.

Average annual temperature is about 19.3°C at the site, and the difference of Max. and Min. temperature in monthly average temperature is small, as it is 3.8°C. This little climate fluctuation leads to little fluctuation of water consumption throughout the year. And based on the design manual in Kenya, the daily maximum water supply is not taken into account. So, it is estimated that the design water supply is equal to the design water supply (daily average) and the design water supply (daily maximum).

**Table 2-14 Design Water Supply in 2007**

	Water Demand (A)	Leakage (B)=0.175 x C	Design Water Supply (C)=A / (1-0.175)
(CASE 1)	614	130	744
(CASE 2)	806	171	977

(unit: m<sup>3</sup>/day)

## (2) Facility Plan

The improvement methods of the existing water facilities are described below,

### 1) Improvement of the intake facilities

#### a) Problems and ways of measure

Problems of the existing water intake facilities are as follows. i) It might be difficult that the existing intake facilities will withstand the rising of the Ndarugu River bed in the future, for example 30 years later, as the river bed has risen about 1m in the past 15 years. ii) We can not operate the pumps during the flood seasons as silt settles at the pump pit. And iii) existing pump house has been inundated twice in the past by water bloom and it might happen again.

The existing site of the water intake facilities is not suitable for the water intake facilities as the site has the problem, such as, the river bed rising and silt sedimentation. It is desirable to shift the water intake facilities to an adequate site if such a site exists. However, desirable sites for the water intake facilities have not been found during the field survey around the existing intake facilities for 200m upstream and downstream side from the facilities. So, three alternatives have been studied to find out an appropriate improvement plan for the water intake facilities as follows,

Alt. A: Improvements to existing water intake facilities
Alt. B: Construction of new water intake facilities beside the existing intake facilities
Alt. C: Development of new water resources

Major facilities and the characteristic of the each alternative are described below,

#### b) Alt. A: Improvements to existing water intake facilities

As an Improvement to the existing water intake facilities, the following rehabilitation works are required; raising the height of the pump pit, installation of the waterproof stop logs, improving the waterproofing of the foundations at the pump house. Although these measures are taken, if the pump system is the same as the present one, silt would be gathered at foot valves, same as the present condition, when you operate the pump during flood season. The existing pumps have been used for about 15 years and they will be required to be renewed soon.

- c) Alt. B: Construction of new water intake facilities beside the existing intake facilities

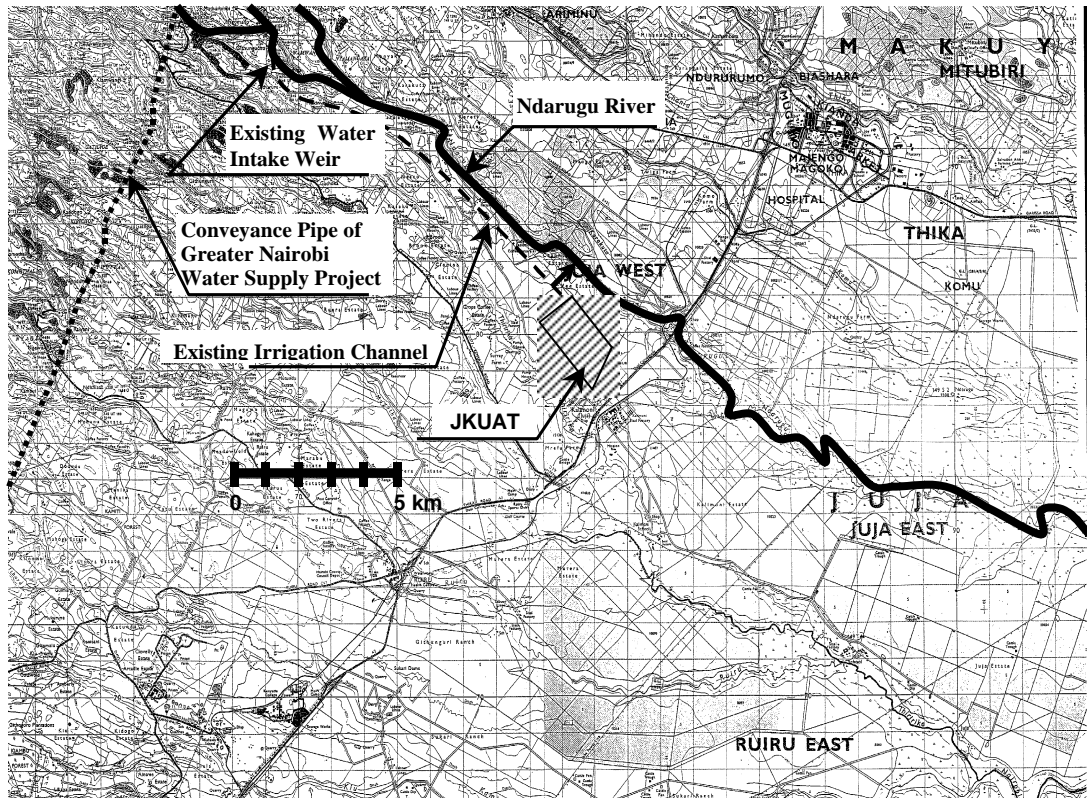
This is a plan to construct new water intake facilities beside the existing intake facilities. As a design condition, the new water intake facilities will be used for about 30 years. The riverbed will rise about 2m after 30 years if the trend continues as it has done in the past 15 years. The new intake facilities would be sustained in the future by setting the height of the suction pit to be 3.5m. But, renovation of the intake facilities would be required after 30 years. Waterproof stop log should be installed at the new intake facilities, in order to keep maintenance of the facilities at a minimum. Submersible pumps should be applied as it has at a higher capacity to move silt with water other than using the existing pump. And a pump of sludge type should be installed as it can remove silt from the suction pit. A control house of the new intake facilities will be constructed at an higher elevation not to be affected by the flood.

- d) Alt. C: Development of new water resources

The following two alternatives are studied for the development of new water resources based on the field survey.

Alt. C1: Receiving water by gravity from upper stream of the Ndarugu River Alt. C2: Receiving water from the Greater Nairobi Water Supply Project
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Location of these alternatives is shown in Fig. 2-7.



**Fig. 2-7 Location of the Candidate Sites of the New Water Resources**

d)-1 Alt. C-1: Receiving water by gravity from upper stream of the Ndarugu River

Main structures required for receiving water by gravity from the upper stream of the Ndarugu River are raw water conveyance pipes with length of about 15-20km, that is, from existing water intake facilities constructed in the colonial period, to the storage pond of JKUAT. There are existing irrigation channels for coffee plantation from the intake weir to a point that is about 1 km away from JKUAT, so it might be possible to extend a water conveyance pipes from the point to JKUAT. The characteristic of the alternative is that the operation and maintenance cost is inexpensive, as the raw water is carried by gravity and not by pumps. However, the construction of the raw water conveyance facilities requires higher implementation cost than other alternatives and it is necessary to study the possibility of installing the conveyance pipes to JKUAT and to design the route. Also, land acquisition is required for the raw water conveyance pipes installed along the existing irrigation channel in the private land, and the procedure would take time.

As a result, the Alt. C1 is not possible to conduct in this project, as there are a lot of constraints to solve. However, if these problems are solved, in view points of technical and social matters, the idea might have been worth being studied.

d)-2 Alt. C2: Receiving water from the Greater Nairobi Water Supply Project

Main structures required to receive water from the Greater Nairobi Water Supply Project are pressure pipes with length of about 20 km from a point of conveyance pipe for the Nairobi City to JKUAT. Merit of this alternative is that JKUAT does not need the existing water purification plant, as the receiving water is treated water. However, the construction cost of the pipe is more expensive than other alternatives. Also it might be difficult to receive water from the Greater Nairobi Water Supply Project because shortage of water have occurred in the recent years in the Nairobi City, so there would not be enough water for JKUAT.

e) Evaluation of the Alternative Study

Alt. B of “Construction of new water intake facilities beside the existing intake facilities” is applied for the Basic Study, as shown in Table 2-15, for selecting an improvement plan of the water intake facilities.

**Table 2-15 Comparison of Alternative Study for Selecting an Improvement Plan of Water Intake Facilities**

Alternative		Evaluation
Alt. A	Improvement of existing water intake facilities	×
Alt. B	Construction of new water intake facilities beside the existing intake facilities	
Alt. C	Development of new water resources	
Alt. C1	Receiving water by gravity from upper stream of the Ndarugu River	×
Alt. C2	Receiving water from the Greater Nairobi Water Supply Project	×

2) Measures against outbreak of water bloom at a storage pond

a) Problem

When water bloom occurs, operation of the water purification plant is stopped and water supply stopped due to the malfunctions of the treatment of the purification plant. In the past, the water bloom has occurred twice, in December of 1998 and 1999. In order to restore the operation, water of the storage pond was emptied by opening a gate, and after cleaning the pond, water is stored in the pond by pumping it up from the Ndarugu River water intake facilities. It takes about one week to restore the water supply and the interruption of water supply deteriorates activities of JKUAT and the living condition.

There are partially parts lower than the bottom of the discharge gate at the storage pond, and it is necessary to pump up water from the parts. This is one of the causes of the long duration for emptying water from the pond.



## b) Measurement

Measurement against outbreak of water bloom at the storage pond is studied to utilize the existing storage pond that has the following merits,

- The pond has a big water storage capacity (about 50days) that it can cope with draught.
- The pond has an effect of settling silt and it reduces the load of the water purification plant.
- The pond has an effect of sterilizing water by ultraviolet rays.
- Water for irrigation is available in the same way as the present.
- Operation of pumps at the Ndarugu River intake facilities can be intermittent, not to operate every day, as the pond has a large capacity and it can be a buffer.

First, following rehabilitation is required as the mitigation against outbreak of water bloom at the storage pond,

- Lowering the base of the discharge gate, so that water could be drained from the pond
- Back-filling partially at the low parts to drain water completely after opening the discharge gate
- Repairing the inlet facilities from the Ndarugu River water intake facilities because the back-filling would affect the inlet facilities

The above measurement leads to smooth water discharge from the storage pond but still it would take about 1 day to discharge water from the pond, as shown below, and it might be more than 2 days when cleaning the pond.

### Dimension of the storage pond

Area (A):	41,000m <sup>3</sup>
HWL (H1):	1548.5m
LWL (H2):	1546.5m
Bottom level of pond (H3):	1545.2m
Base level of discharge gate:	1545.5m
Size of discharge pipe: Diameter	d = 0.8 m (a = 0.5m <sup>2</sup> )
Coefficient of water rate (c):	0.6

Duration of drainage

$$\sqrt[2]{\frac{(H1 - H3)[(A / a \cdot c)^2 - 1]}{2g}}$$

= 93,074 ⇒ 25.9 hours

Second, following methods are required to solve the problem.

- Construction of bank to divide the existing storage pond and make an emergency storage pond, that has two existing intake-pumping stations for water supply and irrigation
- Construction of by-pass pipe to the emergency storage pond

The size of the emergency storage pond is, length: 80m, width: 20m, depth: 2m and volume: about 3,200m<sup>3</sup>. Water in the pond could be discharged by an irrigation pumping station; the capacity is 4.3m<sup>3</sup>/min. It takes about 12 hours to discharge the water, and it would take not more than 1 day to re-start the operation of the water purification plant. Total planned volume of reservoir is of one day design water supply, that is enough volume of water to sustain water supply during the period. So, if the outbreak of water bloom happens, it could be managed in the future with this system and it might not cause a interruption of water supply.

c) Control of storage pond

When there is no water bloom at the storage pond, we operate the Ndarugu River intake facilities and water is stored at the pond through the existing water conveyance pipe. Water drains from the receiving point of the storage pond into the emergency storage pond through a pipe installed inside the bank of the emergency storage pond, and two intake pumping stations operate for water supply and irrigation. (See Fig. 2-9) When water bloom happens at the ponds, following procedures will be taken,

- i) Stop the operation of the water purification plant and the Ndarugu River intake facilities, and close a gate at the bank of the emergency pond, and start the irrigation intake pumps to discharge water in the emergency storage pond. Then clean the pond.
- ii) Open the gate of a drainage pipe of the storage pond, and discharge water and clean the storage pond.
- iii) After you finish item i), you start the Ndarugu River intake pumps and send water into the emergency storage pond through the bypass pipe adjusting the valves.

