TIPAN

Transformation and Integration of the Provincial Agricultural Network

Northwest Frontier Province, Pakistan

Office of International Agriculture
University of Illinois at Urbana-Champaign

In collaboration with
Southern Illinois University at Carbondale

CONSULTANT REPORT

JAMES O. CURTIS

LIVESTOCK FACILITY DESIGN

29 MARCH - 29 APRIL 1986

Submitted to
the Northwest Frontier Province
Agricultural University
Peshawar, NWFP, Pakistan

and

the U.S. Agency for International Development
Mission to Pakistan

A Report of Contract No. 391-0488

by
Office of International Agriculture
University of Illinois at Urbana-Champaign
Southern Illinois University at Carbondale

C6-April 1986

CONSULTANT REPORT

TRAVELER: James O. Curtis, Professor Emeritus of Agricultural Engineering, University of Illinois at Urbana-Champaign

ITINERARY:

29 March 1986	Depart Champaign
31 March 1986	Arrive Peshawar
27 April 1986	Peshawar to Islamabad
28 April 1986	Arrive London
29 April 1986	Personal trip to Germany
6 May 1986	Depart Munich
6 May 1986	Arrive Champaign

PURPOSE: To provide short-term technical assistance as a Livestock Facility Design Specialist.

STATEMENT OF NEED:

"Dairy, poultry, and small ruminant teaching and research facilities are to be constructed. In order to meet the needs of the University and local climatic conditions, special plans must be drawn."

PROPOSED SCOPE OF WORK:

"Assist SOM in the design of the livestock facilities appropriate to the needs of the AU. The consultant is to work closely with the faculty of Animal Husbandry, the Farm Manager and the Animal Husbandry Liaison Committee in developing this design and the location of the facilities. The facilities to be designed are for dairy cattle, poultry, and sheep and goats."

PRINCIPAL ACTIVITIES/ACCOMPLISHMENTS:

Activities concentrated on developing recommendations and plans for farm buildings scheduled in the Phase I Program and to be located at the Farm Center on Experimental Farm. The Farm Center will consist of either existing buildings or buildings to be constructed on the Experimental Farm.

A decision has been made to locate these buildings at two sites. Buildings for use by the Plant Sciences will be located at the site of the existing farm center. Buildings for use by Animal Science will be located at a new site near the northwest corner of the farm.

The Phase I Program of building will include several buildings at the Farm Center. Those included are as follows:

Facility (element)	Net Area	
	Sq. M.	Sq. Ft.
Headquarters (Existing)	0	0
Manager's House (Existing)	0	0
Shop/Machinery Storage	650	6997
General Storage (Renovation)	320	3445
Pesticide Storage	90	969
Poultry Barn (Partial)	300	3229
Threshing Shed	0	0
Seed House	360	3875
Feed Storage/Handling	160	1722
Slaughter House/Meat Storage	0	0
Goats	0	0
Sheep	0	0
Dairy Barn (Partial)	800	8611
Pump House	0	0
Security Gate House (two)	20	215

In developing plans and recommendations for the buildings to be constructed on the experimental farm, I consulted with several individuals and visited several building installations. I interacted on an almost daily basis with Mr. Joe Marion and on a regular basis with Dean Basit Ali Shah, Dr. Iqbal Shah, and Mr. Sherin Khan. In addition, I have had limited discussions with other faculty members in animal husbandry, with Professor Mohammad Tariq relative to machinery storage and shop facilities, with Mr. Mohammad Arshad relative to local building materials and construction procedures, and with Mr. Ajmal Shah relative to any suggestions the

Department of Works might have concerning the farm buildings. Several visits were made to the proposed sites of the Animal Sciences and the Plant Sciences Centers. Single visits were made to the university's dairy farm and to dairy farms at Surezai and at Harichand. In addition, a trip was made to Pirsabak and to the Sugar Research Institute at Mardan to consult with personnel there on their needs for seed storage facilities.

Recommendations and tentative space layouts are given for individual buildings in sections which follow.

Animal Sciences Center

The buildings to be included in the Animal Sciences Center in Phase I include dairy buildings (50 percent of final facility), poultry buildings (50 percent of final facility), feed storage and handling facilities and a security gate house. In addition, some housing units for personnel working at the farm are to be located at the Animal Sciences Center.

Dairy Buildings

The Phase I building program calls for dairy facilities for 50 mature cows plus replacement stock, for milking and milk handling, and for roughage storage. Facilities should be planned to allow for future doubling of herd size. Initial plans are to have about equal number of water buffalo and native bos cattle. Total numbers of livestock for use in planning are as indicated below.

Typical Herd Make-up

Type Animal	Number
Mature Cows	50
Heifers (16-24 mo.)	20
Heifers (13-15 mo.)	6
Heifers (9-12 mo.)	10
Heifers (5-8 mo.)	8
Heifers (3-4 mo.)	4
Calves (0-2 mo.)	4
Total	102

Based on discussions with Dr. Iqbal Shah, Dean Basit Ali Shah, Dr. Bashir and Dr. Mohammad Zakir and on visits to the University Dairy Farm and to the diary farms at Surezai and at Harichand the following suggestions and recommendations were made relative to the diary facilities:

1. For the mature cows provide 50 tie-stalls. These stalls will make it possible to feed the cows according to production and will provide a convenient facility for continuing the practice of hand milking for the present.
2. Provide a minimum of 50 square feet per head (100 square feet would be better if space permits), of outside lot space for the mature cows. Provide a fenceline bunk along one side of this lot for roughage feeding as desired. Provide shade over the bunk and a minimum of a 10-foot wide paved strip along the bank.
3. Provide a 15 x 28 foot building for milk room, office and storage. Plan it so that a milking parlor may be added later - see Midwest Plan Service (MWPS) Plan No. 75248 as a guide. The milk handling

facilities should provide for keeping the buffalo and the bos cattle milk separate. This can easily be done if a can-type cooler is available. Otherwise, two 250 gallon bulk coolers should be provided.

4. Provide a 16 x 16 foot feed room and storage room adjacent to the tie-stall barn.
5. For 13-24 month old heifers, provide free stalls, an outside lot and a fenceline bunk. Provide shade over the bunk and a minimum of a 10-foot wide strip of concrete along the bunk.
6. For 3-12 month old calves and heifers, provide group pens, outside lot, and fenceline bunk. Also provide inside feeding space for these animals.
7. Provide five individual pens for 0-2 month old calves.
8. In planning roughage storage, assume that one-half will be fed directly from the field. Then assuming a medium level of silage feeding, storage will be required for approximately 120 tons of loose hay and straw and 300 tons of silage. This will require a hay storage approximately 16 x 36 x 100 feet in size and two horizontal silos approximately 8 x 20 x 55 feet in size.
9. Summer heat is the main environmental concern. Thus, the animal shelter buildings should provide for free cross circulation of air in hot weather. At least 1/2 of the north and south walls should be openable in summer and closable in winter by using either windows, hinged ventilation panels or curtains.

10. Provide a facility for sprinkling the animals as they exit the tie-stall barn in order to help them to stay cool in hot weather. This facility should provide overhead sprinklers, a concrete slab to collect the excess water, and drainage to carry the water away.

The following is a summary of dairy facilities required:

Buildings in Phase I

Tie-Stall Barn -- 36 x 124	4464 sq. ft.
Young Stock Barn -- 26 x 102	2652 sq. ft.
Milk room, office, storage - 15 x 28	420 sq. ft.
Subtotal	7536 sq. ft.

Other Essential Facilities

Outside lot for mature cows - minimum of 50 x 124 feet.

Outside lot for young stock - minimum of 50 x 102 feet.

Fenceline bunk with shade overhead minimum of 102 feet.

Other Needed Facilities

Fenceline bunk with shade overhead - minimum of 124 feet.

Two above ground horizontal silos, 300 T capacity, 8 x 20 x 55 feet.

Storage for loose or chopped hay and straw, 110 T, 16 x 36 x 100 feet.

Grain and concentrate storage at processing center.

Milking parlor addition to milk room.