- iv) Start the water intake pump at the pond and re-start the operation of the water purification plant and re-start the water supply after water is stored over LWL at the emergency storage pond.
  - v) After you finish item ii), you open the gate of the emergency storage pond, and send water through the existing pipe but not through the bypass pipe and re-start normal operations.
- d) Major dimension of the pond

Major dimension of the pond is shown below,

**Table 2-16 Major Dimension of the Pond**

	Area	Volume (effective water depth=2m)	
Existing storage pond	41,000 m <sup>2</sup>	87,000 m <sup>3</sup>	} Total 80,000 m <sup>3</sup>
Storage pond after division	41,000 - (30 x 90) = 38,300 m <sup>2</sup>	76,6000 m <sup>3</sup>	
Emergency storage pond	20 x 80 = 1,600 m <sup>2</sup>	3,200 m <sup>3</sup>	

As a reference, required time to store or discharge water from the ponds are shown below,

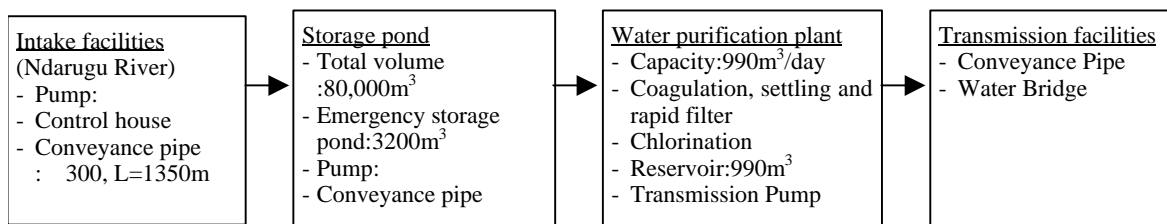
- i) Required time to store water to LWL at the emergency storage pond  
 $(1,600\text{m}^2 \times 0.15\text{m})/4.4\text{m}^3/\text{min.} = \text{about 1 hour}$   
 Pump capacity of the Ndarugu River intake facilities:  $4.4\text{m}^3/\text{min.}$
- ii) Required time to store water to HWL at the emergency storage pond  
 $(1,600\text{m}^2 \times 2\text{m})/4.4\text{m}^3/\text{min.} = \text{about 12 hours}$
- iii) Required time to store water to HWL at the storage pond  
 $76,600\text{m}^3/4.4\text{m}^3/\text{min.} = \text{about 12 days}$
- iv) Required time to discharge water from the storage pond after division

$$T = \frac{2 - 3 \times [(38,300 / 0.5 \times 0.6)^2 - 1]}{2 \times 9.8}$$

$$= 86,945 \text{ sec.} \Rightarrow 24.1 \text{ hours}$$

3) Project contents for improving water supply facilities

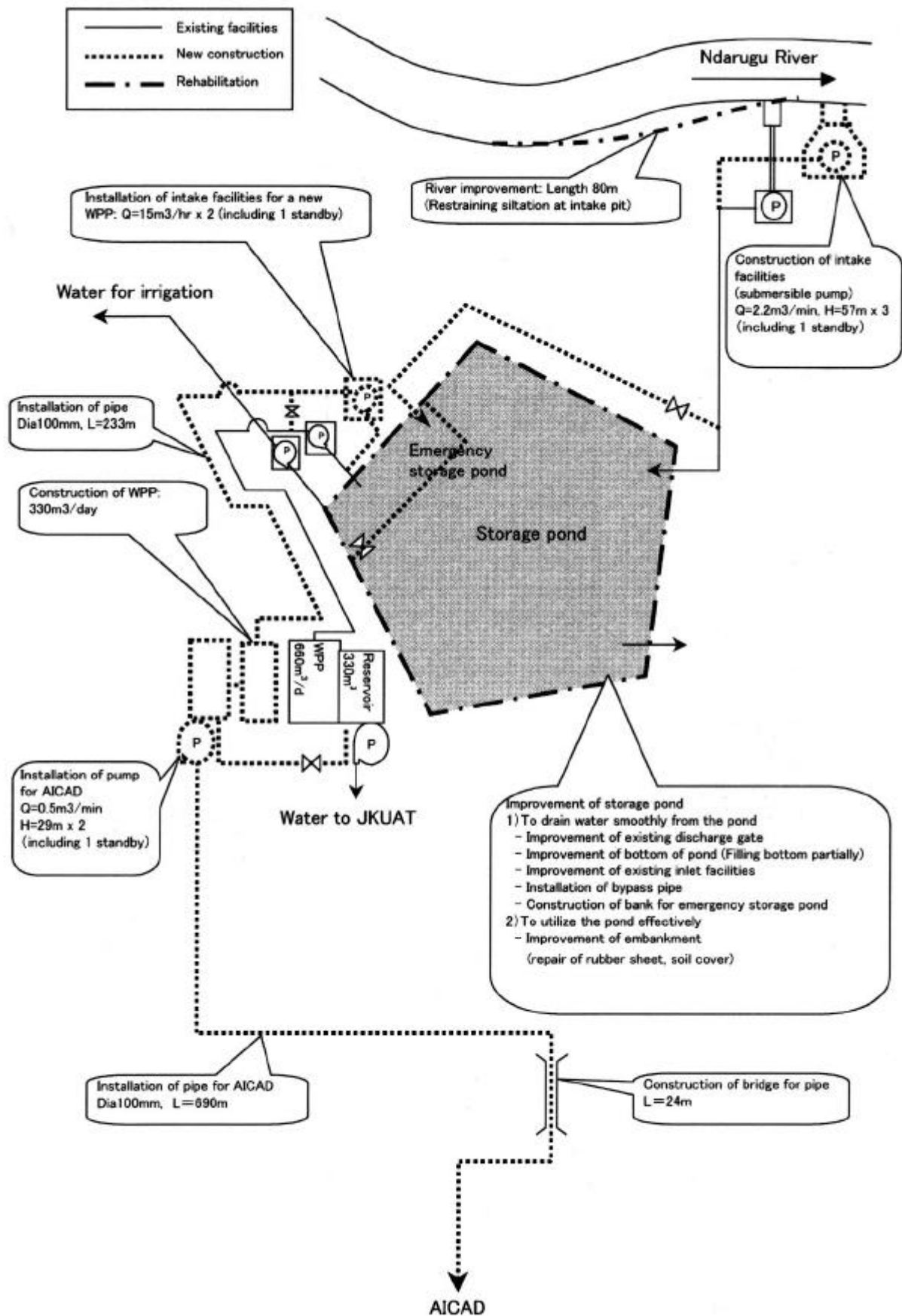
System flow of water supply facilities including existing and new project facilities is shown in Fig. 2-8. And the project contents for improving water supply facilities are shown in Table 2-9 and Fig. 2-9.



**Fig. 2-8 System flow of water supply facilities**

**Table 2-17 Project contents for improving water supply facilities**

Item	Contents
Water Intake facilities (Ndarugu River)	River improvement (Length: 80m, cut and fill) Construction of intake and pump pit Construction of control panel house for pumps Installation of connection pipe to existing conveyance pipe
Storage Pond	Improvement of an existing discharge gate Improvement of bottom of the pond (Filling bottom partially) Improvement of existing inlet facilities Construction of bank for emergency storage pond (height: 2.5m, length: 100m, with connection pipe, gate and spillway) Installation of bypass pipe Improvement of embankment (repair of rubber sheet, soil cover) Construction of intake pumping station at the pond Installation of pipe
Water purification Plant	Construction of water purification plant Construction of reservoir Installation of transmission pump
Transmission facilities	Installation of pipe for AICAD Construction of bridge for transmission pipe



**Fig. 2-9 Conceptual Diagram of Water Supply Project**

### **2-2-1-3 Sewerage System Plan**

#### **(1) Planning Conditions**

The existing sewerage facilities require the rehabilitation so as to restore the original capacity and function, and to accommodate and treat the wastewater from the newly constructed AICAD facilities. The basic conditions for this rehabilitation are described as follows:

##### **1) Fundamental Type of Facilities**

In light of the maintenance/operation of facilities and the cost efficiency in the construction works for the rehabilitation, the sewerage facilities shall function as a common unified facility to collect and treat generated wastewater from the AICAD and the JKUAT.

The wastewater from the AICAD facilities is mixed with the wastewater from the JKUAT facilities at the manhole located in the front of the existing sewerage storage tank, after being collected through sewage pipes lying around the AICAD facilities.

##### **2) Design Sewage Flow and Influent BOD**

The wastewater flow-rate was set based on the service population in July of 2007 (the completion year of the Phase II of PTTC). The sewerage facilities are rehabilitated to restore the capacity and function of the existing facilities under the conditions of the existing flow-rate of collected and transferred sewage. The increase of wastewater flow in the future, however, is taking into account the facilities to be related directly to the rehabilitation such as relay pumps, transfer pumps, etc.

The design flow-rate was calculated based on the return rate of 100% for consumed water and the groundwater infiltration rate of 10% for generated wastewater flow. The BOD discharge rates were set to 50 g/cap.day for residents and 15 g/cap.day for day students and commuters. Based on these premises, the planning conditions with 675 m<sup>3</sup>/day of daily maximum flow and BOD 268 mg/l of influent are shown in Table 2-18.

**Table 2-18 Design Sewage Flow and Influent BOD**

	Wastewater Discharge Rate (l/cap.day)	BOD Discharge Rate (g/cap.day)	Served Population (people)	Generated Wastewater (m <sup>3</sup> /day)	BOD Discharge (kg/day)	BOD Conc. (mg/l)
1. JKUAT Facilities						
1.1 Domestic Wastewater						
Living Student	160	50	2,315	370	115.8	313
Day Student	30	15	495	15	7.4	500
Living Staff	200	50	595	119	29.8	250
Commuting Staff	30	15	984	30	14.8	500
1.2 Laboratory Wastewater				50	2.5	50
1.3 JKUAT Total				584	170.2	292
2. AICAD facilities						
2.1 Domestic Wastewater						
Living Student	200	50	80	16	4.0	250
Day Student	30	15	350	11	5.3	500
Living Staff	200	50	0	0	0	0
Commuting Staff	30	15	95	3	1.6	500
2.2 AICAD Total				30	10.8	365
3. Generated Wastewater Total	613 (m <sup>3</sup> /day)					
4. Influent BOD	181 (kg/day)					
5. Infiltrated Groundwater (10%)	61 (m <sup>3</sup> /day)					
6. Daily Maximum Flow	675 (m <sup>3</sup> /day)					
7. Influent BOD Conc.	268 (mg/l)					

## (2) Outline of Rehabilitation Plan

### 1) Rehabilitation Items

The rehabilitation aims to preserve the environmental sanitation in the campus by removing wastewater generated in the existing JKUAT facilities, the newly constructed AICAD facilities and relevant facilities, and together to prevent the environment from the deterioration to be possibly caused by the discharge of wastewater into the outside.

Based on the survey results for the existing sewerage facilities and the activity plan of the AICAD in the future, the rehabilitation items have been discussed and confirmed with the Kenyan Side as follows:

- a) The new installation of sewage pipes including necessary appurtenances to collect wastewater generated from the AICAD facilities,
- b) The rehabilitation of sewage collection and transfer facilities in the existing sewerage including the transfer pumps, the relay pumps and appurtenances
- c) The improvement of the existing wastewater treatment plant (oxidation ponds). This includes the expansion of maturation ponds and planting of medium-height trees and other necessary items.

- d) The introduction of separated recovery system of laboratory wastewater and the installation of toxic waste storage yard, and the supply of related equipment like waste recovery containers, etc.

## 2) Overall Flow of Sewerage Facilities

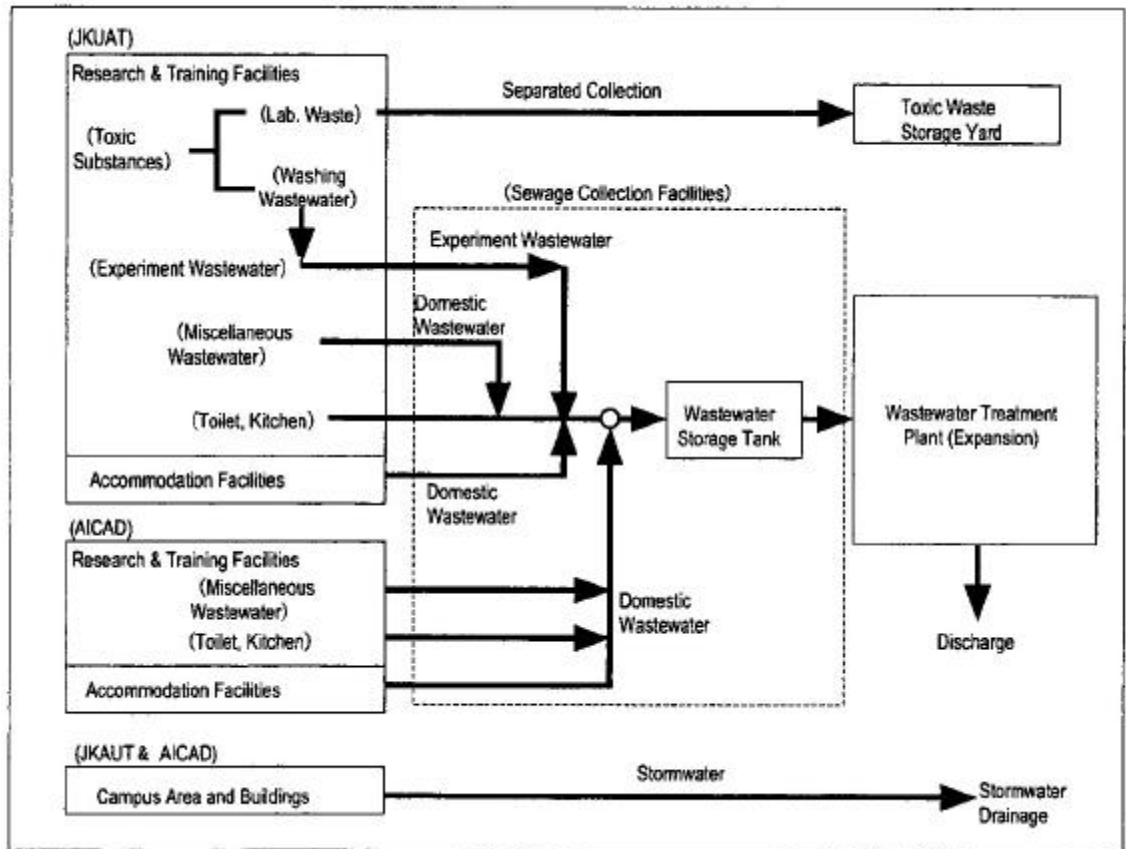
The overall flow chart after the rehabilitation for sewerage facilities is shown in Fig. 2-10.

Wastewater generated from toilets, kitchens, and laboratories in the JKUAT and the AICAD facilities flows in the wastewater storage tank after being mixed with domestic wastewater from dormitories, staff houses, etc. Wastewater is transferred to the wastewater treatment plant from the wastewater storage tank and then is discharged into a rainwater ditch, after being treated in the oxidation ponds (to be expanded).

Dense laboratory wastewater containing toxic substances generated in laboratories of the JKUAT facilities is collected separately and is stored at the toxic waste storage yard. This will be treated or disposed of by a subcontractor or at JKUAT's own activity. Washing wastewater of laboratory containers is mixed with domestic wastewater and treated, because its concentration of toxic substances is relatively low.

Rainwater generated by rainfall in the campus is drained into rainwater ditches separately from wastewater.





**Fig. 2-10 Flow Chart after the Rehabilitation for Sewerage Facilities**

### 3) Overall Layout of Sewerage Facilities

The rehabilitation works of the sewerage facilities, principally, takes place at the same places of the existing facilities. Likewise, the wastewater treatment plant is improved and expanded in the existing treatment site.

The wastewater from the newly constructed AICAD facilities is collected by the newly installed pipes and is led to the manhole located in front of the existing sewerage storage tank. Then, it is mixed with the wastewater from the JKUAT and treated in the oxidation ponds.

The toxic waste storage yard is located to the north of the agricultural machinery workshop, and receives and store up laboratory wastewater.

The overall layout is shown in Basic Design Drawing W-1 & S-1.

#### 2-2-1-4 Equipment Plan

The AICAD project are expected to contribute to the development of human resources, technical expertise and strengthening of self-sustainability of the first stage, Kenya, Uganda, Tanzania, and further stages, of Sub-Saharan African countries through

implementation of miscellaneous projects for poverty elimination and social and economic development based on community partnership,

In view of this, equipment consists of two major components, i.e. one for equipment for AICAD, and the other, is JKUAT equipment which is expected to contribute to AICAD directly or indirectly through provision of JKUAT human resources and academic expertise and facilities and equipment which have been assisted through the cooperation by JICA.

In addition to the above, equipment selection criteria is to be based on the condition that has been agreed during JICA's Study team site survey period as shown in Table 2-19;

**Table 2-19 Criteria for Selection of Equipment**

	Equipment Criteria by MD	Target Dept. or Division
Category- <u>1</u>	AICAD equipment including IT equipment	Administration, Research/Development, Training/Extension, Information
Category- <u>2</u>	Equipment for JKUAT including IT equipment that are used in Second/Third Countries training programs	a) Equipment for 3 Dept. of Faculty of Agriculture and 3 Dept. of Faculty of Engineering
Category- <u>3</u>	Equipment for JKUAT provided by previous Japanese Grant Aid and linked to the AICAD activities which are required and replacement needed.	a) Equipment for 3 Dept. of Faculty of Agriculture and 3 Dept. of Faculty of Engineering and Workshop
		b) Equipment for six Dept. of Faculty of Science, Faculty of Architecture, RCED, IEET which are planning T/E from 2001

**(1) Basic Policy for Selection of AICAD Equipment**

Equipment for AICAD is to be determined as shown in Table 2-20 in accordance with activities above of AICAD.

**Table 2-20 Criteria for Selection of AICAD Equipment**

No.	Section	Criteria for Selection	Quantity
1	Administration Section	- PC, Vehicle and Office equipment and Appliances etc. needed for AICAD administration work are to be selected	12 sets
2.	Joint Research and Development Section	- PC and office equipment etc. needed for coordination for screening and planning of research & development excluding facilities and equipment required for particular research theme are to be selected.	8 sets
3	Training/Extension Section	- PC, Office equipment etc. required for planning of T/E and PC training are to be selected.	15 sets
4	Information Section	- PC, Server required for AICAD LAN system and educational materials equipment are to be selected.	16 sets
5.	Others	- Furniture and appliances required for Hostel are to be selected	2 sets
6.	Total		53 sets

1) Administration Section

General Affairs Department, Financial Affairs Department, Human Resources Department shall each establish PCs for management, communication and connection to internet, annual business plan, financial management, instructor and local consultant database and management.

2) Joint Research and Development Section

This section shall have an R&D Coordinator, a JICA Advisor, an Assistant Coordinator and a Secretary assigned along with the establishment of the headquarter and necessitate adequate office facility which will consist of, four PCs a printer, conference room and a TV to accommodate University professors and local consultants.

3) Training and Extension Section

Computers for computer training laboratory use for one course should be provided. For the seminar room, one set of film projector, automatic roll down screen, TV monitor, audio equipment will be provided. For the two conference rooms, one large and one small, two portable TV sets, one PC projector, one OHP, one white board, and one portable screen will be provided.

For the personnel working in this center, including training coordinator, JICA advisor, training/promotion assistant coordinator, personal computer system connectable to outside internet will be provided.

4) Information Section

In the server room of AICAD center, which will be the core of the LAN system, three servers will be provided to handle security management, internet mail management and LAN system management. A dedicated computer system manager will be assigned to supervise LAN system management, hardware management, software management and computer and internet system trouble shooting.

In addition, a computer for library reference and internet connection, including e-mail function, will be provided at internet café.

For this Information Section, personal computers and printers for information coordinator, JICA advisor, dedicated system manager, IT engineer, librarian, library data manager will be provided.

5) Personal computers for AICAD installation

As shown above, AICAD will be equipped with personal computers with the specification for which shall be as follows;

- a) PC for computer laboratory and internet café shall not be directly linked to major LAN System for security reasons and these computers shall be connected indirectly to AICAD local area network for using only mail and internet connection outside.
- b) PC for AICAD personnel shall be linked with AICAD LAN with appropriate password for security control.

6) Other

This center is intended to conduct two classes of 30 trainees each simultaneously. And in order to transport these trainees and to transport any visitors, one mini-bus with 20seats (with additional sub-seats) shall be provided. This center is to accommodate trainees from Kenya, Sub-Sahara countries and other countries as well as instructors, lecturers and researchers. To accommodate these persons, there shall be adequate number of beds in the dormitory, which shall be managed by the Adminidtration Section.

**(2) JKUAT Equipment and Facility Plan**

The basic policy for selecting and providing the equipment and facility for JKUAT shall be as follows;

- 1) Among the requested materials, the following will be provided in accordance with the agreement with MD in the previous survey;
  - a) Supporting equipment and facility from AICAD second country and third country program and
  - b) Those equipment and facility provided under cooperation program that need repair or replacement.
- 2) With respect to PCs, in view of the PCs retained by JKUAT, they shall not be the subject of this program.
- 3) Printers, OHPs, copiers that were requested from many departments shall be provided in accordance with the individual needs of each Department or research section and not provided under this program in order to avoid any increase of university operating budget.
- 4) Equipment were chosen based on the principle in (1) above and those that are easy to maintain, energy conserving and repairable by the local instructors.

**Table 2-21 Criteria for Selection of JKUAT Equipment**

No.	Dept.	Policy/Criteria for JKUAT Equipment	Quantity
1	Faculty of Agriculture Horticulture	<ul style="list-style-type: none"> <li>- Research and T/E activities are intimately linked to AICAD philosophy and taking a leadership in Sub-Saharan Africa and now conducting T/E program titled “Applied Plant Propagation Technology in Horticultural Crops”</li> <li>- Portable Photosynthetic System, Pressure, Spectrophotometer are to be provided.</li> </ul>	Total ; 6pcs Category- <u>2</u> : 6pcs
2	Faculty of Agriculture, Agricultural Engineering	<ul style="list-style-type: none"> <li>- In order to support AICAD activities on “Waste water pollution and water analysis”and for Msc. course experiment, BOD Analyzer is to be provided and these will be effectively utilized for renovated Waste Water Treatment facility.</li> </ul>	Total ; 1pcs Category- <u>3</u> : 1pcs
3	Faculty of Agriculture Food Processing and Post Harvest Technology	<ul style="list-style-type: none"> <li>- Third country training program titled “Applied Food Analysis”are conducted</li> <li>- Also, these equipment are to be utilized for research on Post harvest handling methods of food crops, mushroom, Qualitative and physiological changes of ripening of bananas grown in Kenya.</li> </ul>	Total ; 17pcs Category- <u>2</u> : 17pcs
4.	Faculty of Engineering Civil Engineering	<ul style="list-style-type: none"> <li>- Third country training program titled “Water Pollution and its Analysis”are conducted, and be responsible for analysis and measurement of waste water from rehabilitated facility of JKUAT, waste water analysis equipment are to be selected.</li> </ul>	Total ; 8pcs Category- <u>2</u> : 8pcs
5.	Faculty of Engineering Mechanical Engineering	<ul style="list-style-type: none"> <li>- Third country training program titled “Design, Production and Maintenance of Fluid Flow Machinery “are conducted, Centrifugal pump and mechanical property measuring equipment are to be selected.</li> <li>- Dept. are intending to strengthening of energy related equipment like Bomb calorimeter, Thermal conductivity Apparatus and Solar distillation apparatus are to be selected.</li> <li>- For replacement of air actuated equipment including Air compressor, equipment for Pipe Testing apparatus, Pipe Manometer, Barometer, Jet Stream Apparatus are to be selected.</li> </ul>	Total ; 15pcs Category- <u>2</u> : 6pcs Category- <u>3</u> : 9pcs
6.	Faculty of Engineering Electrical & Electronics Engineering	<ul style="list-style-type: none"> <li>- Third country training program titled “Applied Electrical and Electronic Engineering Technology “are conducted, related equipment are to be selected.</li> <li>- PC and IT communication equipment being linked to AICAD activities such as Microwave trainer, Antenna equipment are to be selected</li> </ul>	Total ; 11pcs Category- <u>2</u> : 8pcs Category- <u>3</u> : 3pcs
7.	Faculty of Architecture	<ul style="list-style-type: none"> <li>- Drafting table sets for student and trainer use were requested in consideration of shortage of drafting equipment due to damage and opening of two new departments, but these were not targeted for provision, expecting more efficient utilization of existing drafting room.</li> </ul>	Total ; 0pcs
8.	Faculty of Science Zoology	<ul style="list-style-type: none"> <li>- Third country training program titled “Diagnostic Parasitology”, “Laboratory diagnosis of malaria and related blood parasites”, “Pests of export vegetables”, “Integrated Pest Management of Vegetable pests”, “Wildlife Biology and Management” and “Aquaculture” are to be planned from 2001, relating equipment, i.e. VIS Spectrophotometer, Camera Lucida, Analytical Balance and Cell Counter are to be considered.</li> </ul>	Total ; 6pcs Category- <u>3</u> : 6pcs
9.	Faculty of Science Chemistry	<ul style="list-style-type: none"> <li>- Research activities on medically effective natural chemicals, essential oil and soil analysis are active, in fared Spectrophotometer, Water distiller and Analytical Balance are to be selected.</li> </ul>	Total ; 5pcs Category- <u>3</u> : 5pcs