The following sketches suggest space layouts for the diary facilities:

1. Diary Facilities Layout, Appendix A.
2. 50 Tie-Stall Barn for Mature Cows, Appendix B.
3. Cross section through Tie-Stall Barn, Appendix C.
4. Dairy Barn for Young and Replacement Stock, Appendix D.

5. Cross section through young stock barn and through fenceline bunk and shade, Appendix E.

Poultry Buildings

The Phase I building program calls for 300 sq. meters (3230 sq. ft.) of poultry facilities. Earlier, there was a suggestion that this first phase should provide space for 500 laying hens and 1000 broilers. However, at a meeting held in Urbana on March 27, 1986, Professor Mushtaq Mian indicated that these might not be the highest priority facilities. Professor Mian along with Dr. Jim Garlich, his major professor at North Carolina State, agreed to work directly with the architect on the poultry facilities.

Feed Storage and Handling Facilities

The Phase I building program includes 160 square meters (1700 sq. ft.) for feed storage and processing. This could be satisfied with a 32 x 50 foot building. A possible space arrangement is shown in Appendix F. Such an arrangement provides four 16 x 16 foot ground level bins. These bins will provide storage for a total of about 200 tons of cotton seed cake or grains, if stored in bags to an average depth of about 10′. The 18 foot wide drive-through area will provide processing and handling space. It might contain a mixing wagon, a mill, and augers for elevating materials to either the mill or the mixing wagon.

In addition to the above, a 250 gallon tank should be provided adjacent to the feed storage building for the storage of molasses. The molasses can then be withdrawn from this tank in small quantities and hand mixed with the other grain and concentrates and fed to the dairy cattle.

While the main grain storage and processing facilities for all livestock enterprises should be at this centralized facility, a small feed storage and processing room may be required at each livestock facility for adding micro-ingredients and for preparing specialized rations.

Plant Sciences Center

The buildings to be included in the Plant Sciences Center in Phase I include the existing horticulture headquarters, manager's house and bullock barn; a renovated general storage; and new buildings for farmshop and machinery storage, seed house, pesticide storage, and security gate house. In addition, the entire plant center will be surrounded with a security fence - probably of steel "cyclone" type.

Farm Shop and Machinery Storage

A farm shop and machinery storage building is required on the farm in order to provide for servicing, maintaining, and storing the farm's machinery. It is expected that two mechanics and two mechanic's helpers will work nearly full-time in the shop. Space should be provided for storing all of the farm's machinery in order to extend its useful life and for security and housekeeping reasons.

A suggested space layout for the shop and machinery storage is shown in Appendix G. Note that the service area and the repair area are large enough that they will each handle a large tractor or item of farm machinery at the same time. The service area also includes space for lube supplies, oil storage, air compressor and underground outside storage for 15000 liters of diesel fuel. Adjacent to the repair and overhaul area are spaces and equipment for welding, metal working and wood working. In addition,

space is provided in the shop for work benches, parts storage, long material storage, a desk and a filing cabinet. An outside service ramp is suggested adjacent to the 16-foot wide apron on the south side of the shop (see Appendix H).

The preferred system of construction for the shop and machinery storage is masonry walls, steel roof trusses, and corrugated galvanized steel, roofing sheets (see Appendix H for sketch of cross section). Trusses may be supported along the open front by either steel or reinforced concrete beams.

The shop should provide a comfortable and healthful environment for year-round work by the mechanics. The following are required in order to provide this environment: evaporative cooler, space heater, exhaust fan over welding area, ridge vents (birdproof), openable windows on south side for light and cross ventilation, light panels in the north sloping roof, roof overhang to shade the south wall from mid-day summer sun, and a minimum of 1" of foil coated foam plastic or 2" vinyl covered fiberglass insulation under the roofing.

A list of equipment and of hand and power tools that are required to equip the shop is given in Appendix I.

Seed House

A seed house is required to processing and storing seed that is either produced or utilized on the experimental farm. The Phase I building program calls for a facility for this purpose with an area of 360 sq. meters or 3875 sq. feet.

Plans for utilization of this building are not completely finalized at this time. However, it is reasonably certain that the following types of spaces and facilities should be provided:

1. A dry processing working area for receiving materials as they come in from the field. This area should include work benches, storage cabinets, a weighing area with tables and scales, moisture checking equipment, a drying oven, temporary storage for seed cleaning equipment, etc.
2. A wet processing sort and scrub area for such things as washing soil from roots, washing peanuts, washing potatoes, washing containers or equipment, etc. It should contain sinks, a floor sloping to a drain, work benches, storage cabinets, etc.
3. An area for storing seed, forage samples, etc. Areas with three different storage environments are suggested - a 10 x 12 foot walk-in freezer unit with capability of -15°C temperatures, a 12 x 20 foot cold storage room with capability of 5°C and 50% relative humidity, and a 12 x 30 foot cool room with a room air conditioner.
4. An office and a toilet facility for use by farm personnel should be provided.

This building should probably be of masonry construction with brick walls that match present buildings on the farm. The roof should be of insulated masonry to help control heat gain in the building in summer. In addition, the walls and ceiling of the storage areas should be insulated with a minimum of 2 inches of polystyrene insulation. In order to provide an acceptable working environment in the processing areas openable windows

should be installed to provide lighting and cross ventilation and fans should be installed overhead.

A suggested space layout for the seed house is given in Appendix J.

Pesticide Storage

The Phase I building calls for a new pesticide storage with an area of 90 sq. meters (970 sq. feet). A building layout similar to that detailed on MWPS Plan No. 74002 appears to be adequate and is suggested. It provides a 16 x 24 foot building for storage and mixing and a 10 x 16 foot concrete slab adjacent to the building for wash down of equipment and containers.

General Storage Renovation

The general storage requires some renovation and repair work in order to make it more usable. After renovation, it will primarily be used to provide work areas and individual storages for students doing research at the farm.

A sketch in Appendix K gives some renovation suggestions. Lockable individual storages with full-height, wire-covered partitions should be constructed where shown. The building should be wired for electricity and lighting, convenience outlets and fans should be provided. Water should be provided in at least one location in each work area. A large crack in the partition should be repaired. Finally, it would be desirable to add steel trusses and a new corrugated steel roof in order to cure leakage problems and to provide a ventilated attic to aid in heat control.

Fertilizer Storage Renovation

The fertilizer storage is a reasonably satisfactory building, but it needs some renovation in order to make it more usable. Two new partitions should be added in order to facilitate separation of different fertilizer materials (see Appendix K). Also a new 12-foot wide slab with roof overhead should be added along the south side of the building. This will provide some additional outside work area and will also provide weather protection to the doors that provide entrance to the storage areas.

Research Station Seed Storage

Visits were made to the seed processing and storage facilities at Pirsabak and to the seed and fertilizer storage facility used by the Agricultural Development Authority (ADA) and located at the Sugar Research Institute at Mardan. The primary need at Pirsabak appears to be a facility for drying seed corn. Much to our surprise, the facility being used by ADA at Mardan was apparently constructed for drying, processing, and storing seed corn.

It is our understanding that the Mardan facility was built in 1965, but that except for a large fan, the mechanical equipment was never installed and it was never used for seed corn drying. We were also told that plans for the facility and also the mechanical equipment which was never installed may be at Pirsabak (this will require investigation).