No.	Dept.	Policy/Criteria for JKUAT Equipment	Quantity
10.	Faculty of Science Botany	- Third country training program titled “Enthnobotany”, “Crop Pest and Disease Identification and Prevention”, “Plant Biotechnology” and “Environmental Science” are planned from 2001, related equipment such as Draft Chamber and equipment also used in student experiment like Distillation apparatus, Growth Chamber and Water Distiller are to be selected.	Total ; 4pcs Category- <u>3</u> : 4pcs
11.	Faculty of Science Biochemistry	- Third country training program titled “Application of Molecular Biology in Diagnosis of Disease and in Forensic Science” are planned from 2001, related equipment of Spectrofluorimeter and Oven are to be selected.	Total ; 2pcs Category- <u>3</u> : 2pcs
12.	Faculty of Science Physics	- Third country training program titled “Ground Water Exploration” are planned from 2001 and AICAD’s solar energy development research policy, and in order to strengthen Dept. experienced academic and technical expertise, Chiller units to be provided.	Total ; 1pc Category- <u>3</u> : 1pc
13.	Faculty of Science Maths & Statistic	- Third country training program titled “Forecasting Price Indices and Design and Analysis of Surveys” and “Discrete Mathematics and Algebraic Structures” are planned from 2001, Photocopier and OHP are to be provided.	Total ; 2pcs Category- <u>3</u> : 2pcs
14.	Institute of Computer Science & Information Technology	- Now, conducting PC domestic training course and important Dept. for support for JKUAT LAN, Air conditioner, Photocopier and Overhead Projector are to be considered.	Total ; 3pcs Category- <u>3</u> : 3pcs
15.	Institute of Energy & Environmental Technology	- In spite of active T/E course and planned program from 2001, provision of equipment for the division is not targeted.	Total ; 0pcs
16.	Institute of Human Resources Development	- In spite of active T/E course and planned program from 2001, provision of equipment for the division is not targeted.	Total ; 0pcs
17.	Center of Regional Enterprise Development	- In spite of active T/E course and planned program from 2001, provision of equipment for the division is not targeted.	Total ; 0pcs
18.	Farm Dept.	- Training program titled “Strengthening of Rural Women’s Capacity for Community Development”are conducted, and contributing food supplier role in JKUAT, relating equipment are to be provided.	Total ; 2pcs Category- <u>3</u> : 2pcs
19.	Library	- In spite of active leadership in JKUAT, provision of equipment for the division is not targeted.	Total ; 0pcs
20.	Workshops	- In consideration of wide range of present Workshops maintenance activities and requirement for AICAD, old and broken equipment are to be replaced.	Total ; 12pcs Category- <u>3</u> : 12pcs
	Total		Category- <u>2</u> ; 45 pcs Category- <u>3</u> ; 50 pcs

Note: Category-2: JKUAT Second/Third Countries T/E Equipment

Category-3: Equipment for JKUAT provided by previous Japanese Grant Aid and linked to the AICAD activities which require repair replacement

**Table 2-22 Required Rooms and Their Floor Area**

Facility Name	Unit Name/Room Name	Room Area(m2)	No. of Rms	Total Room Area (m2)	Description	
<b>A. Administration / Research/ Training/ Information</b>	1. Administration Unit					
	1-1	Executive Secretarie's Room	48.0	1	48.0	
	1-2	Deputy Executive Secretary's Room	48.0	1	48.0	
	1-3	Chief Advisor's Room	48.0	1	48.0	
	1-4	Administration Finance Coordinator's Office	32.0	1	32.0	
	1-5	Project Coordinator's Room	48.0	1	48.0	
	1-6	Secretaries' Room-1	32.0	1	32.0	
	1-7	Auditor's Room	32.0	1	32.0	
	1-8	Meeting Room	48.0	1	48.0	Capacity 26 persons
	1-9,10,19	Registry & Personnel Office	64.0	1	64.0	Including Copy Room and Storage
	1-11	Public Relations & Reception Office	32.0	1	32.0	
	1-12 ~ 14,28	Accountant Office	64.0	1	64.0	
	1-21 ~ 26	Maintenance Staff Office	39.2	1	39.2	
	1-16	Secretaries' Room-2	32.0	1	32.0	
	1-27	Secretaries' Room-3	32.0	1	32.0	
	1-28	Common space (Corridor Staircase Toilet and etc.)			611.2	
	Sub-total			1,210.4		
	2. Research and Development Unit					
	2-1	R&D Coordinator's Room	32.0	1	32.0	
	2-2	JICA Advisor's Room	32.0	1	32.0	
	2-3	Assistant Coordinator's Room	64.0	1	64.0	
	2-4	Secretaries' Room	32.0	1	32.0	
	2-5	Senior Researcher's Room	48.0	5	240.0	
	2-6	Jounir Researchers' Room	64.0	1	64.0	Capacity 10 persons
	2-7	Meeting Room	64.0	1	64.0	Capacity 30 persons
	2-9	Common space (Corridor Staircase Toilet and etc.)			256.0	
	Sub-total			784.0		
	3. Training & Extension Unit					
	3-1	T & E Coordinator's Room	32.0	1	32.0	
	3-2	JICA Advisor's Room	30.0	1	30.0	
	3-3	Assistant Training Coordinator's Room	24.0	1	24.0	
	3-4	Assistant Extension Coordinator's Room	24.0	1	24.0	
	3-5	Secretaries' Room	18.0	1	18.0	
	3-6	Computer Laboratory/Preparation Room	128.0	2	256.0	Capacity 32 persons
	3-7	Meeting Room-S	48.0	3	144.0	Capacity 30 persons
	3-8	Meeting Room-L	80.0	1	80.0	Capacity 50 persons
	3-9	Seminar Room	336.0	1	336.0	Capacity 162 persons, Including Stage and etc.
	3-10	Common space (Corridor Staircase Toilet and etc.)			523.2	
	Sub-total			1,467.2		
	4. Information & Network Unit					
	4-1	Information Coordinator's Room	32.0	1	32.0	
	4-2	JICA Advisor's Room	32.0	1	32.0	
	4-3	Secretary's Room	16.0	1	16.0	
	4-4	Workshop	40.0	1	40.0	
	4-5	Server Room	16.0	1	16.0	
	4-6	IT Engineer's Room	32.0	1	32.0	
	4-7	e-contents Room	16.0	1	16.0	
	4-8	Electric Information Store	24.0	1	24.0	
	4-9-1/2/3	Internet Library/Library/Librarian Office	160.0	1	160.0	24 Seats and 10,000 Books Stock
	4-10	Procurement Office	16.0	1	16.0	
	4-11	Printing Room	40.0	1	40.0	
	4-12	Editor's Room	24.0	1	24.0	
	4-13	Education Material Product Room-1	16.0	1	16.0	
	4-14	Education Material Product Room-2	32.0	1	32.0	
	4-15	Production Store	24.0	1	24.0	
	4-16	Common space (Corridor Staircase Toilet and etc.)			293.6	
	Sub-total			813.6		
<b>B. Hostel</b>	5. Hostel Unit					
	5-1-1	Guest Room-A	24.0	30	720.0	For Trainees and Physical Handicapped
	5-1-2	Guest Room-B	24.0	4	96.0	For Researchers
	5-1-3	Guest Room-C	24.0	6	144.0	For Researchers with Connection Doors
	5-2	Lounge	56.0	1	56.0	
	5-3	Mini-kitchen	8.0	1	8.0	
	5-4	Administration Office	24.0	1	24.0	
	5-5	Common space (Corridor Staircase Toilet and etc.)			910.0	
	Sub-total			1,958.0		
	<b>Total</b>			<b>6,353.2</b>		
<b>C. Others</b>	6. Garage Unit					
	6-1	Garage	45.0	1	45.0	
	6-2	Mobile Mechanic Store	15.0	1	15.0	
	6-3	M/E Room	60.0	1	60.0	
	Sub-total			120.0		
	7. Others					
	7-1	Guard House	20.0	1	20.0	
	7-2	Outside Corridor			896.0	
	7-3	Others			503.0	Including Terrace and etc.
	Sub-total			1,419.0		

## **2-2-2 Basic Plan**

### **2-2-2-1 Site Layout Plan**

The site layout plan for this project was planned based on the following points giving full consideration to site conditions (environmental and location), in order to improve the previously mentioned problems. The zoning and flow line plan of the facilities are also explained in the following Basic Policy:

#### **(1) Basic Policy**

- 1) Site layout plan of AICAD shall be considered to ensure its functions as the independent institute. And a rational plan in terms of flow lines and functions shall be established considering the relations with the zoning and building layout of the existing campus of JKUAT.
- 2) It is necessary to examine integration of the external space for the new facility of AICAD and the existing facility of JKUAT. The layout of the facilities should be determined not to interfere with their functions, but to integrate architectural, structural and utility designs as a whole.
- 3) It is important to consider spaces between buildings and their orientation in order to keep good ventilation, natural lighting and sound proofing without using mechanical devices throughout the year with consideration of the climate of Kenya.
- 4) Safety, accessibility to the facilities of AICAD from the main gate and security check points should be considered in order to provide an accurate security in the site of AICAD.
- 5) Covered connecting corridor which connect new facilities and existing buildings should be considered to provide protection from rainfall and strong sunlight.
- 6) As the new buildings of AICAD are to be constructed adjacent to the existing JKUAT library, the flow lines between new buildings and the existing library and other buildings shall be carefully considered based on the each functional relation. The harmony with the surrounding landscape shall also be considered.
- 7) The relationship between the new Hostel of AICAD and the existing facilities of JKUAT should ensure each privacy.
- 8) The exterior spaces, such as court yard and inner gardens should be used effectively in order to create a relaxing academic environment. These open spaces will be useful for natural ventilation and lighting.



## **2-2-2-2 Architectural Designs**

### **(1) Floor Plan**

In terms of floor planning, the calculated areas and the layout plan as mentioned above were used and each facility was planned on the basis of the following criteria:

- 1) The floor plan should be coordinated considering the relation between each facility. Contents and function of each facility shall be considered in the floor plan so that the facility can be integrated effectively.
- 2) Considering the zoning and flow lines of the existing buildings of JKUAT, the layout plan for the new buildings and the smooth relations between the new buildings and the existing buildings should be considered.
- 3) It is important to integrate required rooms and equipment effectively so as to correspond to flexibility of planning. Grid span should be considered as standard module, in particular for laboratory and classroom units. Building should be planned with most economical and effective module used in Kenya considering layout plans of computers, equipment, furniture, etc. for economical construction.
- 4) Considering local climatic conditions at the construction site of AICAD, connection method of each building should be considered in order to provide protection from rainfall and strong sunlight.
- 5) In principle, natural ventilation and lighting should be applied as much as possible, and mechanical ventilation and artificial lighting are to be minimized to reduce maintenance costs. However, some of the rooms in the Research and Training sections will need mechanical systems. In this case, consideration should be given to keep good interior environment by effective air-conditioning and in coordination with an appropriate natural ventilation.
- 6) The size and layout of equipment and furniture in each room should be considered as much as possible in the design.

### **(2) Elevation and Cross-Section Plan**

For planning of elevation and cross-section of the building, local building styles, local construction methods and the existing building styles should be considered for references on the basis of the following policies:

- 1) The analysis of the site ground level and floor height of the existing buildings shall be taken into consideration in order to determine the floor level and cross section. In particular, the level of ground and floor level of the existing buildings should be given careful consideration.

- 2) The level of the ground floor will be raised above the present ground level in order to prevent possible rain water inundation and to provide protection from radiant ground heat.
- 3) The roof should be sloped in order to give protection from heat radiation and from strong direct sunlight and to have positive discharge of the rain water.
- 4) Deep eaves, louvers and balconies can help to protect the rooms from direct sunlight and rainfall.
- 5) Louvers and hollow bricks which can allow natural light penetration and air to circulate shall be installed in order to enhance the space environment as well as to provide protection from strong sunshine and rainfall.
- 6) Wall surfaces should have openings as large as possible to facilitate room ventilation and provide a balanced natural lighting and also to reduce the running cost of electrical lighting and equipment.

### **(3) Cost Reduction Measures**

The various cost reduction factors to be considered in the design for AICAD buildings are as follows. The cost performance and the maintenance cost must be taken into account for building design:

- 1) The overall size of the facility is rationalized so as to enhance the utilization rate of the rooms and to promote the effective use of rooms, utilities and equipment.
- 2) The standardization of space is necessary to give flexibility in the design of the buildings. The basic module should be determined by considering how it will be combined to form the overall buildings. Through extensive investigations, the economical span and standard module of Kenya has been successfully determined to adopt to the Basic Design.
- 3) In principal, natural ventilation and lighting are to be applied as much as possible and mechanical ventilation and artificial lighting shall be minimized to reduce maintenance costs. However, some of the rooms in the Research and Training Sections will need mechanical systems. In this case, individual systems will be used in place of a central system.
- 4) Local construction materials should be effectively used so as to reduce the costs for construction and maintenance. Also, in the long-term view of the project together with the consideration of the maintenance costs of the facilities, the finishing materials shall carefully be selected considering the life-span and maintenance characteristics of the materials.

- 5) In the same manner as the existing buildings, gallery type corridors are planned from the viewpoint of the climate in Kenya, in spite of being less efficient compared to the center corridor type. Outside gallery type corridors are adopted for corridor circulation as standards type in Kenya.
- 6) Consideration is given to the installation of high energy-efficient equipment and insulation material in order to reduce operation expenses.
- 7) As mentioned above, cost reduction measures are considered in the design work. However, the reduction of the initial cost shall be considered carefully so as not to cause any cost increase in operations and maintenance and deterioration in quality.

### **2-2-2-3 Structural Plan**

#### **(1) Basic Policy**

The structural plan for the project should be formulated after the overall review of the prepared site and soil conditions.

The structure should be designed to prevent defects such as excessive deflection, settlement, etc. In addition, the building shall have sufficient safety and durability against earthquakes, strong winds, etc. Consideration should also be given to local construction and maintenance conditions.

#### **(2) Standard for Structural Design**

Structural design shall conform to the “Building Code, Republic of Kenya (1987)” in principle, “Code of Practice for the Design and Construction of Buildings and Other Structures in relation to Earthquakes (1973)” and “General Specification for Building Works Republic of Kenya (1976)”. Design Analysis of allowable structural materials, analysis method of structure and design procedure are to be in accordance with the British Standards (BS) which prevail in Kenya, and the Architectural Institute of Japan (AIJ) for design of steel structures, in order to secure safety and rationality in the design.

#### **(3) Methods and Material**

The superstructure is to be made by reinforced concrete and the walls are to be made by natural stone (Nairobi Stone) which are economical and widely used method in Kenya. A steel structural system is to be provided in some parts of the building to achieve the required strength. Reinforcing steel bars, concrete and structural steel are locally available and appropriate measures should be taken for quality control.

Concrete: Design strength  $(F_c) = 210\text{kg/cm}^2$   
(28 days Compressive strength of cylinder test piece)

#### **(4) Foundation**

Independent RC footings are used for the existing buildings of JKUAT. The depth of these independent footings are approximately 1.5 to 2.5 meters. Based on the results of site surveys and soil testing, independent RC footings will be used for the new buildings.

#### **(5) Design Load**

**Wind Load:** The wind load is calculated in accordance with the Building Code of Kenya. Heavy winds which cause significant impact on the buildings have not been recorded at site.

**Seismic Force:** The seismic force shall be calculated in accordance with the “Code of Practice for the Design and Construction of Building and Other Structures in relation to Earthquakes (1973)”, and other relevant Kenyan and British Standards. Where these codes do not adequately cover a particular detail, reference shall be made to the Japanese Building Code.

**Dead Load:** Dead load includes the weight of the structure itself and any permanent fixtures, partition, finishes, etc.

**Live Load:** The live load is calculated in accordance with the Building Code of Kenya, and shall be determined considering the equipment weight and building use.

### **2-2-2-4 Utility and Building Facility Plan**

#### **(1) Plumbing Work**

##### **1) Water Supply System**

###### **a) Source of potable water supply**

Within the existing JKUAT compound, potable water is supplied from the existing water treatment plant that purifies raw water diverted from the Udarugu River. Rehabilitation and improvement of the existing water supply system is planned in this project in order to assure stable water supply for JKUAT and AICAD.

The Water Supply System Plan will provide AICAD with water supply pumps and piping work from the existing water treatment plant to AICAD. Meanwhile the Utility Plan will equip AICAD fully with an elevated water tank and water supply piping within AICAD.

b) Estimated Day Water Demand

Occupants - Staff : 104 persons  
- Day Visitor : 350persons  
- Visitor (Hostel) : 80 persons

Water Demand

Staff, Visitor 454 persons x 30 ltr/day person = 13,620 ltr/day

Visitor (Hostel) 80 person x 200 ltr/day = 16,000 ltr/day  
person

Total 29,620 ltr/day

→ 30m<sup>3</sup>/day

c) Capacity of Elevated Water Tank

An elevated water tank that contains half the amount of day water demand shall be provided.

30m<sup>3</sup> x 1/2 = 15.0m<sup>3</sup>/ (3m x 3m x 2m Height, FRP made)

2) Sewerage System

The relay pumps equipped in the existing sump pit transfer all of the sewerage drain water from JKUAT to the sewerage treatment plant that is located at a distance of 1.5 km north from JKUAT compound. The treated sewerage water percolates downward through the soil or discharges to the river. Rehabilitation and improvement of the existing sewerage treatment plant is planned in this project in order to deal with additional sewerage water from AICAD.

Sewerage pipeline from AICAD to the existing sump pit should be constructed in this scope. Storm water from AICAD Facilities and parking lot should be discharged to the existing open channel running along the west boundary of the site.

3) Domestic Hot Water Supply System

There will be thirty (30) guest rooms equipped with a shower unit and ten (10) guests rooms with a bathroom in the hostel. Central piping system for domestic hot water supply shall be provided to secure an abundant and stable supply of hot water for the guest rooms.

There are several alternatives as the heat sources for the boilers such as electrical power, oil and liquid petroleum gas (LPG) in Kenya. From the point of view of running cost and stable supply, using oil as heat source for the boilers is considered to be the best choice.

Electrical power	Thermal unit rate	2.2Ks/1,000KJ
Oil	Thermal unit rate	1.6Ks/1,000KJ
LPG	Thermal unit rate	1.9Ks/1,000KJ

#### 4) Facilities Plumbing Fixtures

Most of water closets are western type in the existing lavatories within JKUAT. A few water closets are still squatting type. Western water closets will be installed in lavatories of AICAD.

According to the site survey, any plumbing fixture are normally available in the Kenyan market. Local distributors can supply accessories for the plumbing fixtures including any parts and faucets.

#### 5) Fire Fighting Facility

Fire hydrant system and fire extinguishers should be equipped within all areas of AICAD facility in accordance with the Fire Code of the Local Regulations and international standards.

Installation of fire hydrant equipment and piping materials shall comply with the British Standard. In terms of application of fire fighting facilities permit, the chief engineer of the electrical and mechanical department in the Ministry of Roads & Public Works will judge and approve it on behalf of local fire authority, since the Project is going to be executed by grant aid scheme from the Japan Government.

### (2) Air conditioning and Ventilation Work

#### 1) Air conditioning System

The climate is extensively mild in Nairobi throughout the year, although Nairobi is near the equator and because it is located at an altitude of approximately 1,500 meters.

According to the air conditioning design standard of ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers), the outdoor air design condition shall be as follows,

Outdoor: Hot season Dry Bulb 7°C Wet Bulb 18°C Daily Range 13 degree  
Cold season Dry Bulb 10°C

(ASHRAE Fundamentals 1997: at Nairobi)

Therefore, it is concluded that air conditioning system is not necessary for the ordinary rooms provided with natural ventilation. A server room and computer laboratories will be provided with split-type air conditioners to maintain appropriate

indoor design conditions from heat generated by computers and also to provide clean air from dust accumulation.

## 2) Ventilation System

Ordinary rooms will be naturally ventilated through windows. Bathrooms, lavatories and pantries where an electrical oven is equipped will be provided with mechanical ventilation.

### Standards for Ventilation

Room	Method of Ventilation			Unit Air Flow Rate
	Type 1	Type 2	Type 3	
Lavatory				10 Changes /Hour
Bathroom, Shower Rm.				25 m <sup>3</sup> / (Occupant• Hour)
Pantry				10 Changes /Hour
Boiler Rm.				15 Changes /Hour
Electrical Rm.				10 Changes /Hour

Note) Type 1 Provide Fresh air supply and exhaust fan  
 Type 2 Provide Fresh air supply grille  
 Type 3 Provide Exhaust fan

## (3) Electrical Works

### 1) Power Supply Facilities

AICAD is an autonomous institution in principal from JKUAT. Therefore, new medium voltage power supply (3 $\phi$ 3w 11KV 50Hz) will be fed-in individually to AICAD through aerial wiring from outside power distribution line of Kenyan Power Lighting Corporation (KPLC).

According to the KPLC's provisions, KPLC will provide a floor mounted transformer (11KV→3Phase 4Wire 415/240V) within the AICAD compound and execute the wiring work up to the transformer.

Through the discussion with KPLC, it was confirmed that KPLC will be able to supply new required power for the new facility and Kenyan side and should execute all related work for this new power supply according to Japan's Grant Aid Scheme.

The estimated power load is calculated as follows:

Description	Load Density (VA/m <sup>2</sup> )	Floor Area (m <sup>2</sup> )	Total Load (KVA)	Remarks
Lighting and Small Appliances	40	6,000	240	
Air conditioning Equipment	15	6,000	90	
IT related Equipment Other Equipment	-	-	80	
Total			410	

Thus, the estimated power load is approximately 410KVA.

Assuming that the demand factor is 50%, estimated power demand is as follows,





a) Illumination Level

Entrance Hall, Corridor	100 Lux
Lecture Rm. Research Rm.	300 Lux
Library, Computer Lab.	400 Lux
Office	300 Lux
Guest Room in Dormitory	150 Lux
Storage	50 Lux

b) Exit Light

Exit Lights with batteries should be installed at every staircase and exit.

5) Telephone System

New telephone trunk lines will be fed-in individually to AICAD through aerial wiring from outside by Kenya Telekom since AICAD and JKUAT are independent organization to each other. Through the discussion with Kenya Telekom and AICAD, it was confirmed that application fee and installation fee for receiving new telephone lines should be charged to Kenyan side according to the Japan's Grant Aid Scheme.

The specification of the telephone system for AICAD is as follows,

Direct line: 2 lines

Private automatic branch exchanger (PABX) with UPS

Trunk line: More than 3 lines

Extension line: More than 70 lines

6) Public Address System

It is worth considering that Speakers should be installed at every corridor and entrance hall in order to call visitors and staff. This public address system can broadcast emergency calls to the whole building in the case of fire.

7) Emergency Calling System

Emergency Calling System should be provided at the toilets for disabled people. When someone feels sick in the toilet, he or she can call for help by pushing a button which informs the emergency condition to someone outside of the toilet or in the staff office.