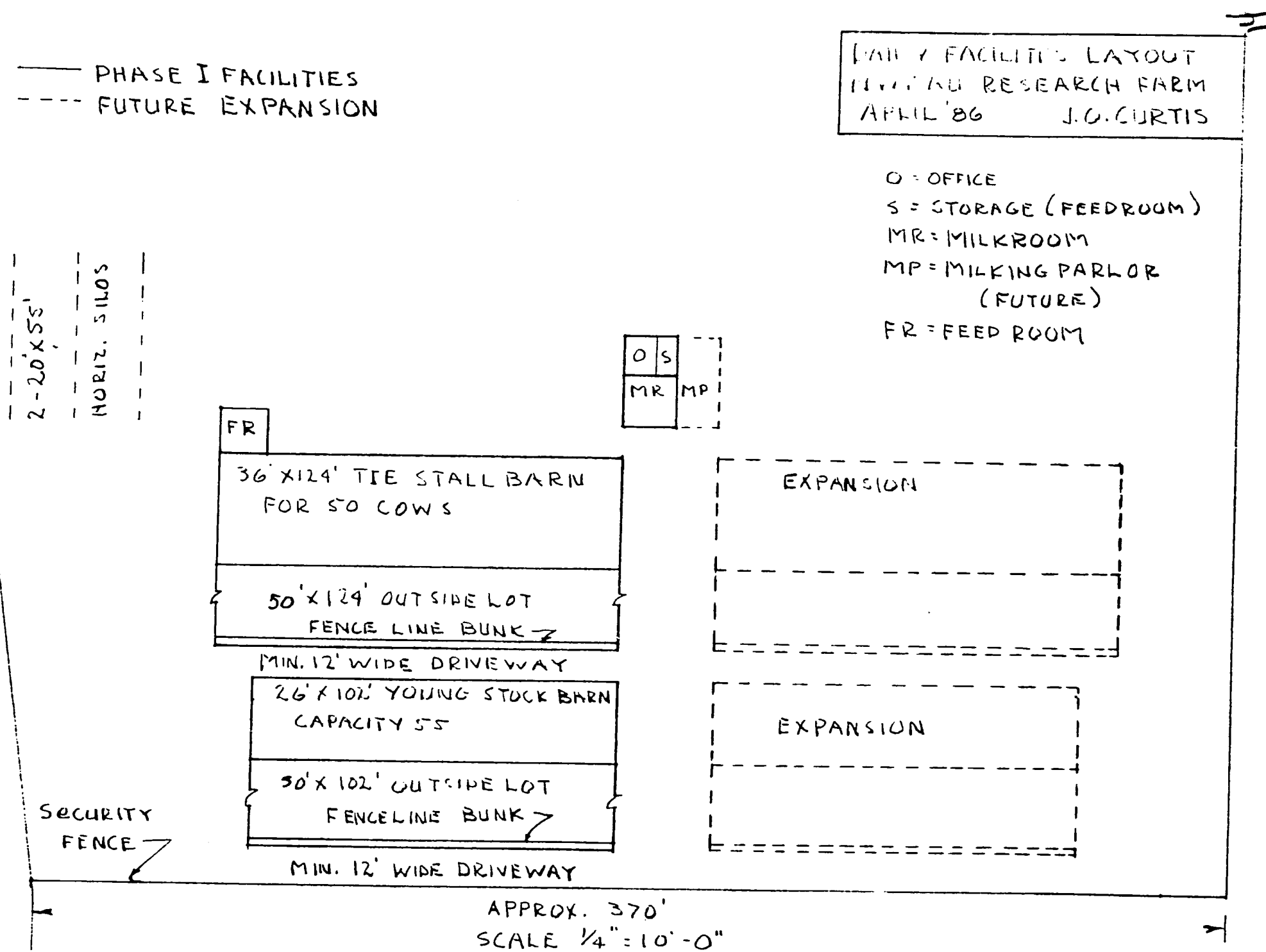
The Mardan facility appears to still be in excellent structural condition and we believe that it could be made operable as a seed corn drier with not much more than a portable elevator for placing the ear corn in the drying bins and then providing a power unit for the fan. Thus, our

tentative recommendation is that the seed corn produced at Pirsabak be trucked to the Mardan facility for drying, processing and storage.

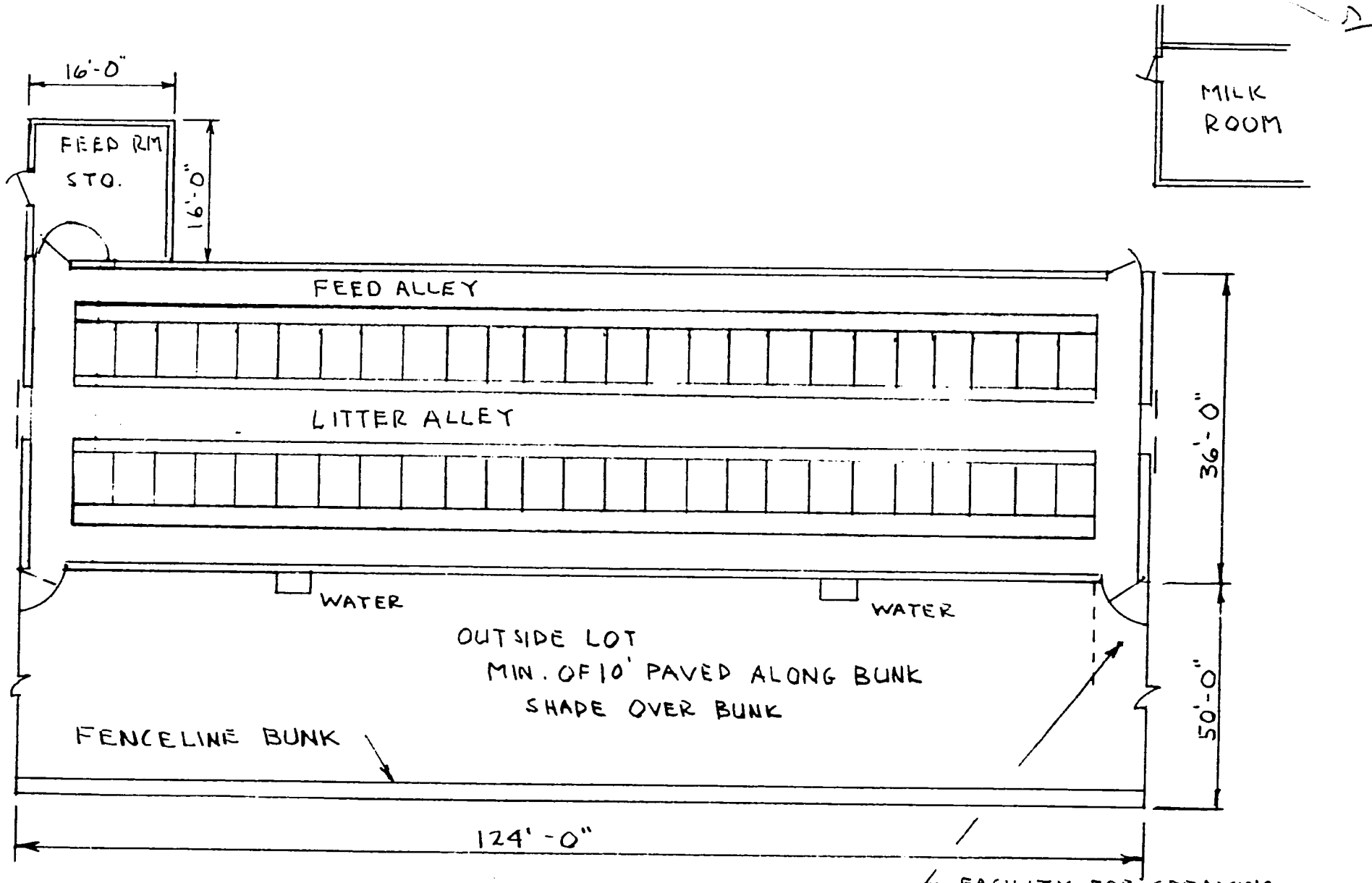
ACKNOWLEDGEMENTS

I sincerely thank the entire TIPAN team at Peshawar for their willingness to take time to counsel with me and to discuss with me their work in relation to the overall project. Special thanks are due Joe Marion for working directly with me in determining the building needs of the NWFP AU Experimental Farm; also, a special thanks to Dr. Errol Rodda for his counsel and for the administrative support which made it possible for me to carry out my assignment. The University faculty with whom I have worked were all cooperative and helpful. I especially thank Dr. Iqbal Shah, Dean Basit Ali Shah, and Professor Sherin Khan. Finally, the social activities arranged by the wives of the TIPAN staff were especially appreciated. These activities contributed a great deal to making the off-duty hours enjoyable.