8) Master Antenna Television System

Master antennas for UHF and VHF wave band should be installed on the roof and TV outlets are to be provided in offices and lecture rooms.

9) Fire Alarm System

Automatic Fire alarm system should be provided in accordance with the Fire Code. The system provides fire detectors in every room and a indicate lamp and push-button in each alarm area. Fire alarm control panel is to be installed in the administrative office on the ground floor. Furthermore, a sub control panel will be equipped in the dormitory office.

10) Lightning Protection System

Lightning protection system should be provided to prevent serious damage to the building structure and electrical facilities.

**(4) Information Technology (IT) Plan**

Design basis of IT Plan for AICAD and JKUAT is as follows,

- The IT Plan mainly aims to establish a flexible and expandable Campus Wide Area Network within both JKUAT and AICAD as an IT infrastructure
- Project priority is set on AICAD and the renovation and improvement of utilities in JKUAT will be executed in order to facilitate the activity of AICAD
- Installation of LAN system equipment and wiring work will be executed in this scope  
Meanwhile, Servers, P/C terminals, OS and Application software will be prepared in the scope of the equipment Plan
- The overall plan is shown in Basic Design Drawing IT-1, IT-2 and IT-3.

1) Local Area Network (LAN) System for AICAD

The LAN system within AICAD is composed of the four sub-loops; Joint Research and Development (R/D) loop, Training and Extension (T/E) loop, Information loop, Administration loop. There will be a server room within the area of the information division. An optical fiber backbone will link from a fiber optic backbone switch installed in the server room to each layer 3 switch equipped in each division in the way of “Star Topology”. The layer 3 switches can avoid data traffic congestion between each division and facilitate easy network management.

Network Specification: From sub-loop to another one

Adopted LAN Standard: 100BASE-FX

LAN Transfer speed: 100Mbps

The connection to the Internet System is assured by using the existing digital leased line through microwave that will be provided by the first Phase of the PTTC project.

## 2) Local Area Network (LAN) System for JKUAT

Compared with the other universities in Kenya, JKUAT hasn't developed the IT infrastructure. Therefore, the Project aims to assist JKUAT in establishing a basis of IT Infrastructure.

There are the existing individual LAN systems that link several P/C terminals in each faculty and department within JKUAT. This project will prepare a switch in every building and link them by using a fiber optic backbone. This Campus Wide Area Network will be connected to the one of AICAD.

The Kenyan side should extend horizontal wiring from the switches to be provided to the existing LAN system and P/C's.

## (5) Garbage and Chemical Waste Disposal

In the existing JKUAT, all garbage and waste aren't segregated. Especially infectious waste generated from the hospital is segregated and burned out by a small incinerator. The staff of the Estate Department periodically collects and brings all of solid waste to the dump station in the farm of JKUAT. Solid waste generated from AICAD will be transported to the dump station of JKUAT.

### 2-2-2-5 Building Material Plan

#### (1) Basic Policy

The building material plan shall be formulated based on the climatic conditions, the location of the site, the local construction situation, construction period, construction cost, and maintenance and operation costs. Particularly, the following matters shall be included:

- 1) The local procurement of construction materials shall be considered to reduce construction costs and shorten the construction period.
- 2) The maintenance and operation costs shall be reduced by considering the adaptation to the local climate, resistance against climate and the selection of materials that are easy to maintain.
- 3) It is important to note that the selection of material should be made to satisfy the essential functions of AICAD and for the effectiveness of research and training and must be considered along with the utility and equipment plans.

- 4) Selection and determination of the building materials shall be based on the studies on local procurement or application of local construction methods.

## **(2) Main Finishing Materials**

The local construction situation and construction schedule as well as method for minimizing operation and maintenance costs should be taken into consideration for the selection of the main finishing materials. And analysis of materials of the existing building of JKUAT will be useful for the reference of material selection.

All the existing buildings of JKUAT have been designed by a Japanese consultant and constructed by a Japanese contractor over three phase as Japan's Grant Aid assistance. At the first phase started in 1978, an administration building, an auditorium building, a library, common classroom buildings, welfare facilities, experiment buildings of faculty of agricultural and technology, training buildings, student dormitories and etc. were constructed, and workshops, warehouses etc. were constructed at the second phase. At the third phase, facilities such as the new laboratory buildings of the faculty of agricultural and technology, experiment buildings of agricultural industry, training room buildings, soil sterilization building, experiment buildings of civil engineering and mechanical engineering, new common classroom buildings, library, canteen and etc. were constructed.

The materials of the existing buildings at the first and second phases are as follows: the roof materials are cement roofing tile and corrugated slate plate. Exterior wall materials are trowel mortar with paint and masonry of Nairobi stones. Floor materials are cast in place terrazzo and clinker tiles. The materials of the existing buildings at the third phase are as follows: the roof materials are cement roofing tile. Exterior wall materials are brick masonry and trowelled mortar with paint. Floor materials are cast in place terrazzo and clinker tiles.

The policy of selection of materials for this Project is to adopt local materials as much as possible, considering about the harmony with the existing buildings and identity of AICAD as well. Besides, material quality and construction methods shall also be taken into consideration.

The selection of materials for this Project will aim at maximizing the adoption of local construction methods and selection of local materials, mainly under the supervision of a Japanese Contractor. This policy intends also to reduce the construction cost. Based on the surveys and studies of materials of the existing buildings, it is considered that this policy will enable proper selection and procurement of building materials under the scheme of Japan's Grant Aid assistance. The results of these considerations are as follows:

## 1) Structural Materials

In principle, the typical local construction method and materials are reinforced concrete for the main frames with concrete block walls and for the oblique roof structures mainly adopts the reinforced concrete structure and partially adopts the steel structure.

In principle, the typical local construction method and materials will be adopted for this Project. However, as for the oblique roof structure, lightweight steel frame on the reinforced concrete flat slab will be adapted considering more rational structural system for this project.

## 2) Exterior Finishing

### a) Exterior Wall

Exterior wall finishing will mainly be by standard Nairobi stone masonry in combination with hammered finish of fair faced concrete and long-lasting weatherproof paint such as sprayed epoxy painting. The hammered finish of fair faced concrete prevails in Nairobi, for example, MOEST and other public building adopted this finishing for fair faced concrete of columns and beams. This method will be adopted to minimize mortar trowel and paint finish for exterior walls. It is necessary to consider the adoption of material quality and local construction methods. Especially the degeneration of paint agent, mold and crack will not only increase the maintenance expense after completion of construction, but will also affect the degradation of concrete frames from water leak. While ensuring that the quality of plastering work is maintained, the use of local available epoxy paint is adopted for external use for its performance and durability. The plastering method above will be aimed at taking advantage of the framework of the Grant Aid, which is to manage a comprehensive construction management by a Japanese general contractor.

### b) Roofs

The cement tiles similar to the existing roof material will be adopted for the pitched roof of the new building which is supported by ridged light weight steel frame roof structure for durability and prevention of water leakage taking into consideration of the durability and to avoid sound transmission from heavy rain and heat absorption from strong sunlight and also maintenance. The appearance of the cement tile roofs will also match the surrounding landscape. It is necessary to carefully consider the shape of tiles and flashing in detail, because there have been traces of water leaks at existing ceilings. The color of the new roof will be selected considering easy maintenance and identify of the new building as well.

c) Windows and Doors

In order to provide better durability and air tightness for external openings, such as windows and doors, local available aluminum sash becoming more popular in recent years in Kenya will be adopted for this Project. Also, steel sash will be used for the some openings facing outside. These similar materials have been used for openings of external wall of the existing buildings.

d) Floors

The floor finish materials for the outside corridor will be cast in place polished terrazzo which is popularly used in Kenya. The polished surface of terrazzo shall carefully be adjusted to prevent of slippage from rain water. The existing buildings of JKUAT have adopted cast in place polished terrazzo and cement tile for the floor finish.

3) Interior Finishing

a) Floors

Cast in place polished terrazzo will be adopted in the new buildings, which are generally used in Kenya, similar to the existing JKUAT floors.

Flooring material for the computer area will be adopting carpet tile for the free access floors in order to facilitate maintenance of computer and electrical wiring.

b) Walls

Paint or mortar will be used as the finishing materials for interior walls which are generally used in Kenya. Sound absorption materials will be adopted in the seminar room, projection room and etc. in order to keep the sound transmission decibel rating down to allowable limits.

c) Ceilings

Suspended ceilings using rock-wool absorption board, painted gypsum board, and paint on mortar will be used in the new buildings. Suspended ceilings of rock-wool absorption board, have been adopted in the existing buildings. Noise absorption material will be adopted in the seminar room.

**(3) Proposed Main Materials**

The criteria for building materials have been analyzed studied in 2-23. Based on the analysis, main materials proposed are as follows;

**Table 2-23 Main Materials Proposed**

	Administration/Research/ Training/Information Building	Hostel	Other Buildings
<b>Exterior Finishing</b>			
Structure	Reinforced Concrete and Steel Structure		
Building Height	8,000mm	8,000mm	4,000mm
Roof	Cement Tile and Urethane Resin Coating for flat roof		
Eaves	Epoxy Sprayed Painting		
Exterior Walls	Nairobi Stone and Fair Faced Concrete with Hammered Finish Mortar Trowel with Sprayed Epoxy Painting Hollow Brick		
Windows	Aluminum		
Doors	Aluminum and Steel		
Exterior Floors	Mortar Bed Cast-in-place Polished Terrazzo (Non-Slip)		
Exterior Ceilings	Cement Board with V.P.		
<b>Interior Finishing</b>			
Floors	Mortar Bed Cast-in-place Polished Terrazzo Base: Cast-in-place Polished Terrazzo Access Floor w/ Carpet Tile Base : Hard Wood w/VP PVC Tile Base : Soft PVC Mortar Troweled Base : Troweled Mortar	Mortar Bed Cast-in-place Polished Terrazzo Base: Cast-in-place Polished Terrazzo PVC Tile Base : Soft PVC Mortar Troweled Base tile: Troweled Mortar	Mortar Troweled w/Hard Coat Paint Base tile: Troweled Mortar Mortar Troweled Base tile: Troweled Mortar
Walls	Mortar Bed w/ Epoxy Paint Sound Absorbent Type Rockwool Board	Mortar Bed w/ Epoxy Paint Sound Absorbent Type Rockwool Board	Mortar Bed w/ Epoxy Paint
Ceilings	Sound Absorbent Type Rockwool Board Plaster Board w/Epoxy paint	Sound Absorbent Type Rockwool Board Plaster Board w/Epoxy paint	Plaster board with Epoxy paint Patching Plaster w/ Epoxy paint
W.C.	Floors Walls Ceilings	Mortar Bed Ceramic Tile Ceramic Tile Decorated Plaster Board	

### 2-2-2-6 Water Supply Facility Plan

The project components for improving water supply facilities is described in Section 2-2-1-2, “Plan of Water Supply”, and the facility design of each content is described below,

#### (1) Water Intake Facilities

##### 1) River improvement

The Ndarugu River curves to the left side starting at about 120m up-stream from the existing intake facilities to 30m up-stream, after that, it turns to right side gradually as shown in Fig. 2-9. So, the right bank, that is right side bank to down stream, has

a shoal around the intake facilities. It is desirable to construct water intake facilities at sites where shoals do not develop, but there are no suitable sites for intake facilities around the existing intake facilities. Improvement of the right bank is applied in the Project in order to reduce the siltation around the intake facilities.

The river improvement starts around 50m up-stream from the intake facilities to about 30 m down stream from the intake facilities along the right bank. The curve of the river from the left side extends up to the intake facilities by the river improvement. The river improvement makes easy maintenance for the intake facilities as the siltation could be reduced at the intake facilities.

Based on Kenyan laws, 10m wide land from rivers belongs to the national land property, and the site of the river improvement is in the area, so the construction could be secured under the law. However, it is necessary to apply the work of the river improvement to the Thika District Office (DC) that controls the Ndarugu River.

#### 2) New construction of Water Intake Facilities

Water intake facilities are constructed beside the existing water intake facilities. Height of the intake pit is 3.5 m to withstand the riverbed rising. Stop log is installed at the inlet part of the intake facilities to secure maintenance of the suction pit.