APPENDIX A


PHASE I FACILITIES
FUTURE EXPANSION
DAIRY FACILITIES LAYOUT
NORTH RESEARCH FARM
APRIL '86 J.G. CURTIS
O = OFFICE
S = STORAGE (FEEDROOM)
MR = MILKROOM
MP = MILKING PARLOR (FUTURE)
FR = FEED ROOM
2-20'X55' HORIZ. SILOS
O
S
MR
MP
FR
36'X124' TIE STALL BARN FOR 50 COWS
50'X124' OUTSIDE LOT FENCE LINE BUNK
MIN. 12' WIDE DRIVEWAY
EXPANSION
26'X102' YOUNG STOCK BARN CAPACITY 55
30'X102' OUTSIDE LOT FENCELINE BUNK
MIN. 12' WIDE DRIVEWAY
EXPANSION
SECURITY FENCE
APPROX. 370'
SCALE 1/4" = 10'-0"

APPENDIX B

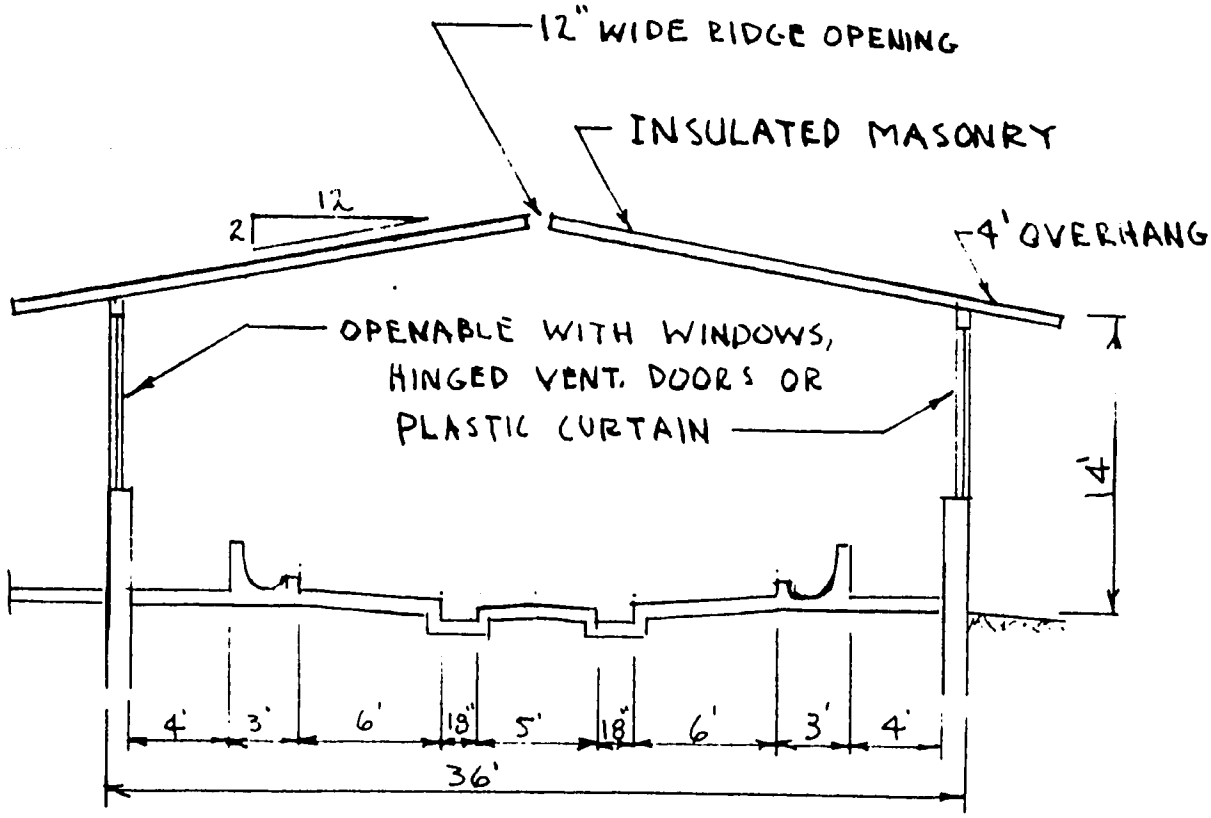


50 TIE STALL BARN FOR MATURE COWS

SCALE 1/16" = 1'-0"

J.O.C. 4/86

APPENDIX C

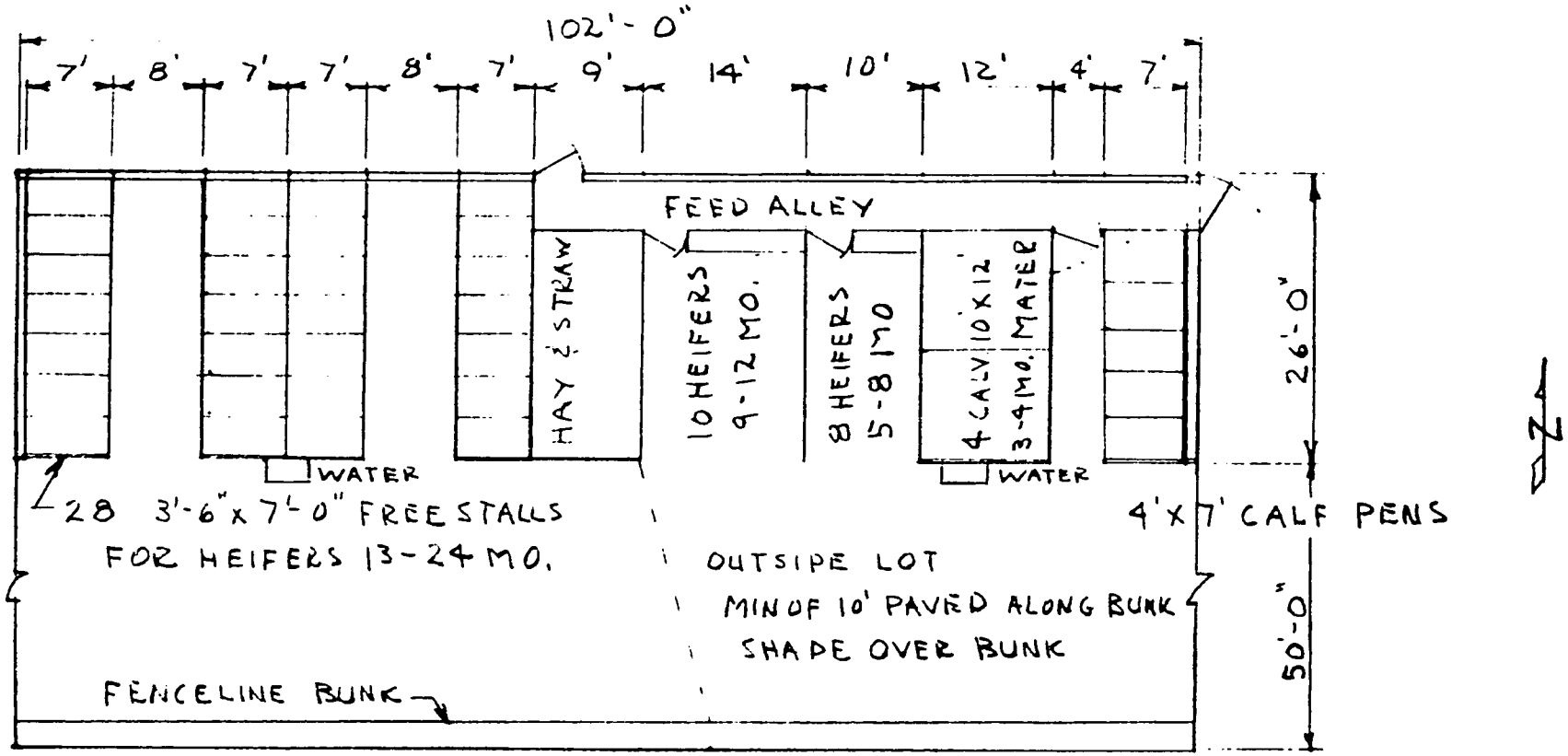


CROSS SECTION THROUGH TIE STALL BARN

SCALE 1/8" = 1'-0"

J.O.C. 4/86

APPENDIX D

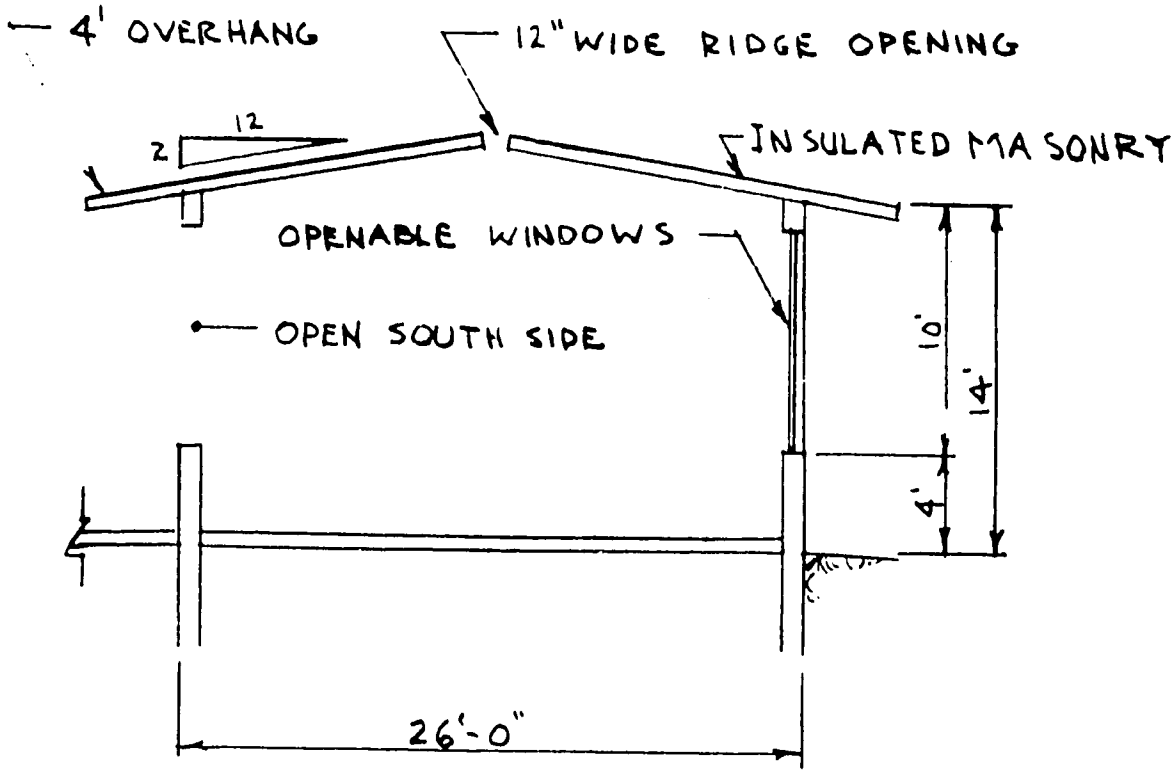


NOTE: SOUTH WALL OPEN ABOVE 4 FOOT HEIGHT
NORTH WALL HALF OPEN WITH ABILITY TO CLOSE WITH CURTAINS, WINDOWS, OR HINGED PANELS

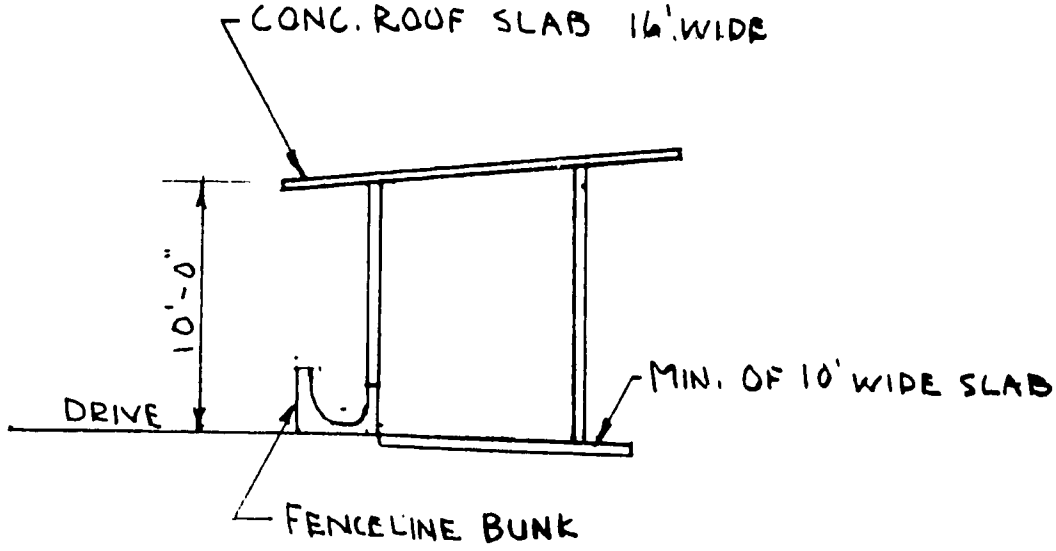
DAIRY BARN FOR YOUNG AND REPLACEMENT STOCK (CAPACITY 55)
SCALE 1/16" = 1'-0"

J.O.C 4/86

APPENDIX E



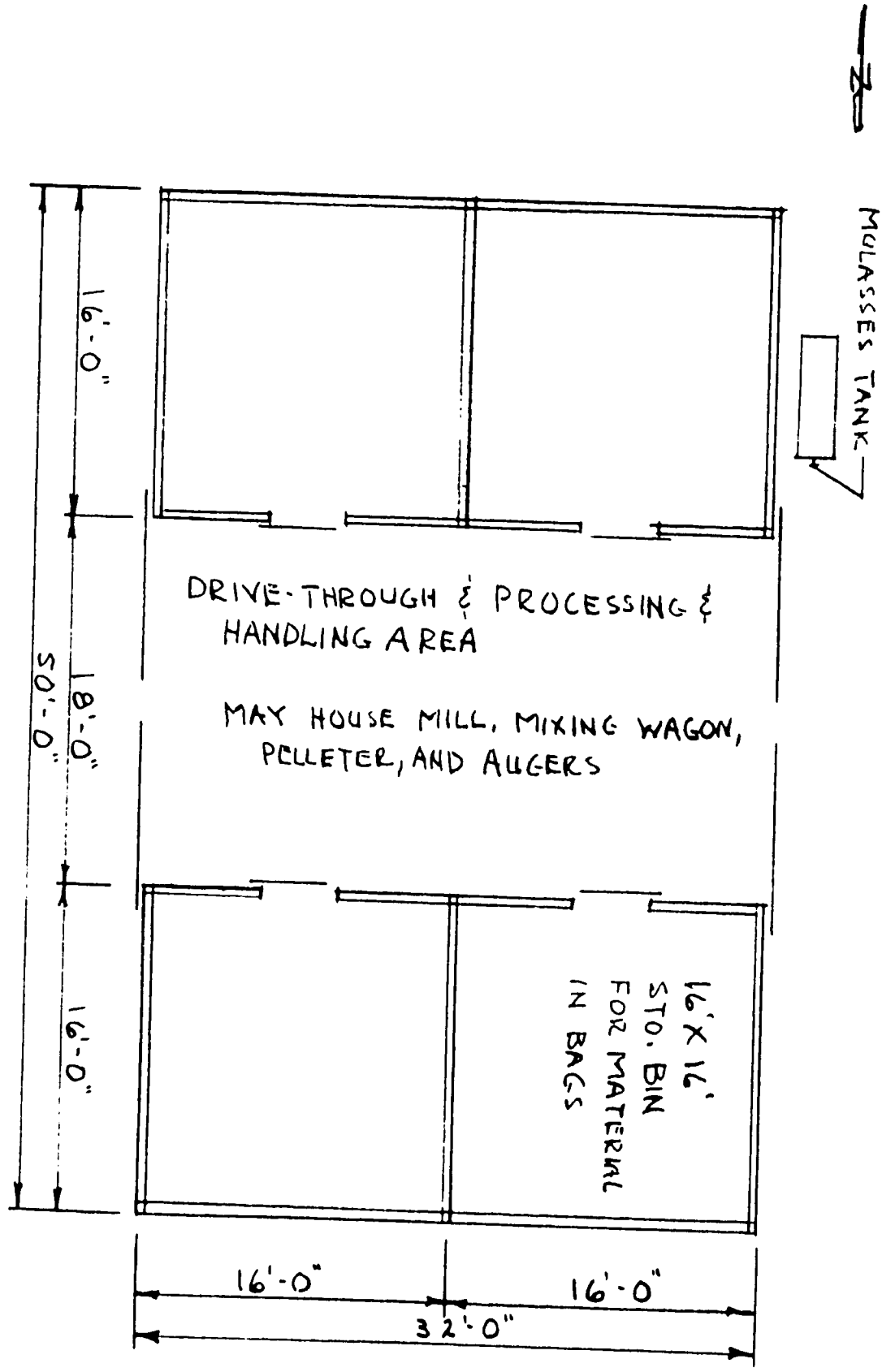
CROSS SECTION THROUGH YOUNG STOCK BARN
SCALE 1/8" = 1'-0"