Submersible pumps are applied as they can withstand flooding and have higher capacity to send silt with water than existing pumps. Pumps installed consist of 3 pumps of 2.2m<sup>3</sup>/min (one is standby) as the velocity of the conveyance pipe (diameter: 300mm) is to be more than 1 m/sec not to settle silt inside the pipe.

A sludge pump is installed for the maintenance of the suction pit.

#### 3) New construction of Control Panel House

The floor level of the control panel house for the pumps is at the elevation 1507.0m that is higher than the HWL, 1505.1m (100 years return period). The control house is also used as a storage for the sludge pump and stop logs.

#### 4) Connection of the conveyance pipe

There are existing conveyance pipes, diameter=300mm, ductile cast iron pipe, Length=1,350m, from the existing Ndarugu River water intake facilities to the JKUAT storage pond. Connection pipe, diameter=300mm, ductile cast iron pipe, length=25m, is installed from the new water intake facilities to a point of the



existing conveyance pipe. In most part, the existing conveyance pipe will be utilized after the project.

5) Construction of one way surge tank

There is an existing one way surge tank, but it is not enough to prevent water hammer caused by the new submersible pumps. So, one way surge tanks will be installed at two sites to prevent water hammer between the water intake facilities and the existing surge tank.

**(2) Storage Pond**

1) Improvement of a drainage gate

The base of the drainage gate will be lowered.

2) Back fill partially at low parts of the pond

Back fill is done partially at low parts that are lower than the base level of the drainage gate in order to drain water completely after the drainage gate is opened.

3) Repairing the inlet facilities

Retaining wall, height is about 1.5m, will be constructed around the inlet of pipe because the back filling would affect the inlet facilities.

4) Construction of bank for the emergency storage pond

Bank for the emergency storage pond, length about 100m, height: 2.5m, will be constructed. The bank has pipes to connect the two ponds with a gate and a spillway.

5) Installation of by-pass pipe

By-pass pipe (Dia: 300mm, L: 467m) is installed to send water to the emergency storage pond from a point at the existing conveyance pipe.

6) Improvement of rubber sheet at the storage pond

Original design water depth of the storage pond is 2m, but you can store water only to 1m water depth, as the rubber sheet installed inside of the pond is partially damaged. If you store water over 1m depth, water leakage increases and also it might cause destruction of the bank. It is necessary to repair the rubber sheet to store water to 2m water depth, because full capacity of the storage pond is required to secure water for water supply and irrigation during the dry season when restrictions are made for intake of the amount of water from water rights.

Rubber sheets may have been damaged by invaders of malicious mischief. It is necessary to protect the rubber sheets from damage, by soil cover which is applied on the rubber sheets.

The current water rights to receive water in dry seasons are 861 m<sup>3</sup>/day for drinking and irrigation. The water right is not enough to secure water demand in dry seasons, January to March, utilizing the storage pond of the capacity 80,000 m<sup>3</sup>. So, it is necessary to increase the water rights to be 15,000 m<sup>3</sup>/day.

7) Construction of water intake pumping station

A new water intake pumping station, which sends water to an expanded water purification plant, is constructed beside the existing water intake pumping station at the storage pond. The pumping station has 2 pumps with 15 m<sup>3</sup>/hour capacity (one is for stand-by).

8) Installation of pipe

Pressure pipe is installed between the new water intake pumping station and a new water purification plant. The pipe diameter is 100mm and length of 233m.

**(3) Water Purification Plant**

1) Expansion of water purification plant

Present amount of supplied water is about 700m<sup>3</sup>/day, that is over the capacity of the existing water purification plant (660m<sup>3</sup>/day). If the water demand increases further water shortage would occur.

Design water supply is 744m<sup>3</sup>/day (CASE1: including water demand of AICAD in 2007 and present water demand of JKUAT), and expansion of the water purification plant is required as the present plant capacity is not enough to supply water.

Present water purification plant consists of 2 lines of 330m<sup>3</sup>/day plant. Expansion of the water purification plan is planned to extend one more line of the 330m<sup>3</sup>/day plant, as the same plant extension is convenient and effective on the operation and maintenance. The plant could be expanded and designed; with one more line, 330m<sup>3</sup>/day.

By the extension of the water purification plant in the project, the capacity of the plant becomes 990m<sup>3</sup>/day. Loading ratio of the plant is about 75% as the design water supply is 744m<sup>3</sup>/day.

Amount of water supply required in CASE2, including increased water demand of JKUAT in 2007, is 977m<sup>3</sup>/day. It is also possible to supply water in the Case 2 as the capacity of the water purification plant is bigger than the required water supply.

Maximum duration of electric power failure is 22.5 hours and it happens about once a week including small power failure based on the record between 1998 and 2000. So, a generator will be installed to secure electric power for 24 hours.

2) Expansion of reservoir

Capacity of the existing reservoir is 330m<sup>3</sup>. It is necessary to store water for one day of design water supply that is 990m<sup>3</sup>/day, so reservoir of 660m<sup>3</sup> volume has to be extended. With this extension, water supply would not be interrupted by outbreaks of flooding.

A connection pipe shall be installed between the existing reservoir and the new reservoir, will be the two reservoirs are utilized for the common reservoir of the existing and new water purification plant.

3) Installation of booster pump

2 booster pumps of 0.5m<sup>3</sup>/min (1 is standby) will be installed at a new reservoir to send water to an elevated water tank of AICAD.

**(4) Transmission Pipe**

1) Installation of transmission pipe

Transmission pipe, diameter: 100mm and length: 690m, will be installed from the new reservoir to AICAD facilities.

2) Construction of bridge for water transmission pipe

Bridge for water transmission pipe, length: 24m, will be constructed over a drainage channel.

**(5) Plan of Instrument**

Required instruments for improving the water supply system are shown in Table 2-24. The instruments are used for simple water quality analysis and survey of water leakage.

**Table 2-24 List of Instruments for Water Supply**

Instruments	Quantity	Necessity
pH meter	1	Daily water quality analysis
Turbidity meter	1	Daily water quality analysis
Residual chloride meter	1	Daily water quality analysis
Water flow meter by ultrasonic waves	2	Management of water flow to survey leakage in a block
Leakage detector bar	1	Detecting leakage points

### **2-2-2-7 Sewerage Facility Plan**

Summary of project components for improving sewerage facility is described in Section 2-2-1-3, “Sewerage System Plan”, and the each content is described below.

#### **(1) New Installation of Sewage Pipes for AICAD Research and Training Facilities**

This is described in the other sector.

#### **(2) Rehabilitation of Sewage Collection/Transfer System**

##### **1) Transfer Pump (for Wastewater Storage Tank) and Pump Room**

The transfer pumps have an important role to transfer wastewater from the JKUAT and the AICAD facilities to the wastewater treatment plant. This, however, presently has the problems which follow:

- a) Two (2) sets out of three (3) sets installed are breakdown,
- b) The electricity consumption is very large, due to too small pipe diameter (150 mm) for the sewage flow and the pump type with high-head (50 mAq) and large power (54 kw),
- c) The maintenance and repair works are difficult due to a special type of vertical motor direct-drive,
- d) The maintenance and repair works are difficult due to the deep installation level of about 7 m in the underground room,
- e) These cannot deal with the electricity stoppage which happens often due to no connection to emergency power line,

In light of the present situation, the following countermeasures, along with the expansion of the transfer pipe, are taken for the transfer pumps.

Basic Design Drawing S-3 shows the outline of the transfer pumps and the pump room.

##### **a) Renewal of Transfer Pumps**

All sets of transfer pumps are renovated as follows:

Number of pumps: 3 sets (including one standby)  
Type: Submersible with dismount device  
Capacity: 125 mm in dia. x 1.4 m<sup>3</sup>/min x 22 m in head x 11 kw  
Appurtenance: Magnetic flowmeter (1 set)  
Maintenance crane (1 set):  
Control panel and electrical works (including the connection to emergency power source)

b) Expansion of Transfer Pump Room

The transfer pump room accommodating the transfer pumps, control panels, etc. is expanded next to the existing wastewater storage tank.

2) No.1 Relay Pump (for Staff Housing)

The existing no. 1 relay pumps (2 sets) have a breakdown due to the long-time submersion in the pump room. This is renovated to submersible pumps and the existing underground pump room is used for a pump pit. Together, the emergency power equipment which is constructed in the space land next to the west of the Machinery Workshop Building is provided.

Number of set: 2 sets (including one standby)  
Type: Submersible with dismount device  
Capacity: 80 mm in dia. x 0.4 m<sup>3</sup>/min x 15 m in head x 3.7 kw  
Appurtenance: Control panel and electrical works (including the installation of emergency power source), emergency electricity room

3) No.2 Relay Pump (for Agricultural Management Building)

The existing no. 2 relay pump (1 set) is replaced, since this has been left broken-down for along time. This pump has a minimum capacity correspondent to the discharge pipe diameter of 50 mm.

Number of set: 1 set  
Type: Submersible with dismount device  
Capacity: 50 mm in dia. x 0.05 m<sup>3</sup>/min x 13 m in head x 0.75 kw  
Appurtenance: Control panel and electrical works

4) No.3 Relay Pump (for Farm Complex Building)

The existing no. 2 relay pump (1 set) is replaced, since this has been left broken-down for along time. This pump has a minimum capacity correspondent to the discharge pipe diameter of 50 mm.

Number of set: 1 set  
Type: Submersible with dismount device  
Capacity: 50 mm in dia. x 0.05 m<sup>3</sup>/min x 13 m in head x 0.75 kw  
Appurtenance: Control panel and electrical works

5) Expansion of Transfer Pipes

The existing transfer pipe with a diameter of 150 mm, from the wastewater tank to the wastewater treatment plant, is too small for transferred wastewater flow. This

is why the head of the existing transfer pumps is very high. In order that the velocity inside of the pipes at the two (2) sets operation is below the standard velocity, the following transfer pipe will be installed along the existing one.

Sewage pipe: VP 150 mm in dia. x 940 m in length  
Appurtenance: Changeover valves, header pipe

#### 6) Expansion of Collection Pipes

The pressure pipe for the Agriculture Administration Building is broken due to corrosion and the Farm Administration Building is equipped with no collection pipes, despite the fact that wastewater is generated during experiment and training. For these places, the following renovation and expansion of sewage collection pipes will take place.

Sewage Pipes:  
(Agriculture administration building) VP 50 mm in dia. x 200 m in length  
(Agriculture workshop building) VP 100 mm in dia. x 150 m in length  
Appurtenance: Stop valves, Check valves, Manholes

#### 7) Restoration of Manhole Cover

The missing or broken covers for sewage collection pipes in the existing JKUAT will be restored as follows:

Type: 600 mm in dia. (Cast iron)  
Quantity: 10 sets

### **(3) Rehabilitation of Wastewater Treatment Plant**

#### 1) Rehabilitation Scheme

The existing wastewater treatment plant consists of four (4) oxidation ponds and its effective volume is 15,000 m<sup>3</sup> in total. Although treated water is led to the ground infiltration facilities, it does not function properly due to the existence of rock layer near the ground surface and the breakdown of infiltration pipes.

The existing oxidation ponds are not properly maintained and managed, without the sludge removal for some 20 years and the water quality control. It also does not exert a proper purification function by microorganism and generate offensive odor, affected by the inhibition function of toxic substances discharged from laboratories.

Because there is no practically applied standard for discharged wastewater in Kenya, the target water quality in this Project is supposed to be decided through the individual negotiation with the management authority. At this stage, there is a

possibility that the environmental impact assessment is required based on the Environmental Management and Coordination Law enforced in 1999. (The detail procedure of this Law is unknown, since this Law has started just recently and rare actual example in enforcement).

As the result of the discussion based on the survey results mentioned above, the rehabilitation of the wastewater treatment plant targets more than about 80 % of BOD removal rate and, to attain the target, the following major measures were confirmed:

- a) To improve the treatment performance, the removal of sludge deposited on the bottom of the oxidation ponds and the expansion of oxidation ponds using the land space for the ground infiltration facilities are carried out,
- b) The planting of medium-height trees along the boundary of the site (except for the Thika Road side ) are carried out as the mitigation measure against odor generation.