CROSS SECTION THROUGH FENCELINE BUNK AND SHADE
SCALE 1/8" = 1'-0"

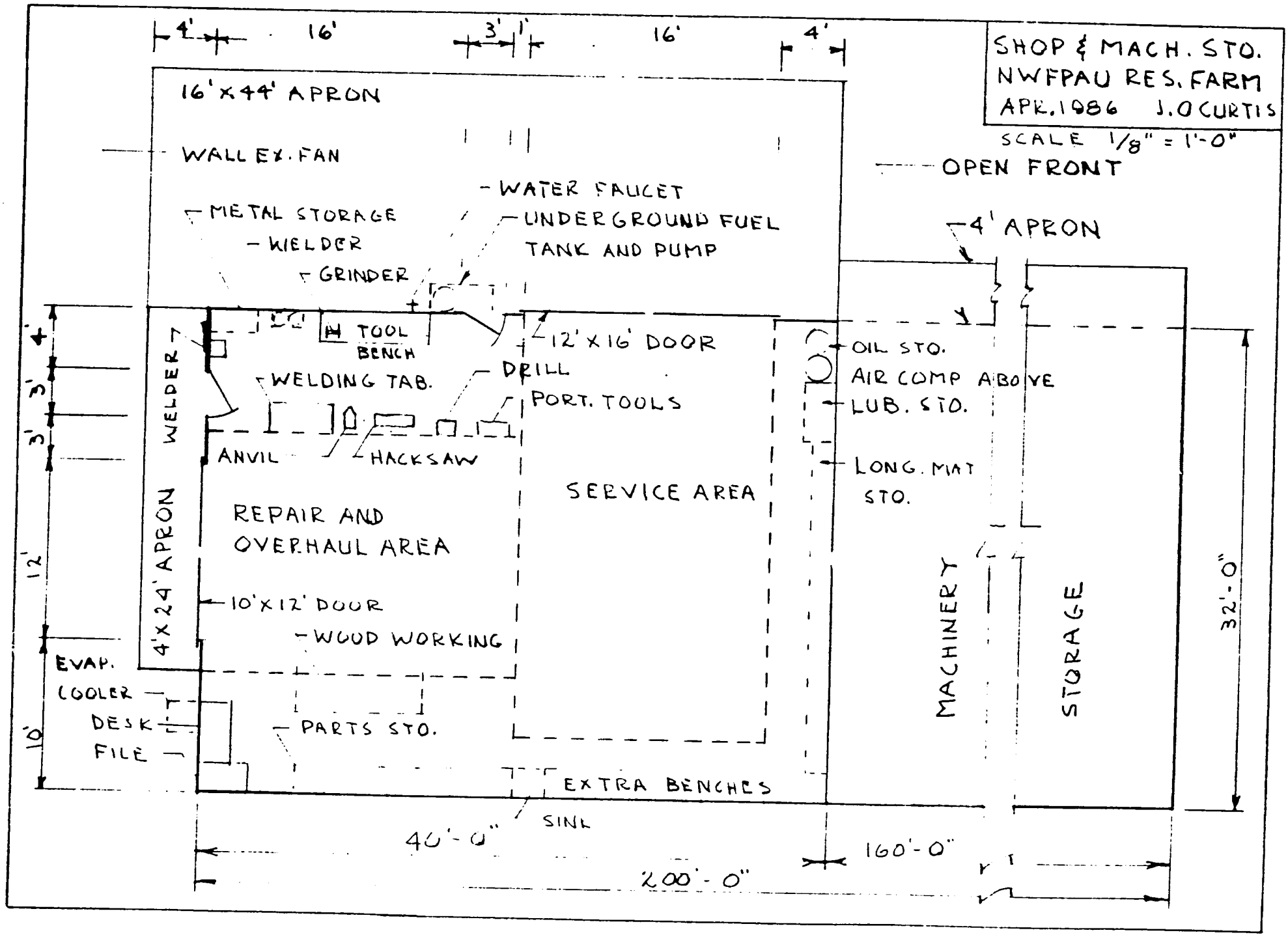
J.O.C. 4/86

APPENDIX F



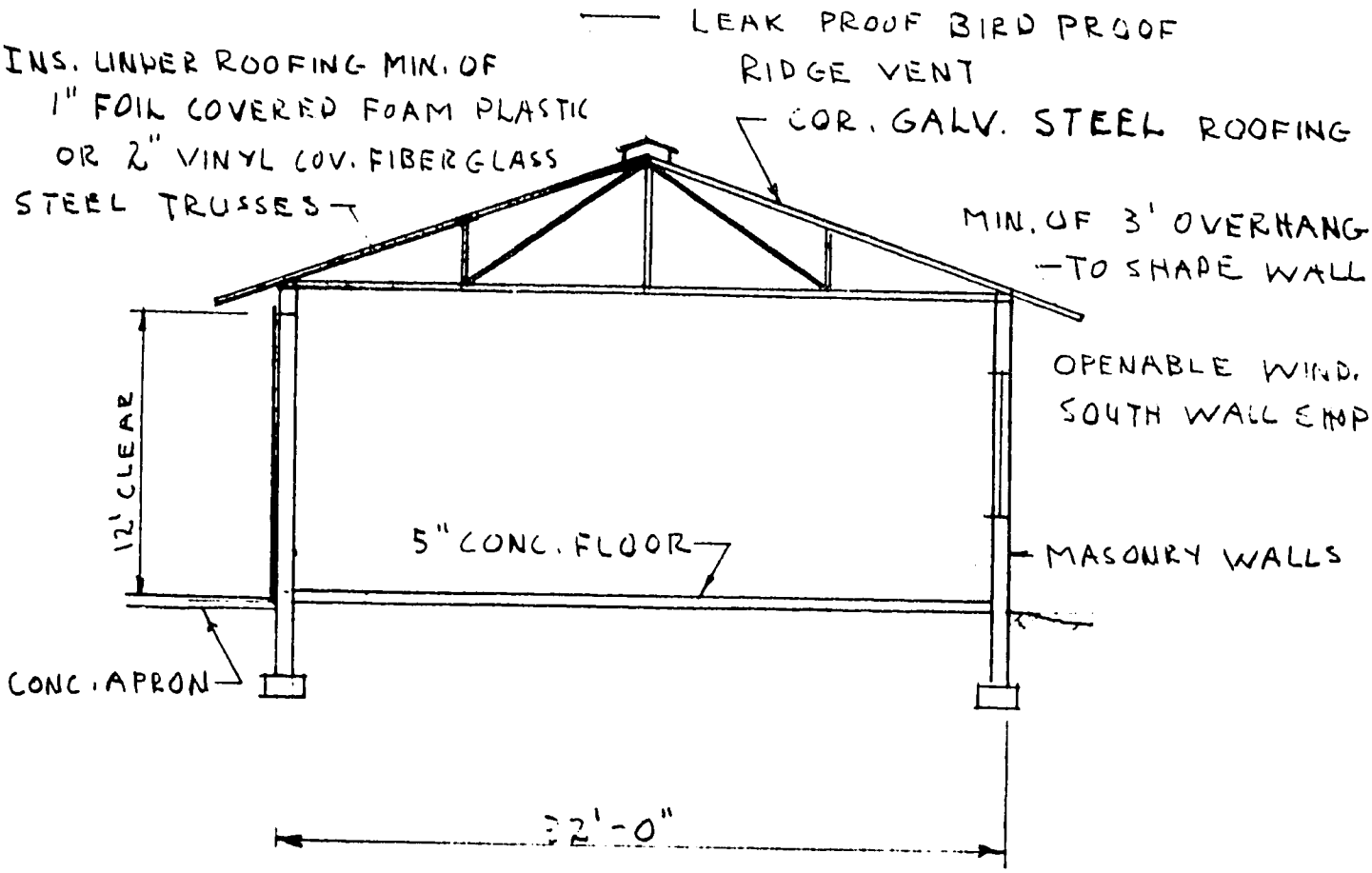
PLAN OF FEED PROCESSING AND STORAGE FACILITY
SCALE 1/8" = 1'-0"