At present, treated water of the wastewater treatment plant flows into the wet land beyond the Thika Road through the rainwater ditch. The rainwater ditch receives domestic wastewater from the surrounding houses on the way. To prevent possible groundwater pollution, it should be examined that treated water be diverted into the Ndargu River through the ditches, which are planned as a nearby regional project

## 2) Examination on Rehabilitation of Oxidation Ponds

The following alternatives were examined as the measures for the improvement of the existing oxidation ponds:

Alternative (A): The additional oxidation pond is installed using the open space, in which the ground infiltration facilities are set at present (the expansion of oxidation ponds),

Alternative (B): The existing ponds are modified to the aerated lagoons by the addition of aeration equipment to the existing oxidation ponds (the modification to the aerated lagoons).

Both the Alternatives are compared in Table 2-25. Although the higher treatment performance may be expected in the Alternative (a), it requires the electric power for the operation of aeration equipment. As a result of the discussion with the Kenyan Side, it was decided that the Alternative (A) was selected assuming the BOD removal rate of 80 %, in light of the possibility of the provision for maintenance and management expense of the JKUAT and the AICAD.

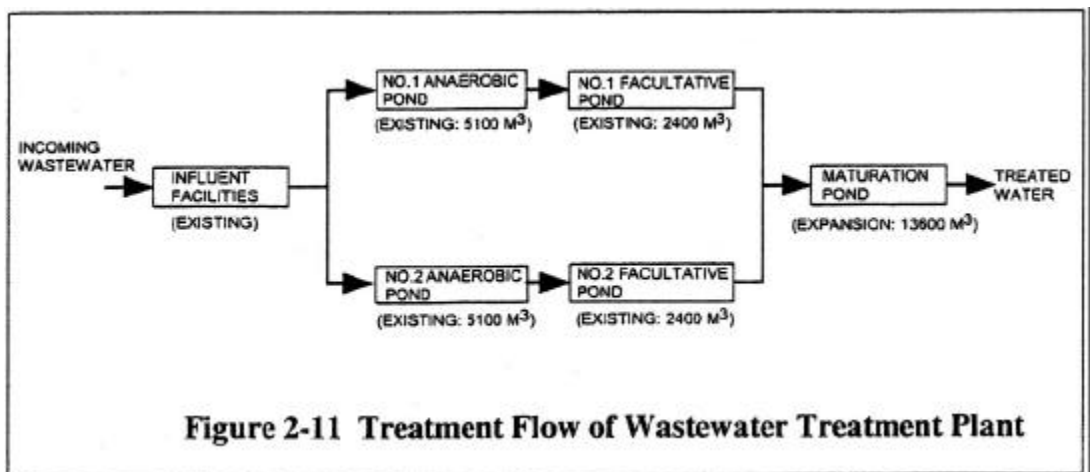
**Table 2-25 Comparison on Improvement of Wastewater Treatment Plant**

Items	Alternative (A) (Expansion of oxidation ponds)	Alternative (B) (Modification to the aerated lagoons)
1. Aeration	No	Aeration equipment (1.5kw x 8 units)
2. Total volume of oxidation pond	28,600 m <sup>3</sup>	15,000 m <sup>3</sup>
3. BOD removal rate	75 - 85 %	80 ~ 90 %
4. Operation manpower	Once-a-day inspection	24 hours stay
5. O&M expense	Low	High (240 kwh/day)
6. Construction cost	Low	High

In the future, there is a possibility that wind force or solar heat may be used as the energy for aeration. It has been confirmed that this is the issue with which should be dealt by the Kenyan Side.

3) Rehabilitation Plan of Oxidation Ponds

Using the land space in the site, the oxidation ponds are modified to the three-step treatment comprising of the anaerobic, facultative and maturation pond by the expansion of the oxidation pond (one pond), as shown in Fig. 2-11.



The rehabilitation works of the oxidation ponds are as follows and the detail plan of facilities is shown in Basic Design Drawing S-2.

a) Expansion of the maturation pond

Type: Earthen (concrete panel on the side wall, clay finishing on the bottom)

Dimension: 60 m in width x 170 m in length x 2.0 m in depth (water depth 1.5 m)

Volume: Effective 13,600 m<sup>3</sup>

Appurtenance: Influent pipe and influent pit  
Effluent pipe and effluent pit



b) Sludge removal of existing oxidation ponds and sludge disposal

The sludge removal from the existing oxidation ponds takes place. The deposited sludge is removed by pumps, vacuum vehicles or shovel cars, after emptying the oxidation ponds and is transported to the outside. The removed sludge is disposed off there after being transported to the JKUAT farm and being dried naturally. Periodical measurement of the quality of underground water should be carried to monitor the outflow of toxic substances from the disposal site.

c) Tree plating and others

To mitigate the emission of offensive odor to the surrounding areas, medium-height trees (about 4 m in height) are planted around the boundary of the site (except for the side of the Thika Road).

#### **(4) Collection/Disposal of Laboratory Waste**

1) Separate Collection of Laboratory Waste

The "separate collection system" is introduced to prevent toxic substances from intruding into domestic wastewater and other wastewater.

The survey results on the JKUAT research and training facilities indicate that 22 laboratories, out of laboratories belonging to the agriculture, engineering, science faculty and related institutions, possibly can handle toxic and hazardous substances. Laboratory waste is collected in container with about 20 liters volume in each laboratory, separated to six (6) categories (heavy metals, cyanides, fluorides, acids, alkalis and organic solvents).

Laboratory waste collected from each laboratory is transported to the toxic waste storage yard located to the north of the agriculture workshop and is stored in the storage room after being transferred into chemical drums. Wastes such as acids and alkali, which the JKUAT staffs can treat by themselves, are treated and disposed at the workshop.

2) Toxic Waste Storage Yard and Related Equipment

The facilities and equipment necessary for the execution of the separated collection of laboratory waste are as follows. The area of the storage room is planned under the conditions that the storage year is from 8 to 10 years.

a) Toxic waste storage yard

i) Storage room:

Construction: Reinforced block (Floor: Acid-proof and corrosion-proof finishing)

Dimension: 10m in width x 14m in length x 4.0m in height (1 building)

Appurtenance: Entrance and exit (1 set)

Exhaust fan (1 set)

Container storage rack (1 set)

ii) Workshop:

Construction: Shelter without side wall (Floor: Acid-proof and corrosion-proof finishing)

Dimension: 6.0m in width x 10m in length x 4.0m in height (1 building)

Appurtenance: Hoist crane (1 set)

Waste pit (1.0m in width x 1.0m in length x 1.5m in depth, 1 unit)

Drain pipe and valve (PVC 100mm in dia.)

b) Collection container

Quantity: 120 set (including spare)

Volume: 20 liter

c) Chemical drum for storage

Quantity: 21 units (for three (3) year operation)

Volume: 200 liter

d) Transport cart: 8 units

e) Drum porter: 2 units

### 2-2-2-8 Equipment Plan

Basic policy for equipment plan and condition for equipment planning including AICAD activity analysis has been explained in the previous clause, in these condition, objectives and outline of specification for major equipment selected are explained bellow;

**(1) Necessity of AICAD Equipment (Category –1)**

1) Mini Bus

The training program under AICAD consists of two courses each limited to 30 trainees concurrently. In order to provide transportation to outside training sites, site investigation a minibus with 20 seats with 5 emergency seats is necessary.

2) PC for Internet Library

The utilization of internet is not widely spread in African countries including Kenya and provision for internet system and training is urgently needed. For this purpose, AICAD library shall be equipped with four computers with internet connection to train not only those in the internet training course but also other trainees, AICAD facility users and visitors by having actual access to the internet and data collection from overseas internet information. These computers shall not be linked with AICAD LAN for security reasons.

**(2) Equipment for JKUAT including IT equipment that are used in second and third country training programs (Category -2)**

1) Portable Photosynthesis system

Horticulture is becoming a growing export industry in Kenya and it is now being studied as a source of income for women in rural areas. The system is used for measurement of CO<sub>2</sub> intake and O<sub>2</sub> generation under given condition of temperature, humidity and light strength, and re-conditioning and improvement of existing plantation for achievement of high productivities. The photosynthesis system is very useful and effective research and student experiment and often used for demonstration as a part of agricultural promotion activity and needs to be portable and capable of running on batteries or stationary power supply.

2) AA Spectrophotometer

It is popularly used in food inspection for metallic ion detection. The “applied food analysis technology” has long been a core of the third country cooperative training program. The existing instrument has become obsolete and should be replaced by a new instrument featuring automatic sampler and automatic flame/furnace changer.

3) High Pressure Liquid Chromatography (HPLC)

This instrument is used in the analysis of amino acids, organic acids, sugar and food additives in food analysis. The existing instrument has a worn out pump and a

column and should be replaced. This instrument will be effectively used in the third country training programs as well.

4) UV-VIS Spectrophotometer

This instrument is used for analysis of food additives, vitamins, sugar, enzymes and other special ingredients. The existing instrument is obsolete and should be replaced.

5) pH meter

The Civil Engineering Department conducts a third country training in water treatment and water analysis. More desk-top pH meters with advanced features such as self adjusting function and data storage function are needed.

6) Turbidity meter

For the same reasons as above, portable turbidity meter capable of running on batteries or stationary power supply should be provided.

7) Combined Bending and Torsion Apparatus

Because of current system being obsolete, a new system is necessary for student study as well as for group study.

8) Voltmeter/ Ammeters

These meters were provided earlier, but due to wear and tear they should be replaced and quantities increased for basic study and training.

**(3) Equipment for JKUAT provided by previous Japanese Grant Aid and linked to the AICAD activities which repairing and replacement (Category -3)**

1) BOD Measurement Units

In the Master Course study, experiments in the environmental engineering are performed without the benefit of BOD measurement instrument. In the water quality study, which was started in 2000, there is only one measurement instrument utilizing Beaker. The addition of this instrument will greatly enhance the waste water management which results from this project.

2) Thermal Conductivity Apparatus

In the Mechanical Engineering Department, experimental devices for heat transport and material characteristics measurement were lacking and created a problem in student experimental program. Stationary heat transfer coefficient measurement

and heat transfer characteristic measurement devices should be provided. This system will be effective in developing a replacement for cancer causing asbestos as thermal insulator.

3) Bomb Calorimeter Set

For the same reason as above, propane cylinder and pressure regulator for gas calorimeter should be provided.

4) Educational robot system

While there were some robotics for intelligence and for demonstration owned by the Mechanical Engineering Department, these devices were not suitable for applied experiments and had not been utilized extensively. In view of advanced level of automatic control in the department and wide use of PCs, this system may be more effectively utilized. Introduction of this system is expected to re-vitalize activity in this technology area.

5) VIS Spectrophotometer

The spectrometer that was supplied in the past is obsolete and should be replaced for group study of students and training.

6) Infrared Spectrophotometer

The Chemistry Section of Science Department is engaged in the study of identifying African and Kenyan unique natural resources as well as essential oil and vitamins. Addition of this instrument will enhance the current study level and will be effectively used in training programs.

7) Laminar Flow Hood

In the Botany Department, lack of experimental hood is causing environmental problem within the building. It is necessary to provide hoods as required.

8) Chiller unit

Dept. of Physics of Faculty of Science is engaged in a study of vacuum plating with substantial results. Chiller unit will be provided as a part of support for recycle energy joint study after 2001.

9) Fluorescent Spectrophotometer

Dept. of Biochemistry of the Faculty of Science needs this instrument for identification of organic material. The existing color comparator is obsolete and will be replaced by this instrument.

10) Demonstration Microscope

Farm field training is becoming popular under Kenyan domestic training program and third country training program. The Demonstration Microscope is to be provided for lecturer' use for the purpose of showing and teaching an existence of parasite and virus in a vegetable which are prevalent in Kenya and East Africa.

11) Power Pipe Threading Machine

With the increasing need to upgrade water supply piping and perform repair of the existing piping in addition to outside contract work, a new pipe bending machine will be provided to replace the old obsolete machine.

12) Welder

In addition to an increasing need for repair of equipment within the university, there is an increasing demand for outside contract work as the capability of the workshop improved for repair and maintenance and sales from such outside order reach one million shillings for each month. As the existing welders have become obsolete, a gas welder and a TIG welder for food processing purpose will be provided.

13) Copier

Requests were made from each of the departments for copy machines, but in order to control the use of copy papers, effective use of scanner is recommended. Copiers will be provided to each department or to each building.