J.O.C. 4/86

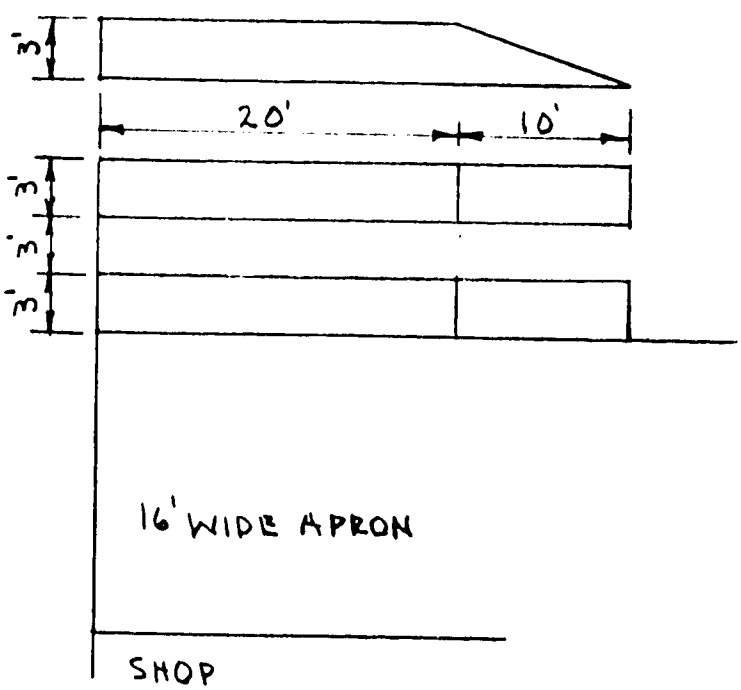

SHOP & MACH. STO.
NWFPAU RES. FARM
APR. 1986 J. O CURTIS
SCALE 1/8" = 1'-0"
4'
16'
3'
1'
16'
4'
16' x 44' APRON
WALL EX. FAN
OPEN FRONT
WATER FAUCET
METAL STORAGE
UNDERGROUND FUEL TANK AND PUMP
WELDER
GRINDER
4' APRON
TOOL BENCH
12' x 16' DOOR
OIL STO.
AIR COMP ABOVE
WELDING TAB.
DRILL
PORT. TOOLS
LUB. STO.
WELDER
ANVIL
HACKSAW
LONG. MAT STO.
SERVICE AREA
REPAIR AND OVERHAUL AREA
4' x 24' APRON
10' x 12' DOOR
WOOD WORKING
MACHINERY
STORAGE
32'-0"
EVAP. COOLER
DESK
FILE
PARTS STO.
EXTRA BENCHES
SINK
40'-0"
160'-0"
200'-0"
4'
3'
3'
12'
10'

APPENDIX G

APPENDIX H



CROSS SECTION THROUGH SHOP
SCALE 1/8" = 1'-0"



SUGGESTED LOCATION AND GEOMETRY OF SERVICE RAMP
SCALE 3/32" = 1'-0"

J.O.C. 4/86

APPENDIX I

SUGGESTED LIST OF TOOLS

General

- Portable crane—2 ton.
- Short chassis jack—1½ ton.
- Adjustable safety stands—5 ton.
- Smash-proof creeper.
- Air compressor—two-stage, 2 to 5 hp, 60-gal tank minimum, 150 to 200 PSIG, 25' and 50' - ½" hoses.
- Tire pressure gauge—regular and liquid.
- Slide hammer and attachments.
- Gear puller—assorted sizes with attachments.
- Engine Cradle on Wheels
- Hot water Tank
- Pressure Tank for Water
- Motor Washer
- Fuel Pump (Elec and Hand)
- Tire changer (Car and Lt. Truck)
- Hand Held Tachometer

Welding and metal working

- Arc welder—225 amp minimum, 25' cables, safety helmet, assorted welding clamps, chipping hammer, and wire brush
- Oxy-acetylene welder—two-stage, portable cart, safety goggles, 50' hose, one-way valves.
- Anvil.
- Bench vice—6".
- Bench grinder—8", ¾-1 hp.
- Disk grinder—7", 1 hp.
- Portable power hacksaw—5" round, 10" flat capacity.
- Drill press—½", ½ hp, 5-speed minimum.
- Straight shank twist drill bits—1/16"-½" by 1/64".
- Electric drills—¼", ⅜", and ½" variable speed, reversible.
- Punches and chisels—assorted sizes.
- "C" clamps—3"-12".
- Wrecking and pry bars.
- Tap and die set—N.C. and N.F., ¼"-1".
- Bolt cutter—30"x½" capacity.
- Metal files—assorted types and sizes.
- small Lathe for bolts & pins
- Tap and die set -- metric
- DC Welder/generator (Diesel)

Other hand tools

- Impact wrench and sockets—⅜", ½", and ¾".
- Adjustable wrenches 6", 10", and 16".
- Vice grips—7" and 10".
- Open end wrenches—¼"-1⅝". *
- Combination wrenches—¼"-1 5/16". *
- Box end wrenches-¼"-1½". *
- Socket sets—deep and standard, 6 and 12 pt, ¼", ⅜", ½", ¾". *
- Torque wrench—0 to 150 ft-lb, ½".
- Set screw wrenches—.050"-5/16".
- Screwdrivers—standard and phillips, assorted sizes.
- Hammers—assorted types and sizes.
- Pliers—assorted types and sizes.
- Mallets—rubber and rawhide.

* Also metric

Carpentry and wood working

- Circular saw—1½-2 hp, 7¼", assorted blades.
- Sabre saw—¼ hp, variable speed, assorted blades.
- Hand saws—rip, crosscut, keyhole, back.
- Brace, auger bits—¼"-1", expansive bit ⅞"-3".
- Wood chisels—assorted sizes.
- Wood files—assorted sizes.
- Squares—rafter, try, combination.
- Level—2' and 4'.
- Steel tape—10', 25', and 100'. 5, 10 and 50 meter

Plumbing

- Pipe wrenches—8", 10", and 14".
- Pipe vise.
- Pipe cutter.
- Pipe reamer.
- Hacksaw.
- Flaring tool set.
- Propane kit.

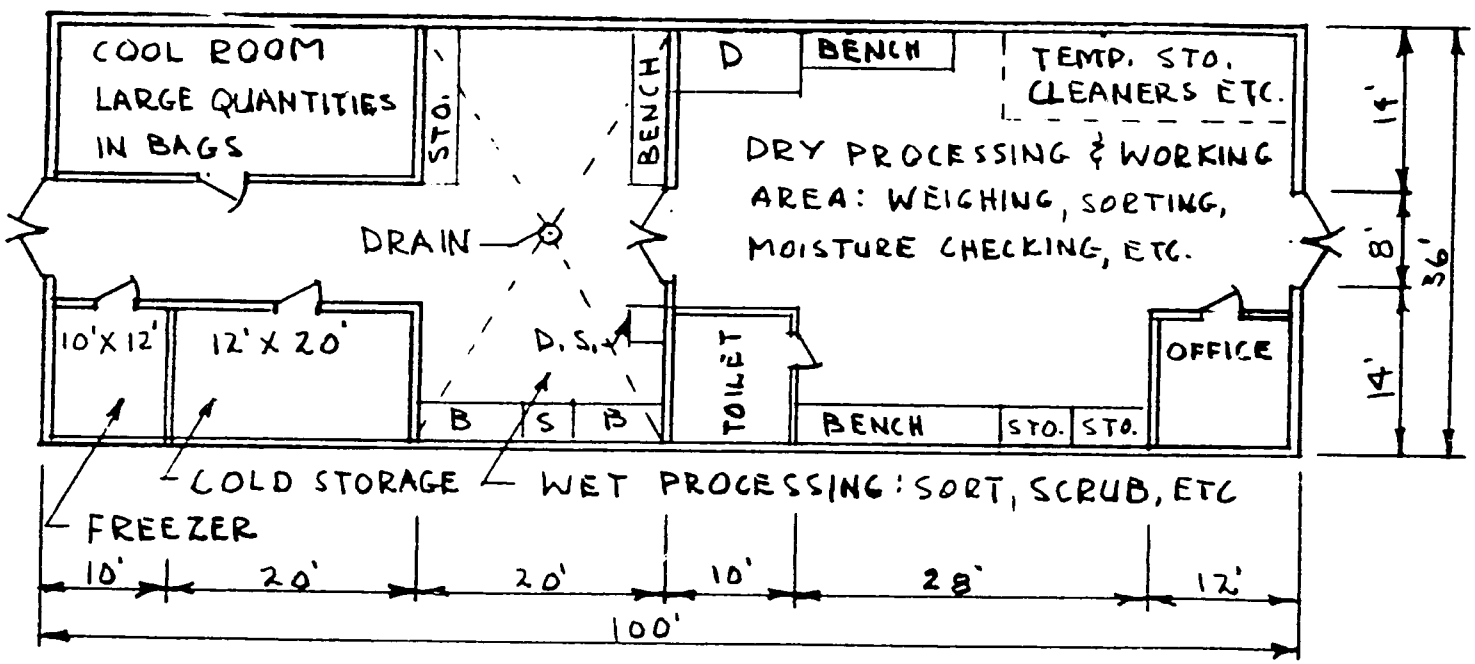
Electrical. *

- Soldergun kit.
- Electrical connection repair kit.
- Timing light—volt-ohm ammeter.
- Spark plug gauge.
- Feeler gauges—.001"-.040".
- Spark plug cleaner

* All should be 220 v, 50 cycle

APPENDIX J

B = BENCH
D.S. = DEEP SINK
D = DRYING OVEN W/TRAYS
S = SINK



PLAN OF SEED STORAGE

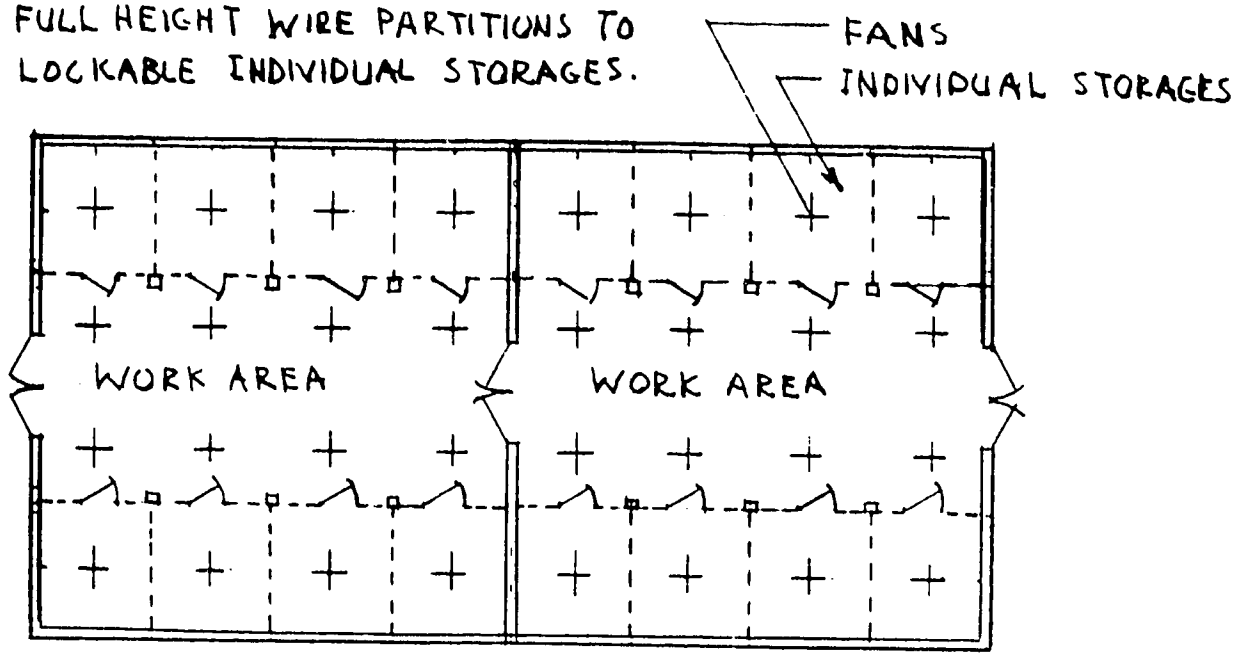
SCALE 1/16" = 1'-0"

J.O.C 4/86

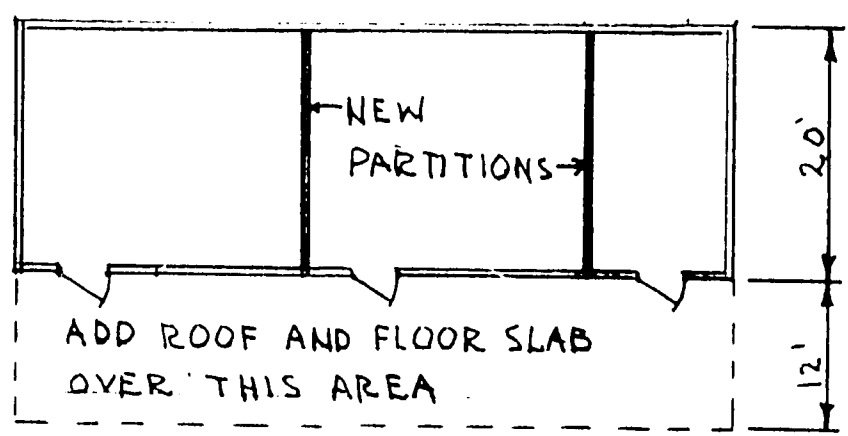
APPENDIX K

ADD FANS, LIGHTS, WATER AND ELECTRICAL OUTLETS.

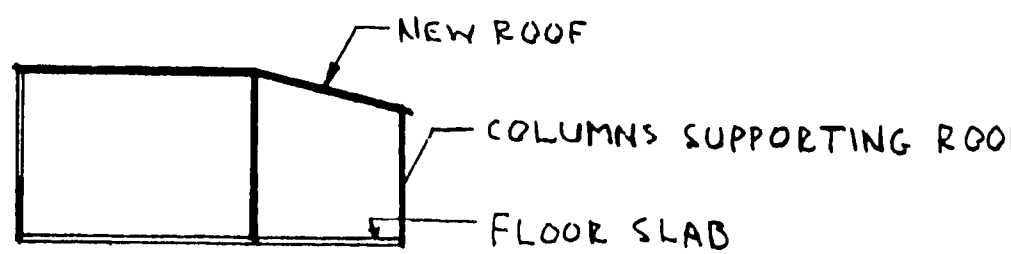
PROVIDE FULL HEIGHT WIRE PARTITIONS TO FORM LOCKABLE INDIVIDUAL STORAGES.



GENERAL STORAGE RENOVATION



PLAN VIEW



CROSS SECTION

FERTILIZER STORAGE RENOVATION

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